T.C.
SAKARYA UNIVERSITY
INSTITUTE OF SOCIAL SCIENCES
DEPARTMENT OF ECONOMICS

FINANCIAL DEVELOPMENT, HUMAN CAPITAL AND ECONOMIC GROWTH NEXUS IN WESTERN AND CENTRAL AFRICA: A COMPARATIVE ANALYSIS

Mahamane Lawali ATAHIROU MAHAMANE

PHD THESIS

Thesis Supervisor: Prof. Dr. Fuat SEKMEN

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"This thesis was defended online on 21/10/2025 and was unanimously accepted by the jury members whose names are listed below."

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Prof. Dr. Mustafa AKAL	Successful
Prof. Dr. Mustafa Cahit UNGAN	Successful
Prof. Dr. Hacı Bayram IŞIK	Successful
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- Retrospective studies in accordance with the personal data protection law.)

Mahamane Lawali ATAHIROU MAHAMANE

21/10/2025

THE PREFACE

This work is the result and aftermath of long years of study, and often interrupted, shortened nights filled with worry and stress. It is the culmination of a hope, a wish, a vision I've had since a very young age to, one day, become a PhD holder. It's actually a dream that is becoming a reality. I've always had in mind this saying of Martin Luther King Jr.'s: "I have a dream". Well, my own dream has been to become a doctor, allowing me to better serve my family, my homeland, and the Muslim community.

I, sincerely, thank my supervisor, Prof. Dr. Fuat SEKMEN, for his fruitful advices and technical, moral, and financial support, without which this thesis simply could not have been defended. I thank him, once again, for his great patience and determination in accompanying me throughout this long journey since my first year of doctoral studies and particularly the grueling thesis submission processes in these last times.

I express my special gratitude to Prof. Dr. Mustafa Akal and the other members of the jury for their valuable advices in improving the quality of this thesis.

I also wish to thank the head of the Economics Department, Prof. Dr. Aziz KUTLAR, for listening to, guiding, and advising my fellow doctoral students (Eveda Ozdilek, Azizullah Faizi, Mehmet Firat, Gökhan etc.) and me.

I also have a special thought for my fellow doctoral students and those at TOMER, with whom we shared our days of classes and research, whether in classrooms, the library, the university restaurant, or simply on the campus.

The opportunity to study in Turkey, especially thanks to the Turkish Government Scholarship, was an immense blessing, and I am very grateful. I thank the Turkish people for their hospitality, which allowed us to discover and interact with this rich Turkish civilization, which will undoubtedly inspire me throughout my life.

I dedicate this work to my biological parents (Aminata Amadou and Late Atahirou Mahamane), but also to my male and female guardians (Baba Ira Abdou Mamane, Baba Kano Ali Mamane, Tanti Yilli, Tanti Amina, ...), who supported me in my studies since elementary school after the death of my father.

I pray Allah to forgive, have mercy, and raise my late father to the Jannatul Firdaus.

Mahamane Lawali ATAHIROU MAHAMANE

21/10/2025

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ABBREVIATIONS

AES : Alliance of Sahel States

AIC : Akaike Information Criterion

BCEAO : The Central Bank of the West African States

BEAC : The Bank of Central African States

BIC (SBIC) : Bayesian information criterion or Schwarz information criterion (SIC)

CEMAC : Central African Economic and Monetary Community

ECOWAS : Economic Community of West African States

FCFA : The Franc for The Financial Community of Africa (Currency)

FD : Financial Development

FDI : Foreign Direct Investment

FEVD : Forecast Error Variance Decompositions.

GMM : Generalized Method of Moments

Ha : Alternative hypothesis

HC : Human Capital

Ho : Null hypothesis

HQIC : Hannan-Quinn information criterion

LDCs : Least Developed Countries

MENA : Middle East and North Africa

OIRF : Orthogonalised Impulse Response Functions

RQ : Research Question

SSA : Sub-Saharan Africa

VARX : Vector Auto Regressive with eXogenous variable

WAEMU : West African Economic and Monetary Union

WAMZ : West African Monetary Zone

WBCPD : World Bank Commodity Price Data

WDI : World Development Indicators

ZMAO : West African Monetary Zone

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ABSTRACT

Title of Thesis: Financial Development, Human Capital and Economic Growth Nexus in Western and Central Africa: A Comparative Analysis

Author of Thesis: Mahamane Lawali ATAHIROU MAHAMANE

Supervisor: Prof.Dr. Fuat SEKMEN

Accepted Date: 21/10/2025 **Number of Pages:** xii (front part) + 125 (main part)+ 42 (add)

This thesis analysed the relationship among Economic Growth (GDP/Income), Financial Development (FD), and Human Capital (HC) for 20 Sub-Saharan African countries from 1970 to 2023 using the panel VARX approach. Results suggested, among others, that Trade (in all the zones); Health HC and Oil Prices (in Global and ECOWAS models); Health and Education HC (in ECOWAS and WAMZ); Money Supply (in FCFA zone and WAMZ); and GGE (General Government Expenditure), Education HC and General Price Level (in WAEMU); have positive impacts on income. Nevertheless, GGE (in FCFA zone), and both HC types (in BEAC and FCFA areas) effects on income are negative. FD (irrespective of the proxy used) is positively impacted by GDP (in FCFA and WAEMU zones); and negatively impacted by Health Human Capital (in FCFA and WAEMU zones). FD (proxied by DC (Domestic Credit)) is positively impacted by Income (Global, ECOWAS, FCFA, WAEMU, and WAMZ models); Education HC (in CEMAC, FCFA zones); Health HC (in ECOWAS) and Broad Money/BM (in CEMAC); and is negatively impacted by Education HC (in WAMZ); Health HC (in Global model) and BM (in WAEMU). As for economic and financial policies, the West and Central African monetary authorities, governents and policymakers in general, should stimulate economic growth by producing more goods and services for export, by facilitating access to domestic credit, by encouraging health and education investments by public as well as private sectors, and avoiding expansionary monetary policies. Contrariwise, specifically for WAEMU case, some inflation (like increasing money supply) may boost economic growth.

Keywords: Financial Development, Human Capital, Economic Growth, Sub-Saharan Africa, PVARX Model.

ÖZET

Başlık: Batı ve Orta Afrika'da Finansal Kalkınma, İnsan Sermayesi ve Ekonomik Büyüme Etkileşimleri: Karşılaştırmalı Bir Analiz

Yazar: Mahamane Lawali ATAHIROU MAHAMANE

Danışman: Prof. Dr. Fuat SEKMEN

Kabul Tarihi: 21/10/2025

Sayfa Sayısı: xii (ön kısım) + 125 (ana kısım)+ 42 (ek)

Bu tez, 1970-2023 yılları arasında 20 Batı ve Orta Afrika ülkelerinde Ekonomik Büyüme, Finansal Kalkınma ve İnsan sermayesi arasındaki ilişkiyi panel VARX yaklaşımı kullanarak analiz etmişir. Sonuçlar, Ticaretin (tüm bölgelerde); Sağlık ve Petrol Fiyatlarının (Kapsamlı model ve ECOWAS'ta); Sağlık ve Eğitim (ECOWAS ve WAMZ'de); Para Arzı (FCFA bölgesi ve WAMZ'de); ve Genel Devlet Harcamaları (GDH), Eğitim ve Genel Fiyat Seviyesi'nin (WAEMU'da) gelir üzerinde positif etkileri olduğunu göstermektedir. Bununla birlikte, GDH 'nin (FCFA bölgesinde) ve her iki insan sermayesi türünün (BEAC ve FCFA bölgelerinde) gelir üzerindeki etkileri negatiftir. Finansal Gelişme (kullanılan vekilden bağımsız olarak) GSYİH'den (FCFA ve WAEMU bölgelerinde) positif etkilenir; ama Sağlıktan (FCFA ve WAEMU bölgelerinde) negatif etkilenir. Finansal Gelişme (yurtiçi kredi tarafından vekil edilince) Gelirden (Kapsamlı model, ECOWAS, FCFA, WAEMU ve WAMZ); Eğitim'den (CEMAC, ve FCFA bölgesinde); Sağlık'tan (ECOWAS) ve Para Arzı'ndan (CEMAC'ta) positif etkilenir; ama Eğitim'den (WAMZ'de); Sağlıktan (Kapsamlı modelde) ve para arzından (WAEMU'da) negatif etkilenir. Finansal ve Ekonomik Politikalara ile ilgili, Batı ve Orta Afrika para otoriteleri, hükümetler ve genel olarak politika yapıcılar, ihraç edilecek daha fazla mal ve hizmet üreterek, yurtiçi krediye erişimi kolaylaştırarak, kamu ve özel sektörlerin sağlık ve eğitim yatırımlarını teşvik ederek ve genişletici para politikalarından kaçınarak ekonomik büyümeyi teşvik etmelidir. Tersine, bazen, özellikle WAEMU örneğinde olduğu gibi, bir miktar enflasyon (mesala Para Arzı artırmak) ekonomik büyümeyi artırabilir.

Anahtar Kelimeler: Finansal Kalkınma, İnsan Sermayesi, Ekonomik Büyüme, Sahra Altı Afrika, PVARX Modeli.

INTRODUCTION

The Subject of the Research

This research focuses on the investigation, assessment and comparision of the extent to which financial development (proxied by Broad Money and Domestic Credit) and human capital accumulation (proxied by Life Expectancy for health human capital and government expenditure on education for education human capital) has directly or indirectly impacted on the Economic Growth of some Sub-Saharan African economies within and across countries over the period 1970-2023. The countries of interest are those of the Economic Community of West African States (ECOWAS) namely Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo, and the Central African Economic and Monetary Community (CEMAC) namely Cameroon, Chad, the Central African Republic, Equatorial Guinea, Gabon, and the Republic of Congo. Some countries from the ECOWAS bloc (The Gambia, Ghana, Guinea, Liberia, Nigeria, and Sierra Leone) form the West Africa Monetary Zone (WAMZ / ZMAO). The FCFA ZONE, sharing the same currency, the Franc CFA, comprises all the countries from the WAEMU or BCEAO zone, and from the CEMAC or BEAC zone.

Importance of the Research

Africa contains the largest number of the world's LDCs. It accounts for 30 of the 45 countries designated by the United Nations as LDCs, underscoring the continent’s disproportionate representation in this category, and thus pointing out its underdevelopment (List of LDCs, 2025). Moreover, among the 21 member states of the zones analysed by this study, up to 13 fall under the LDCs designation.

So, to question and understand some key factors underlining this relatively lower development of the SSA countries, this study wanted to examine the interlinkages and the contributions of the financial sector and human capital to the development or underdevelopment of these economies.

Firstly, the link between finance and economic growth may run through various transmission channels. The so–called AK model (Yt=AKt) illustrates three meaningful connections between financial and economic variables (Thiel, 2001). As we know, a well-

developed financial institution and a strong and well competitive financial sector are necessary to allocate funds between lending and deposit units, support investment projects in the economy and promote efficient market (Levine, 1997).

Secondly, human capital refers to the workforce's knowledge, skills, creativity, and abilities. The recipient of the 1992 Nobel Prize in Economic Science, Gary S. Becker (1993), demonstrates how investment in an individual's education and training is like business investments in equipment. Moreover, Becker (2007) extends the concept of human capital to include health (among others) in addition to education and training.

Besides financial development, the role of human capital is, thus, essential in the Economic Growth process. According to Lucas (1988) and Romer (1986) if capital is efficiently allocated to the human capital, the return can be getting back in the shape of a stable return to scale.

Overall, investing in the development of its workers or population generally promotes innovation, boosts production, and improves profitability, all of which spur economic growth, which in turn tends to lift more people out of poverty by improving their living conditions.

Finally, an interdependency may exist between human capital and financial development. In the literature, there has been a growing interest in the nexus between finance and human capital in their relationship with economic growth. Notably, early works in this regard include De Gregorio and Guidotti (1995), Pagano (1993), De Gregorio (1996), Outreville (1999), Papagni (2006) and Ang (2008). Outreville (1999) observes that well-educated people have better access to information and are more likely to behave as less risk-averse people, and he concludes that higher education leads to lower risk aversion and higher savings. Ang (2008) suggests that efficient financial systems promote economic productivity through provision of credit facilities to facilitate HC accumulation and development of technology-intensive industries. Consequently, a financially developed market allocates more efficiently available resources to promote investments in human capital via access to credits for education/training expenditure, health expenditure, and welfare activities; conversely, human capital may affect financial development since skilled and well–educated people may create financial innovations necessary for financial development; additionally, education allows economic agents to

transit from informal sector to formal sector opportunities, reducing thus the size of the informal economy (Kılıç and Özcan, 2018).

Purpose of the Research

Given the importance of the subject discussed above, the purpose of this thesis is to assess and compare the impact of HC and FD on growth and vice versa for 20 SSA countries across four economic unions (WAEMU, WAMZ, ECOWAS, CEMAC) from 1970 to 2023 using a panel VARX model. The specific research questions of this study include:
RQ1: Does HC or FD have any statistically significant impact on economic growth?
RQ2: Does growth statistically significantly affect HC or FD?
RQ3: Does HC statistically significantly affect FD, and vice versa?
This study seeks to contribute to the existing literature by filling the research gap, given the fact that no research has yet analyzed and compared the relationship between human capital, financial development, and economic growth for ECOWAS, CEMAC, WAEMU, WAMZ, and FCFA zones by applying a panel VARX methodology.

Research Methodology

Annual data (1970-2023) fetched from the World Bank database are used. Due to the lack of abundant data or observations in the African dataset, some missing values, whenever possible, have been generated by means of interpolation to improve the results.
The variables of interest are real GDP as Proxy for Economic Growth, Broad Money and Domestic Credit to private Sector ratios to GDP as Proxies for financial development, Government expenditure on education and Life Expectancy as human capital Proxies. Some control variables are also included. Trade/Economic openness (sum of import and export), general government expenditure (final government consumption) and inflation (Consumer Price Index) to control respectively for external influences, public sector activities and macroeconomic stability. Also, Crude Oil Prices are considered as an exogenous variable. An oil price increase could lead to a (considerable) surplus of an oil-exporting country thus increasing its openness, GDP, … For an oil-importing country, the increase of the oil price could raise prices.
Natural log form of all the variables are taken. One lag for endogenous variables is assumed. Only contemporaneous values are included for the exogenous variable (OPr).

Variable plots, summary/descriptive statistics, cross-sectional dependence and unit root tests are conducted under STATA 17 package.

A PVARX (1,0) is estimated (Dynamic Panel VARX estimation, GMM Style), its stability is checked (eigen values/modulus), impulse response functions (OIRF) and forcast error variance decompositions (FEVD) are computed following the methodology of Abrigo & Love (2016), who consider a k–variate homogeneous panel VAR of order p with panel–specific fixed effects represented by the following system of linear equations:

$Y_{\mathrm{it}} = Y_{\mathrm{it-1}}\mathrm{A}_1 + Y_{\mathrm{it-2}}\mathrm{A}_2 + \ldots + Y_{\mathrm{it-p-1}}A_{\mathrm{p-1}} + Y_{\mathrm{it-p}}A_{\mathrm{p}} + X_{\mathrm{it}}B + u_{\mathrm{i}} + e_{\mathrm{it}}$	(1)
$i \in \{1,2,\ldots,N\}, t \in \{1,2,\ldots,T_{\mathrm{i}}\}$	

Where Y_{it} is a (1×k) vector of dependent variables (GDP, BM, DCP, PTR, LE, TRD, CPI10, and PCGE), X_{it} is a (1×l) vector of exogenous variables (OPr), and ui and eit are (1×k) vectors of dependent variable–specific panel fixed–effects and idiosyncratic errors, respectively. The (k×k) matrices A_1, A_2, …, A_{p-1}, A_p and the (l×k) matrix B are parameters to be estimated. It is assumed that the innovations have the following characteristics:

$E(e_{it}) = 0$, $E(e'_{it}e_{it}) = \Sigma$, and $E(e'_{it}e_{is}) = 0$ for all t > s. That is to say they are white noise.

The model is fitted simultaneously as a system of equations using the GMM estimation procedure. The GMM-style procedure is widely used in Panel VARX modeling because it controls for endogeneity, accounts for unobserved heterogeneity or fixed effects, allows for exogenous shocks (e.g., crude oil prices) and yields efficient estimation.

The Panel VARX model is an extension of the traditional Panel VAR model that allows for richer dynamics and more flexible modeling of economic systems. In contrast to the traditional Panel VAR, Panel VARX incorporates both endogenous and exogenous variables, allows weak exogeneity for external shocks modeling and is applicable to open systems and regional spillovers. Researchers have been using Panel VARX models to treat oil price volatility, exchange rate fluctuations, and global interest rate movements as exogenous variables. Since SSA countries are open economies, exposed to external shocks and structural heterogeneity, this study uses the model to account, also, for oil price external influences on states of the regional economic communities. For more detailed information on the model, please consult Abrigo & Love (2016).

As for the reference system, the APA 7th edition style is used for the citations.

Moreover, the Stata Do-File resulting from the Stata codes used for statistical computations in this study is provided in Table 57 (see Appendix 13) to whom it may concern for any replication or further studies.

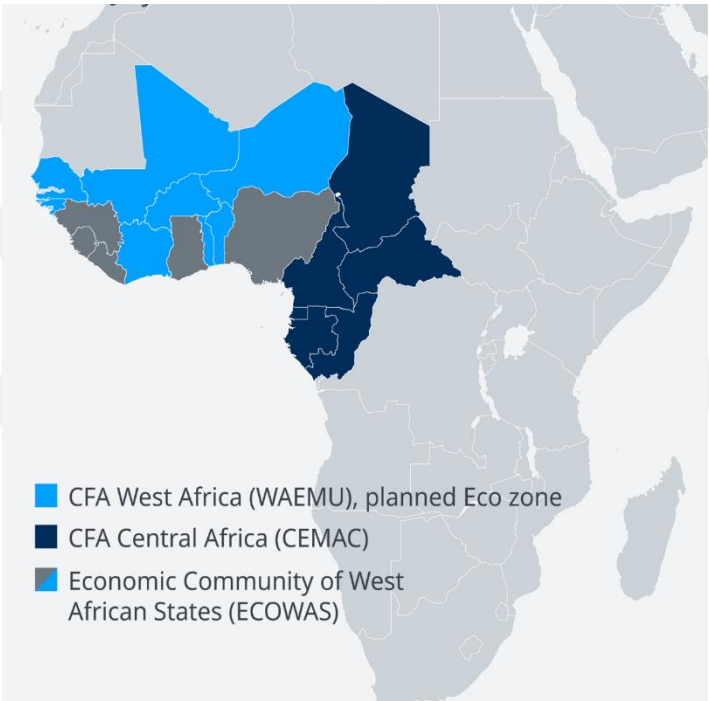
The Limitations of the Research

Unavailability of sufficient data forced us to drop Liberia from the sample countries under analysis. Moreover, the available and up-to-date data are only up to 2023. The panel data is unbalanced because of many missing observations. Due to a lack of sufficient historical data on the financial development index and the human capital index, traditional alternative proxies are used instead.

CHAPTER 1: BACKGROUND AND LITERATURE REVIEW

1.1. Background

From Map 1 below, we can distinguish between WAEMU (in light blue color), CEMAC (in dark blue color), and WAMZ (in gray color) zones. The ECOWAS zone comprises both WAEMU and WAMZ zones (Map 2). While the FCFA zone encompasses WAEMU and CEMAC (Map 3).



Map 1: Map of the Global Zone

Source: Deutsche welle (DW) and international monetary fund

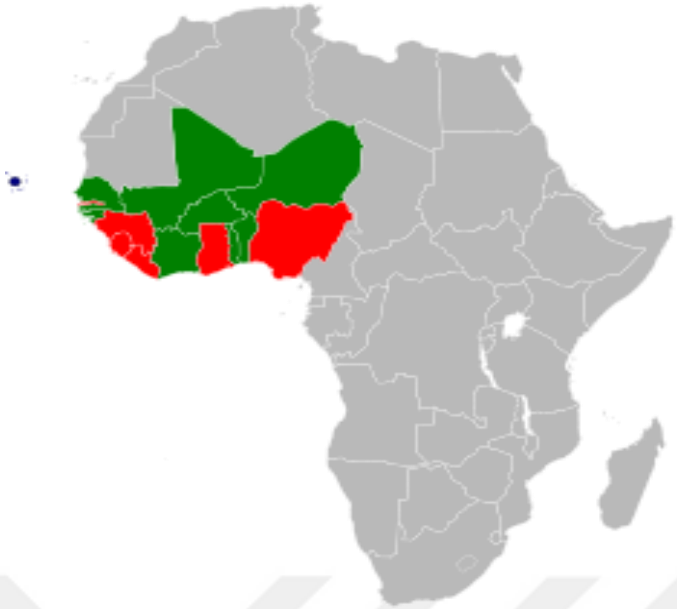
The WAEMU zone, or UEMOA in French and referred to as BCEAO zone, was established to promote monetary and financial stability as well as economic integration among countries that share the West African CFA franc as a common currency. From 1962 to 1994, it was known as the West African Monetary Union (WAMU or UMOA in French), established in 1962 by a Treaty between France and the seven newly independent countries (Benin, Burkina Faso, Ivory Coast, Mali, Niger, Senegal, and Togo). In 1994, it was reformed from UMOA/WAMU to UEMOA/WAEMU as a result of a Treaty signed

in Senegal by the heads of state and governments of the seven previously colonies of French in West Africa. In 1997, Guinea-Bissau, a former Portuguese colony, joined the union as the eighth member state.

WAEMU common institutions include its Council of Heads of State and Council of Ministers; Commission, Court of Justice, and Court of Accounts (located in Burkina Faso); the Central Bank of West African States (BCEAO) in Senegal; the Banking Commission of the West African Monetary Union (CB-UMOA) and Financial Markets Authority of the West African Monetary Union (AMF-UMOA), both in Ivory Coast; and the West African Development Bank (BOAD) in Togo (West African Economic and Monetary Union, 2025). WAEMU has a GDP of approximately $175 billion, and a total population of about 137 million for 2023 (UNCTAD, 2024). It covers a land area of roughly 3,5 million km^2.

Formed in 2000, the West African Monetary Zone (WAMZ) is a group of six countries (Gambia, Ghana, Guinea, Nigeria, Sierra Leone, and Liberia that joined in 2010) within ECOWAS. Apart from Guinea, which is francophone, they are all English-speaking countries. WAMZ has a combined land area of approximately 1,60 million km² and a population of around 264,46 million in 2004, while Nigeria, the largest economy within the zone, accounted for about 80,4 % of the zone's GDP in 2017 (SACU, 2025; George and Godwin, 2018). The WAMZ area attempts to establish a strong stable common currency called the eco to rival the CFA franc. The eventual goal is for the CFA franc and eco to merge, giving all of West and Central Africa a single, stable currency. With the exit of Mali, Niger and Burkina Faso from ECOWAS, two structural options for a single currency could emerge: the "Sahel" for the AES and the "Eco" for the ECOWAS member countries (West African Monetary Zone, 2025). Surprisingly, on 22 December 2019, it was announced that the West African CFA would be reformed and replaced by an independent currency to be called Eco. So, in May 2020, the French National Assembly agreed to end the French engagement in the West African CFA franc, including the foreign reserve deposit requirements, thereby facilitating the transition to the Eco. Despite initial plans for this monetary union by late 2020, setbacks including the COVID-19 pandemic, global geopolitical uncertainties, and failure to meet criteria resulted postponements, with the next launch target date set for July 2027 (CFA franc, 2025).

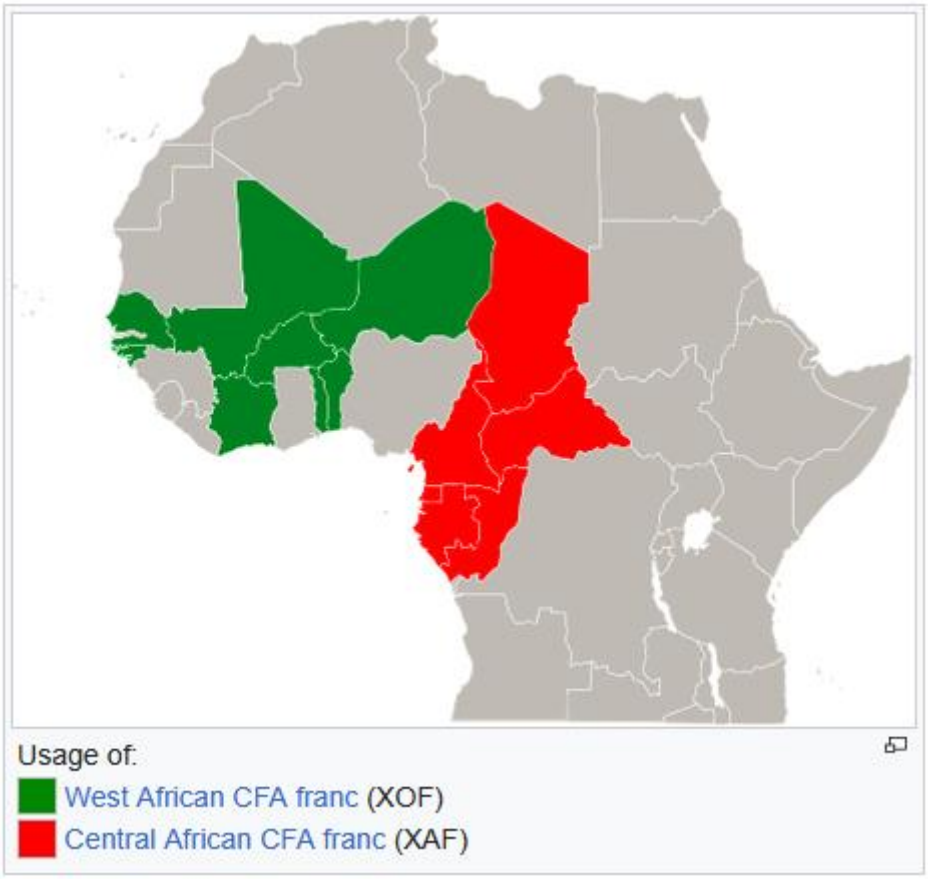
The ECOWAS zone was established in 1975 by the Treaty of Lagos (ECOWAS, 1975) and was formed initially from the region's former French, British and Portuguese colonies, and independent Liberia (fifteen countries), to promote economic integration across the region. It has since evolved to include political and military cooperation, as well. It consists of the following institutions: ECOWAS Commission, Community Court of Justice, Community Parliament, ECOWAS Bank for Investment and Development (EBID), West African Health Organisation (WAHO), and the Inter-Governmental Action Group against Money Laundering and Terrorism Financing in West Africa (GIABA). ECOWAS 15 member states, collectively, comprise an area of 5113115 km^2, have an estimated population of 440,42 million and a real GDP of 800,827 billion US dollars (constant 2015 US$), in 2022, according to Sekmen et al., (2025). Also, serving as a peacekeeping force in the region, ECOWAS member states often send joint military forces to intervene in a politically instable member country or at times of unrest. ECOWAS suspended Guinea and Mali in 2021, Burkina Faso in 2022, and Niger in 2023, following a military coup in these countries. Moreover, on 6 July 2024, the military leaders of Niger, Mali, and Burkina Faso signed a new pact to form a confederation, a political union of sovereign states: The Alliance of Sahel States (AES). On 28 January 2024, Niger, Mali, and Burkina Faso announced via a joint statement that they were withdrawing from ECOWAS. On 15 December 2024, the ECOWAS Conference of Heads of State adopted a six-months exit transition period (29 January 2025 to 29 July 2025) (ECOWAS, 2025).



Map 2: Map of ECOWAS Zone

Source: Wikipedia

The Economic and Monetary Community of Central Africa (red part of Map 3) is an association of the six Central African states of Cameroon, Central Africa, Chad, Equatorial Guinea, Gabon and the Republic of Congo. In late 1964, the five newly independent countries established, by the Brazzaville Treaty, the Customs and Economic Union of Central Africa, known as UDEAC. In 1972, the framework was reformed with a treaty revision and new monetary cooperation agreement that resulted in the BEAC relocation from France to Cameroun. Later on in 1983, Equatorial Guinea joined the Union, which aims to promote the economic and monetary integration of its member states through a common currency, the Central African CFA franc. It has a total of 65,52 million inhabitants in an area of 3,02 million km² (Members of the CEMAC, 2025). CEMAC's common institutions include its Council of Heads of State and Council of Ministers; a Commission in Central Africa, Court of Justice in Chad, and Parliament in Equatorial Guinea; the Bank of Central African States (BEAC) in Cameroon; the Central African Banking Commission (COBAC) and Central African Financial Market Supervisory Commission (COSUMAF), both in Gabon; and the Development Bank of the Central African States (BDEAC) in the Republic of Congo. CEMAC countries also share the Regional Insurance Control Commission (CRCA, Gabon) with other African countries of the Franc Zone (CEMAC, 2025).



Map 3: Map of FCFA Zone

Source: Wikipedia

The CFA franc is the name of two currencies used in fourteen African countries by 210,4 million people, who have a combined annual GDP of US$313,7 billion, as of 2023: the West African CFA franc used in eight West African countries, and the Central African CFA franc used in six Central African countries. The ISO currency codes are XOF for the West African CFA franc and XAF for the Central African CFA franc. Although the two currencies are commonly called CFA franc and have the same value (both CFA francs have a fixed exchange rate to the euro guaranteed by France: €1 = F.CFA 655.957), they are not interchangeable. It is therefore not a common monetary zone but two juxtaposed zones (CFA franc, 2025).

1.2. Literature Review

Numerous studies have investigated the relationship between financial development, human capital, and economic growth and have found varying results. Some studies found statistically significant positive impacts of human capital and financial development on the real sector, irrespective of the proxies used. Moreover, those studies emphasize the complementarity effects of these indicators (FD, HC) on the economy.

Dwyfor et al. (2002) evaluate the contributions of human capital (primary and secondary school enrolment rates and public expenditure on education) and financial development (the ratio of M2 to GDP, the ratio of domestic credit to GDP) to economic growth in a panel of 82 countries covering 21 years (1972–93) based on the random effects estimation procedure. Results suggest that money makes a statistically significant contribution to growth, irrespective of whether money or credit is employed as a measure of the monetary factor. Also, the interaction between credit and human capital makes a statistically significant contribution to growth, irrespective of the precise measure of human capital. Overall results suggest that financial development is at least as important as human capital in the growth process.

Hakeem and Oluitan (2012) investigate the relationship between human capital and financial development (the domestic credit to the economy, broad money, and liquid liabilities) in South Africa for the period of 1965–2005 using DOLS, ECM, and Levels VAR techniques. The study uses primary school, secondary school, and tertiary institution enrolment rates as indicators of education human capital and Life Expectancy at birth as indicators of health human capital. The results suggest evidence of bi–directional causality and that income is a possible transmission mechanism.

Kargbo et al. (2016) examine the link between financial development and human capital accumulation on economic growth in Sierra Leone for the 1980–2012 period, using the Ordinary Least Squares (OLS) technique. They show that the simultaneous interaction of financial development and human capital is significant and positively impacts growth.

Ibrahim (2018) uses the System GMM technique on a sample of 29 SSA countries over the period 1980–2014 to find that both human capital (primary pupils–teacher ratio and secondary school gross enrolment rate) and financial development (the ratios of private and domestic credits to GDP) unconditionally promote economic growth.

Oyinlola and Adedeji (2019) examine the impact of human capital (secondary school enrolment index, life expectancy, and total factor productivity) on inclusive growth (GDP per worker) and interrogate how the financial sector catalyzes this process by applying the system GMM technique on 19 sub–Saharan African countries over the period 1999–2014. Their findings support a positive direct impact of both human capital and financial development (Private credit to GDP (%), Bank overhead costs to total assets (%), and Bank net interest margin (%)) on inclusive growth. Their results also show that financial development promotes the extent to which human capital can facilitate inclusive growth.

Using the ARDL model on the Nigerian Economy, Orji et al. (2019) showed that financial development (Credit to Private Sector/GDP Ratio) through the human capital development (School Enrollment Rate) channel has a positive and significant impact on economic growth in Nigeria. Also, the study showed the existence of unidirectional causality running from financial development to human capital development in Nigeria.

GMM technique was applied to data from 23 Indian states for the period 1999–2013 by Arora and Jalilian (2020) to examine the mutual influence mechanism among financial development, human capital, and economic growth at the sub–national level. They suggest evidence of a positive relationship between human capital, financial development, and economic growth.

Sarwar et al. (2021) investigate financial development, human capital, and their interaction on economic growth of emerging economies. They applied the two–step system GMM technique on 83 emerging countries' data for 2002–2017. The study used two financial development indicators: domestic credit provided by the financial sector and domestic credit to private sectors, and two human capital indicators: secondary school enrollment and primary pupil–teacher ratio. The findings indicate that financial development positively and significantly affects economic growth. Human capital also has a positive impact on economic growth. Financial development and human capital interactively affect economic growth for emerging economies positively and significantly.

Some studies have linked the positive impacts of human capital and/or financial development on the real sector to some conditions.

Therefore, Oyinlola and Adedeji (2020), using Difference GMM econometric technique on eleven SSA countries' data from 1999 to 2014, find that human capital has a direct positive impact on growth only when measured in terms of its efficiency, but irrespective of the measures of financial development.

Also, Tinta (2022) found that using the Augmented Mean Group algorithm on a sample of 48 SSA countries and covering the period 1980 to 2019, there is a threshold of the level of Economic Growth beyond which the effects of human capital (the percentage of tertiary educated people) occur on the performance of the financial system (Financial development index as proxy), and thus on the economic growth. According to him, the effects of human capital are only observed in high–income and upper–middle–income countries. Nevertheless, the findings confirm the feedback hypothesis between economic growth and financial development.

Finally, some studies found mixed or inconclusive results.

Thus, Hakeem (2010) employs a panel data fixed effect, random effects, and maximum likelihood estimation techniques on SSA countries and finds that the stock of human capital (the average of the educational attainment) is important for growth in the region but does not find strong impact of financial development (liquid liabilities, broad money, private credit and domestic credit ratios of the GDP) in the region. He, however, finds robust complementarity features in the interaction of both finance and HC on growth.

Also, Abubakar et al. (2015) use the ratios of broad money, domestic and bank credits to GDP as financial development indicators and employ panel Fully Modified and Dynamic OLS techniques on ECOWAS countries (1980–2011) and reveal that bank private credit and domestic private credit contribute significantly to economic growth in the ECOWAS, both directly and through their influence on human capital accumulation. They concluded that broad money as a ratio of GDP is not statistically significant in influencing economic growth, both directly and indirectly, via the human capital channel. On the contrary, real economic activities instead cause broad money growth. However, the financial intermediation activities of banks and related institutions (in the form of credit facilities) support the accumulation of human capital, which has also contributed significantly to the real GDP growth of the ECOWAS region.

In chapter 3 of her PhD thesis, Forouheshfar (2017) studies the impact of the financial markets on economic growth for 15 MENA countries. The GMM estimates suggest a negative effect of financial sector development (proxied by Private credit, Bank deposit, and Liquid liabilities ratios to GDP (%)) on the real sector. According to her, the results underline the expansion of an inefficient financial sector in the region, meaning that there are problems of credit allocation and weak financial supervision and regulation.

Ali et al. (2021) applied fixed and random effects models on 12 low–income countries from 1980–2016 to examine how financial development and economic growth influence human capital in low–income countries. Broad money supply and private sector credit positively and significantly impact human capital. Interestingly, bank credit showed a negative and significant effect on human capital. Nonetheless, they found a significant positive relationship between human capital and economic growth.

To sum up, and as seen above, the results of the studies so far conducted still have mixed findings, and very limited studies have assessed the mutual impacts and the feedback hypothesis between human capital, financial development, and economic growth (that is also the economic growth impact on human capital and financial development), especially for SSA countries. No study has yet analyzed and compared the relationship between human capital, financial development, and economic growth across ECOWAS, WAMZ, CEMAC, WAEMU, and FCFA zone countries using the panel VARX approach. This research gap is precisely what this study aims to address.

Table 1 below presents a recap of the various measures of financial development and human capital accumulation so far used in the literature.

Table 1: Measures and Effects of FD and HC

Factors	Proxy	Effects of Proxy	Span	Author(s)
Financial Development	broad money,	Negative/insignificant	Sierra Leone 1980-2012 OLS	Kargbo et al., 2016
	liquidity liabilities	Negative/insignificant		
	credit to the private sector	Positive/ significant		
	Credit to Private Sector/GDP Ratio	See result on the interactive term	Nigeria ARDL 1991-2013	Orji et al., 2019
	ratio of broad money to GDP	Positive/not significant Direct & indirectly	ECOWAS 1980 to 2011 FMOLS/DOLS	Abubakar et al., 2015
	ratio of domestic private credit to GDP	Positive/significant		
	ratio of bank private credits to GDP	Positive/significant		
	liquid liabilities, broad money, private credit	all statistically insignificant	14 SSA countries 1970-2000 FE, RE,ML	Hakeem, 2010
	and domestic credit	significant but negatively		
	the ratio of private credit to GDP	positive and significant	29 SSA countries 1980–2014 system GMM	Ibrahim, 2018
	the ratio of domestic credits to GDP	positive and significant		
	ratio of M2 to GDP	Positive/significant	82 countries 1972-1993	Dwyfor Evans et al., 2002
	ratio of domestic credit to GDP			
	ratio of M2/GDP, M3/GDP, DC/GDP and DCp/GDP	domestic credit, broad money and liquid liabilities r significant	South Africa 1965 to 2005 DOLS, ECM &VAR	Hakeem & Oluitan, 2012
	domestic credit (DCfs)	Both significant and positive	83 emerging countries, 2002 to 2017. system GMM	Sarwar et al., 2021
	domestic credit to private sectors (DCps)			
	Private credit, Bank overhead costs to total assets (%),and Bank net interest margin (%)	Positive & significant	19 SSA Countries 1999 to 2014 system GMM	Oyinlola & Adedeji, 2019
Human Capital	secondary enrolment rate	Positive/insignificant	Sierra Leone 1980-2012 OLS	Kargbo et al., 2016
	Prim & Sec. School Enrollment Rate	See result on the interactive term	Nigeria ARDL 1991-2013	Orji et al., 2019
	total primary, secondary and tertiary school's enrolment	See result of the interactive term	ECOWAS 1980 to 2011 FMOLS/DOLS	Abubakar et al., 2015
	educational attainment	positively and statistically significant	14 SSA countries 1970-2000 FE, RE,ML	Hakeem, 2010

	primary pupil–teacher ratio	negative and significant	29 SSA countries	Ibrahim, 2018
	secondary school gross enrolment rate	positive and significant		
	primary and secondary school enrolment rates	negative	82 countries 1972-1993	Dwyfor Evans et al., 2002
	real public expenditure on education			
	Prim. sch., second. Sch. and tertiary institutions enrolment rates	secondary school enrolment significant	South Africa 1965 to 2005 DOLS, ECM &VAR	Hakeem & Oluitan, 2012
	Life Expectancy at birth	significant		
	secondary school enrollment (SSE)	positive	83 emerging countries, 2002 to 2017. system GMM	Sarwar et al., 2021
	primary pupil-teacher ratio (PPTR).	negative		
	secondary school enrolment and life expectancy	Positive & significant	19 SSA Countries 1999 to 2014 system GMM	Oyinlola & Adedeji, 2019
	total factor productivity			
Interactive term	FD*HC	All Positive/significant	Sierra Leone 1980-2012 OLS	Kargbo et al., 2016
	(Prim & Sec. School Enr. Rate)* (Credit to Private Sector/GDP)	Positive/significant	Nigeria ARDL 1991-2013	Orji et al., 2019
	FD*HC	Positive and significant except with broad money	ECOWAS 1980 to 2011 FMOLS/DOLS	Abubakar et al., 2015
	FD*HC	Positive and significant	14 SSA countries 1970-2000 FE, RE,ML	Hakeem, 2010
	FD*HC	All positive and statistically significant	29 SSA countries	Ibrahim, 2018
	Credit* either of human capital measures	Positive significant	82 countries 1972-1993	Dwyfor Evans et al., 2002
	FD*HC	positive and significant	83 emerging countries, 2002 to 2017. system GMM	Sarwar et al., 2021
	FD*HC	Positive&significant	19 SSA Countries 1999 to 2014 system GMM	Oyinlola & Adedeji, 2019

Source: Authors' design

CHAPTER 2: THE GLOBAL MODEL (20 AFRICAN COUNTRIES)

2.1. Summary and Descriptive Presentation of the Variables

2.1.1. Overview of Key Variables

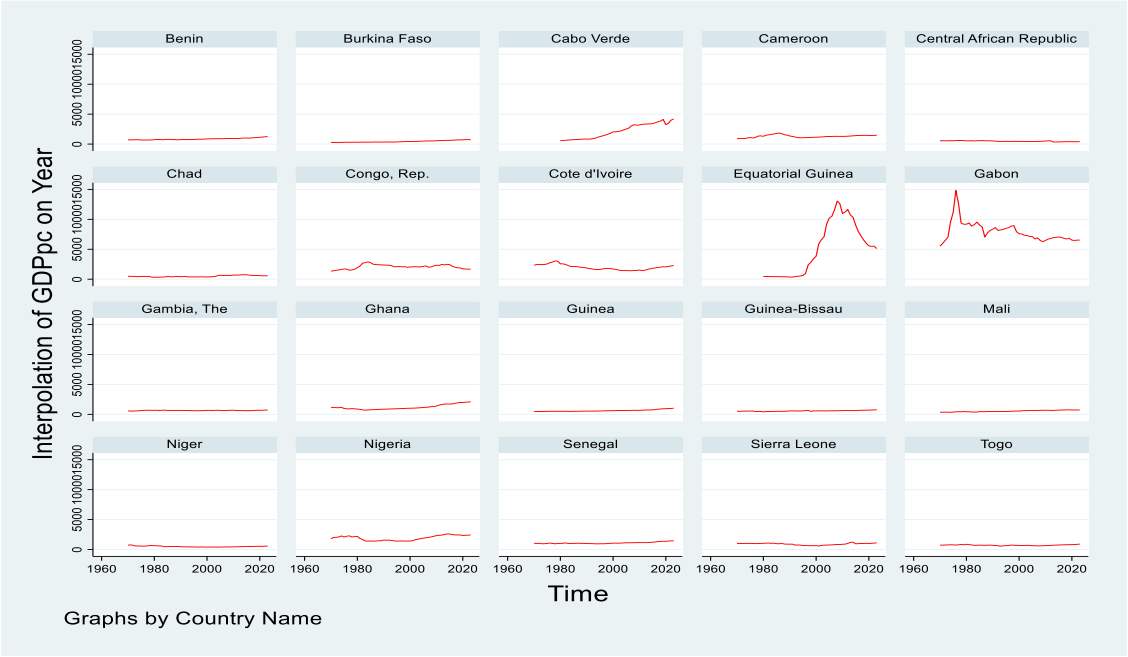
Table 2: Overview of Key Variables

Indicator Name	Acronym	Definition	Data Source
GDP per capita (constant 2015 US$)	GDP	GDP per capita is GDP divided by population. Gross Domestic Product is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	WDI
Domestic credit to private sector (% of GDP)	DC	Domestic credit to the private sector (% of GDP) refers to financial resources provided to the private sector by financial corporations.	
Broad money (% of GDP)	BM	Broad money (% of GDP) is the sum of currency outside banks; demand deposits other than those of the central government; the time savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper.	
Government Expenditure on Education	GEE	Share of General Government Expenditure on Education (referred to as education human capital)	
Life Expectancy at birth	LE	Life Expectancy at birth (referred to as health human capital) indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	
Trade (% of GDP)	Trd	Trade is the sum of exports and imports of goods and services. It is measured as a share of GDP.	
Consumer Price Index	CPI	The Consumer Price Index reflects changes in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. Here, it is referred to as inflation and the base year is 2010.	
General Government Expenditure	GGE	General government Expenditure includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most national defense and security expenditures but excludes government military expenditures that are part of government capital formation.	
Real Crude Oil Price / barrel	OPr	It is the average of the Brent, Dubai, and WTI crude oil annual prices in real US dollars per barrel.	WBCPD

Source: Authors' design

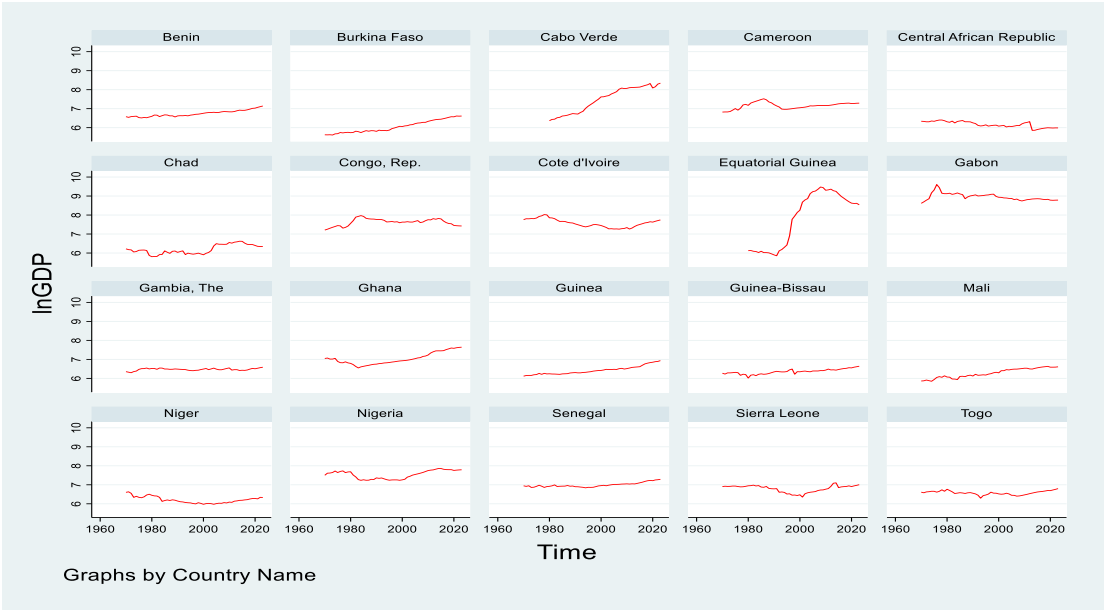
2.1.2. Graphical Representations of the Variables of Interest

2.1.2.1. GDP and lnGDP Plots



Graph 1: GDP

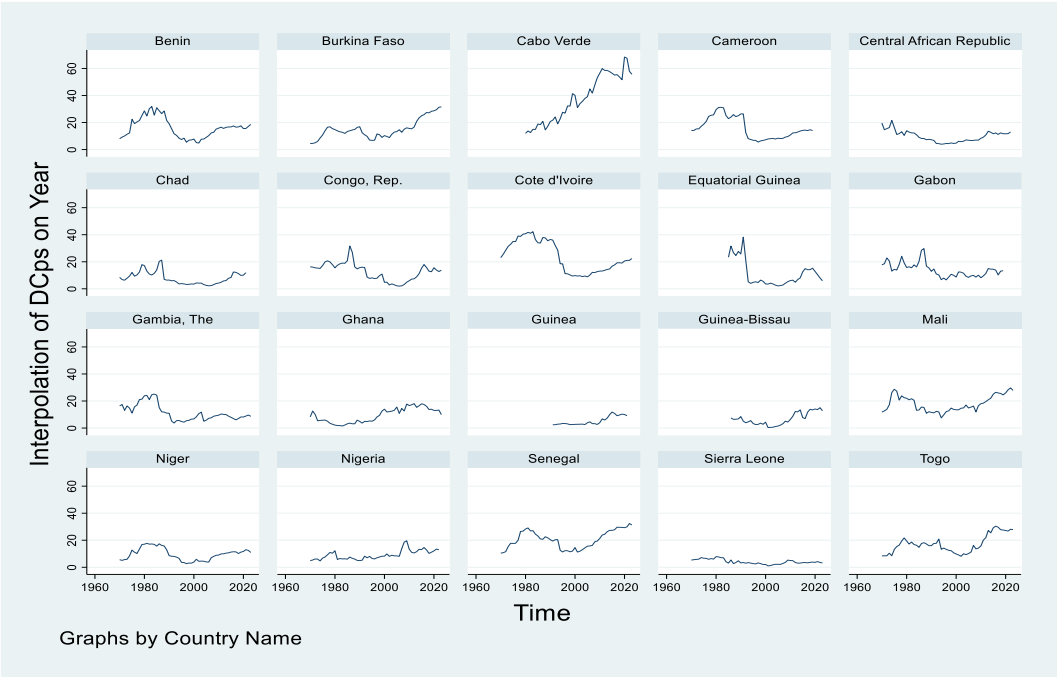
Source: Author's generation from Stata 17



Graph 2: **ln**GDP

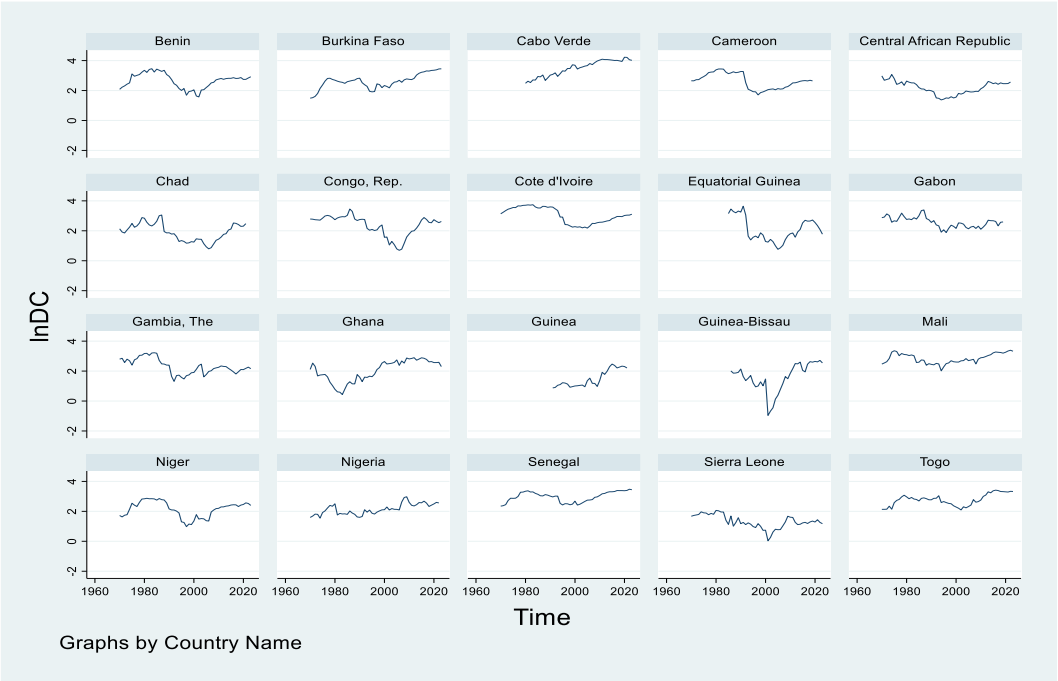
Source: Author's generation from Stata 17

2.1.2.2. Domestic Credit (DC) Ratios to GDP Plots



Graph 3: DC

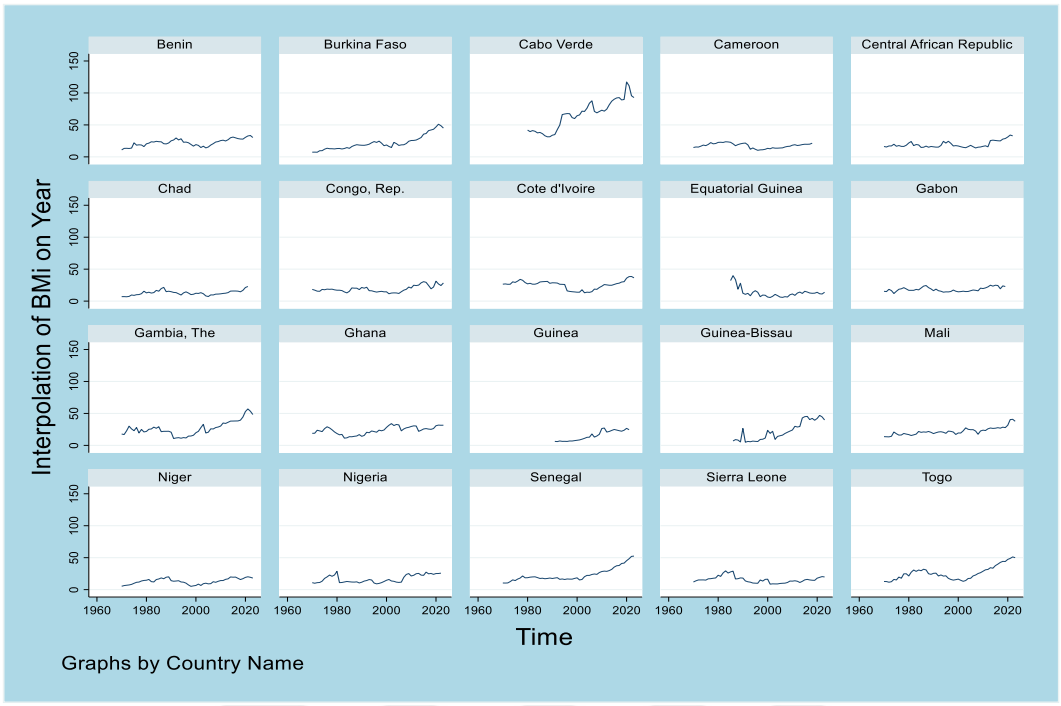
Source: Author's generation from Stata 17



Graph 4: lnDC

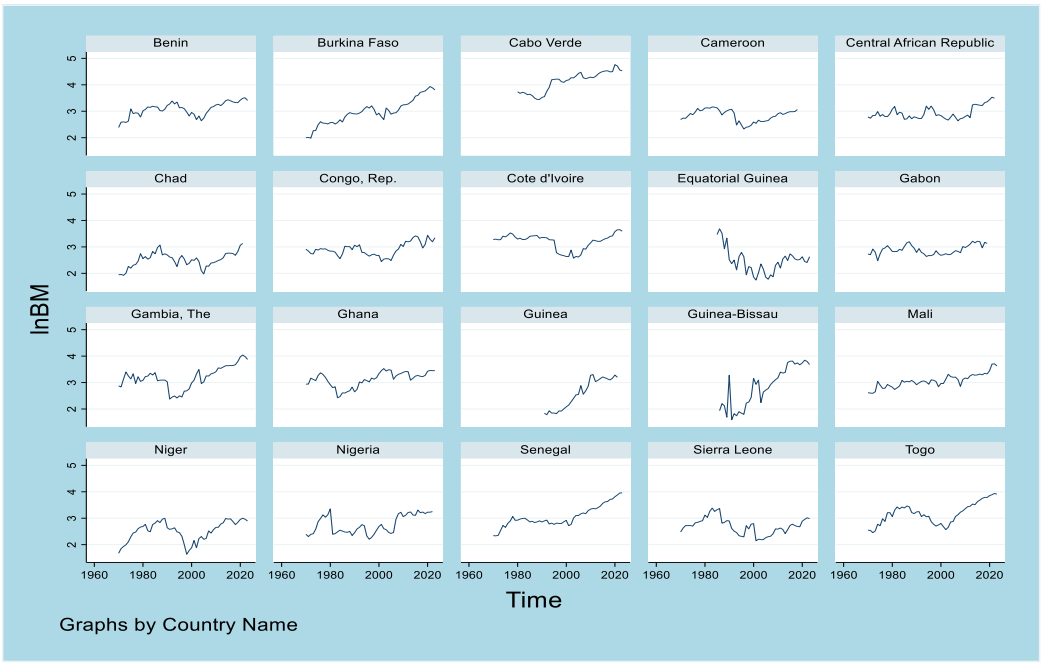
Source: Author's generation from Stata 17

2.1.2.3. Broad Money (BM) Ratios to GDP Plots



Graph 5: BM

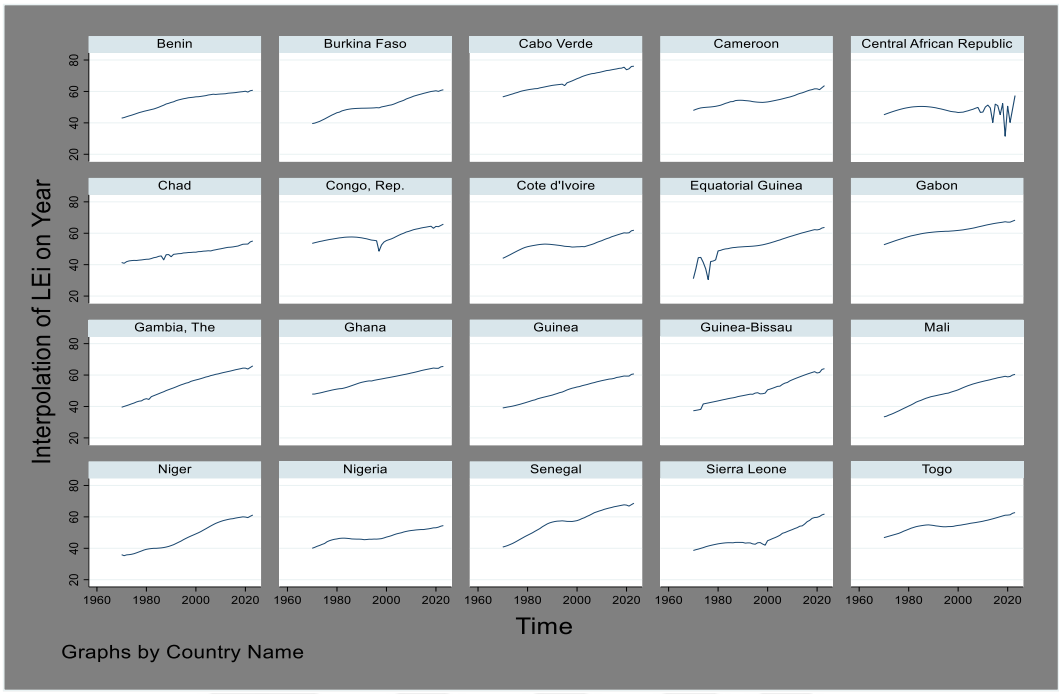
Source: Author's generation from Stata 17



Graph 6: lnBM

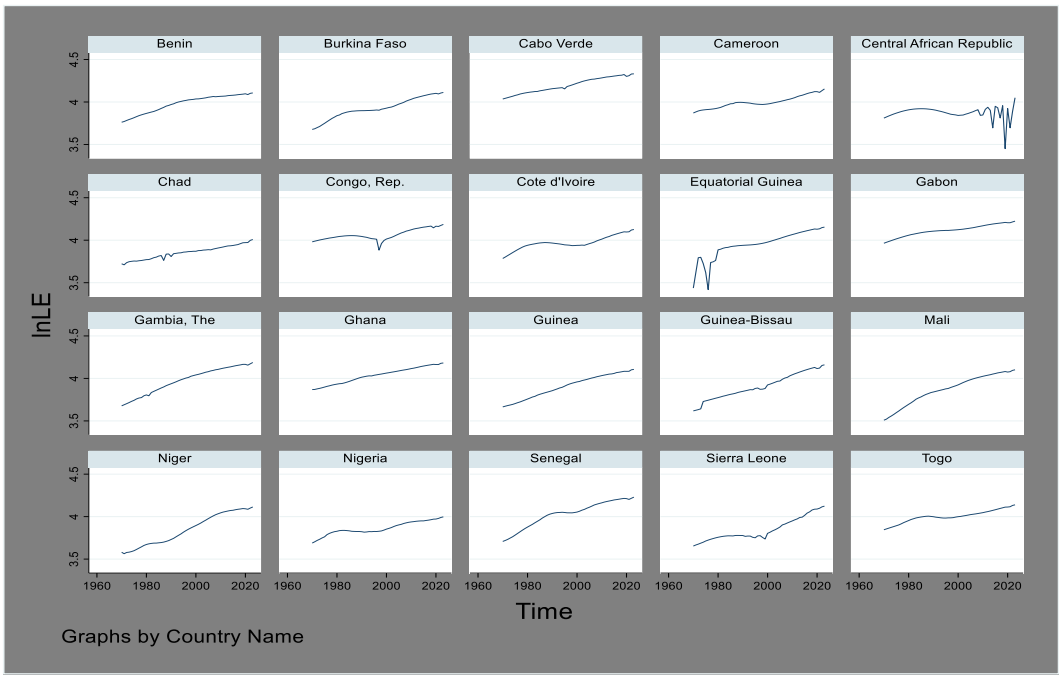
Source: Author's generation from Stata 17

2.1.2.4. Life Expectancy Plots



Graph 7: LE

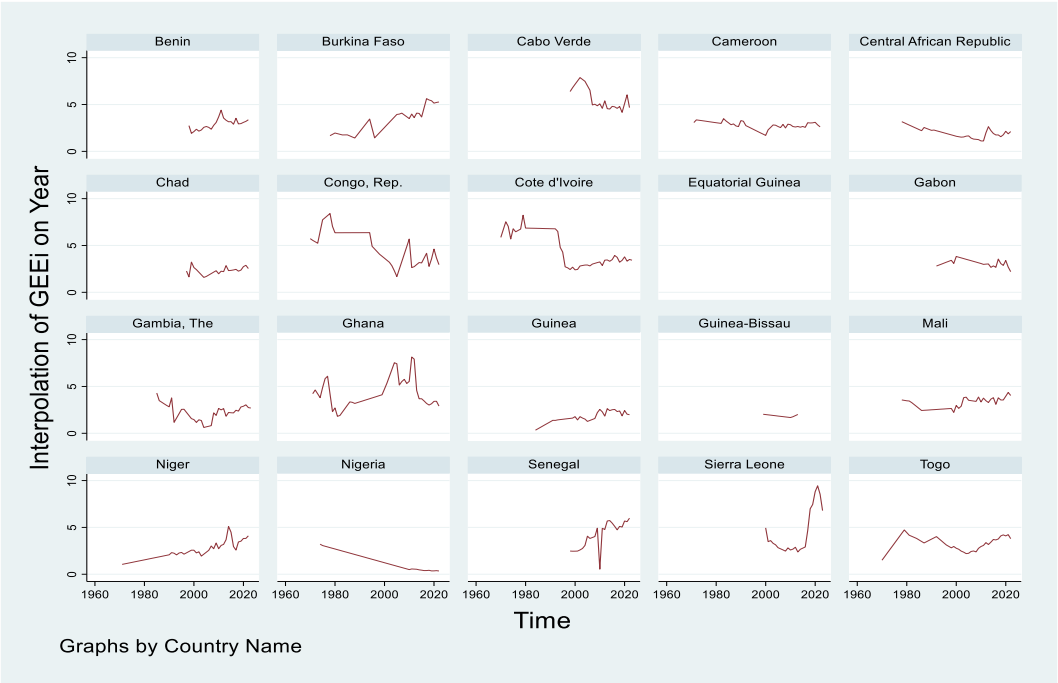
Source: Author's generation from Stata 17



Graph 8: lnLE

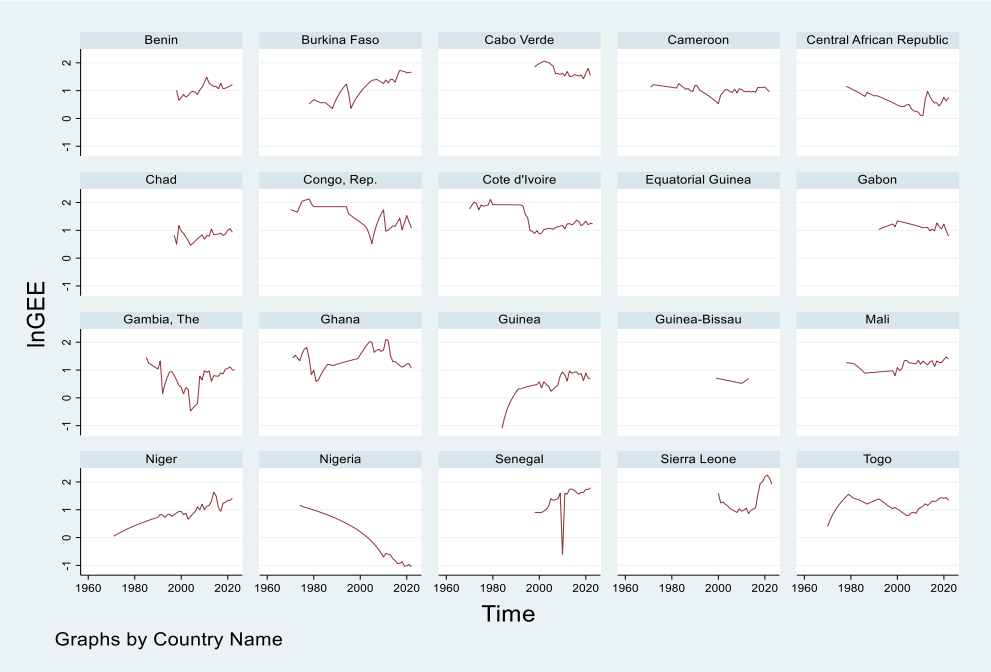
Source: Author's generation from Stata 17

2.1.2.5. Expenditure on Education Plots



Graph 9: GEE

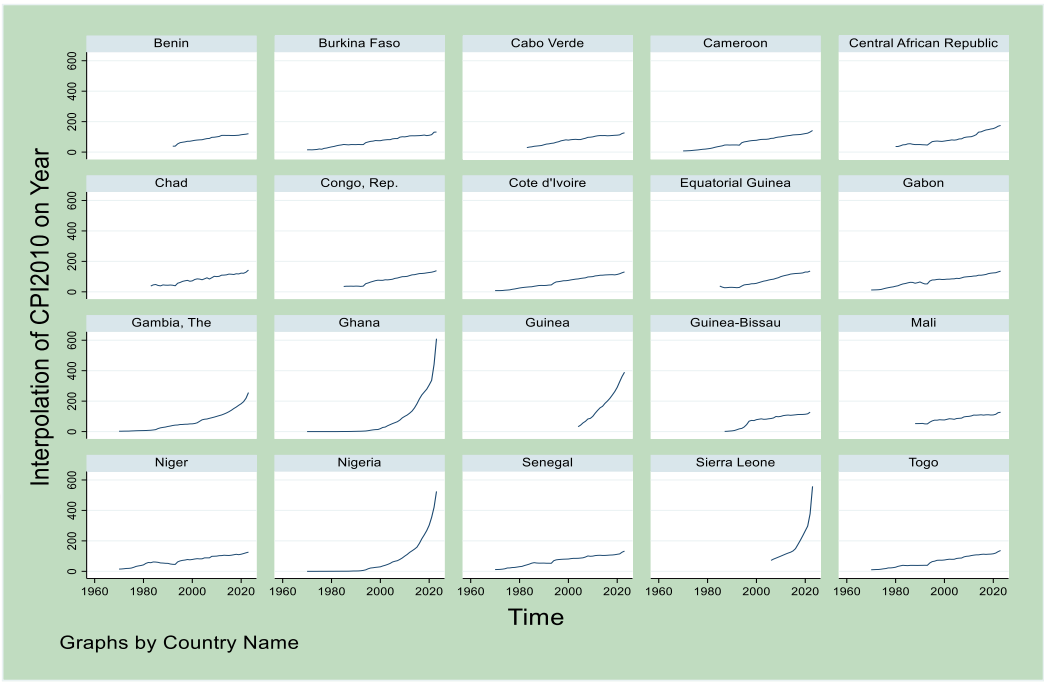
Source: Author's generation from Stata 17



Graph 10: lnGEE

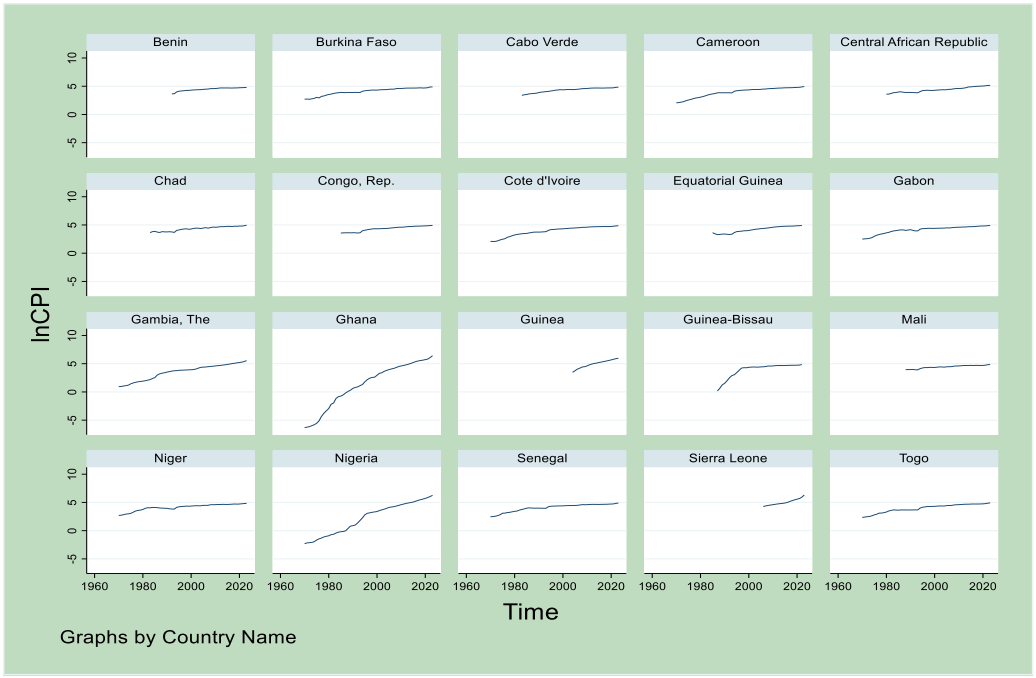
Source: Author's generation from Stata 17

2.1.2.6. Inflation Plots



Graph 11: CPI

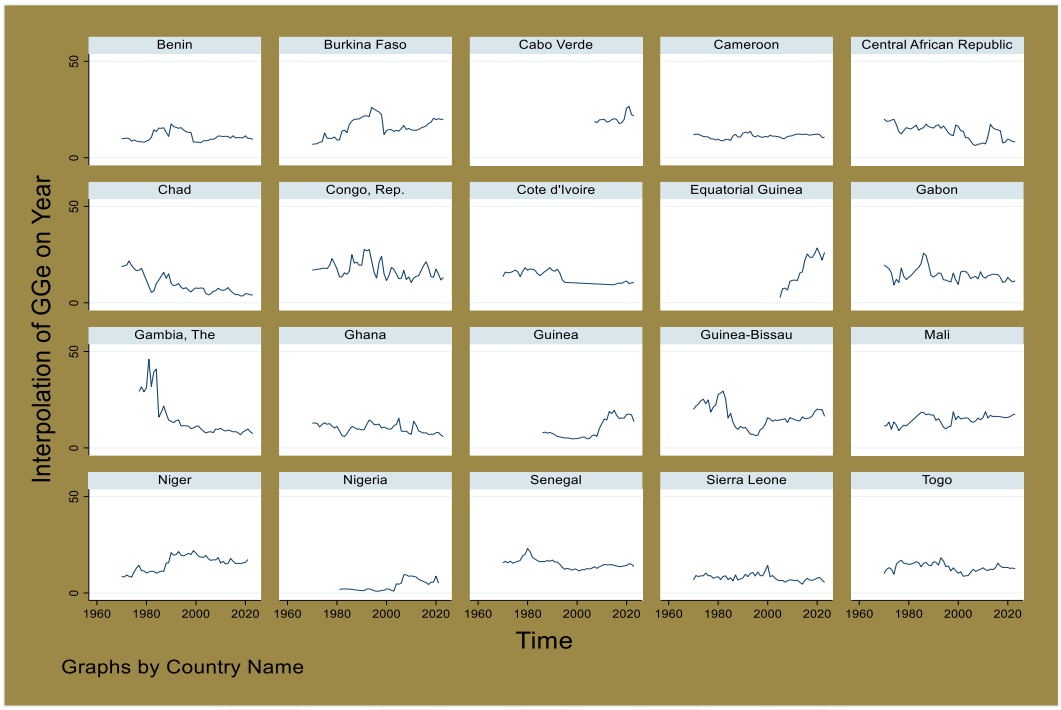
Source: Author's generation from Stata 17



Graph 12: lnCPI

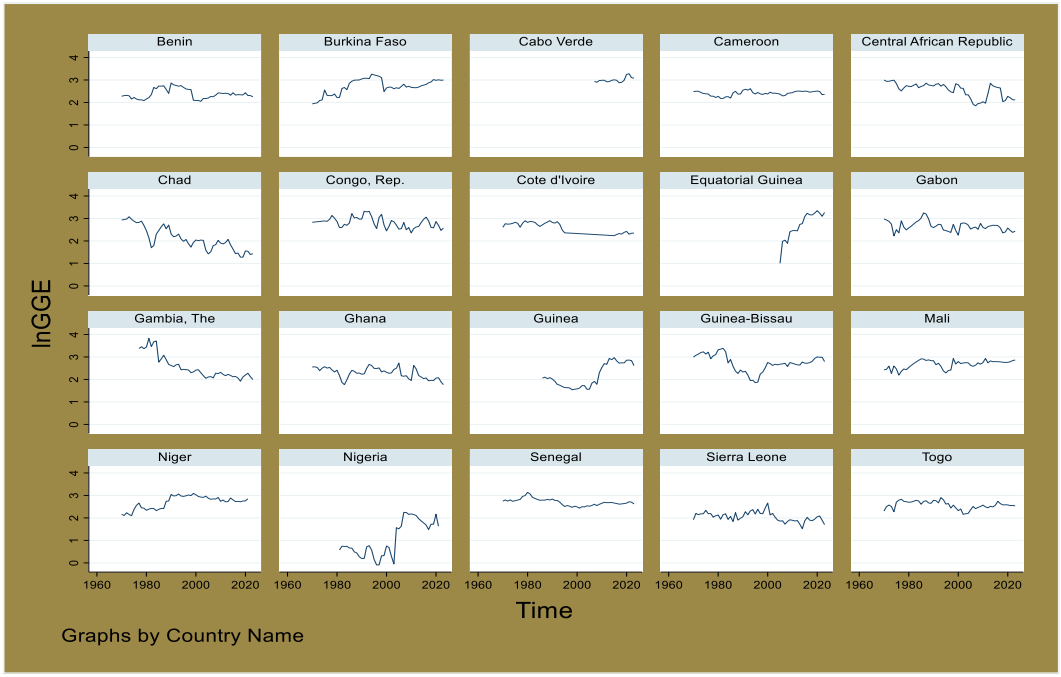
Source: Author's generation from Stata 17

2.1.2.7. Final Government Consumption Plots



Graph 13: GGE

Source: Author's generation from Stata 17



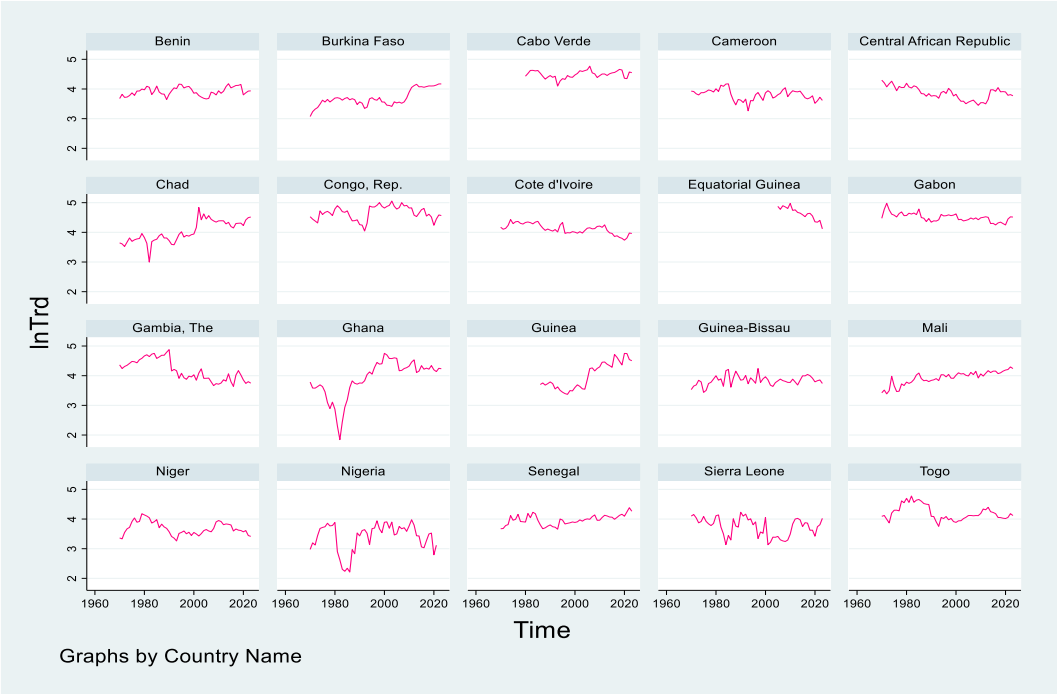
Graph 14: lnGGE

Source: Author's generation from Stata 17

2.1.2.8. Trade Openness Plots

Graph 15: Trd

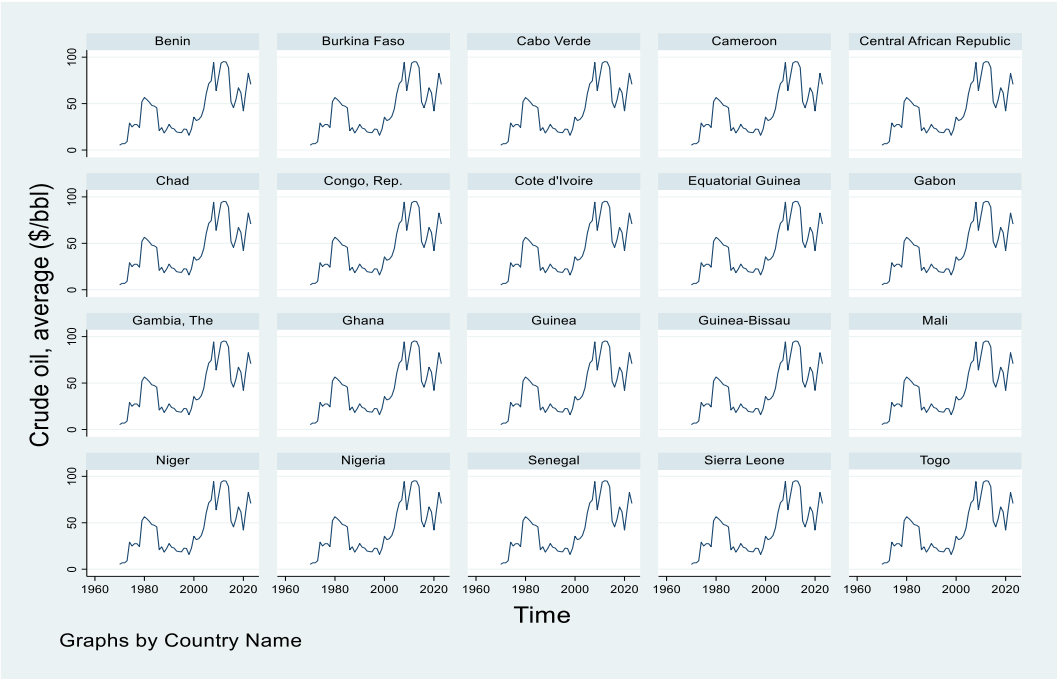
Source: Author's generation from Stata 17



Graph 16: lnTrd

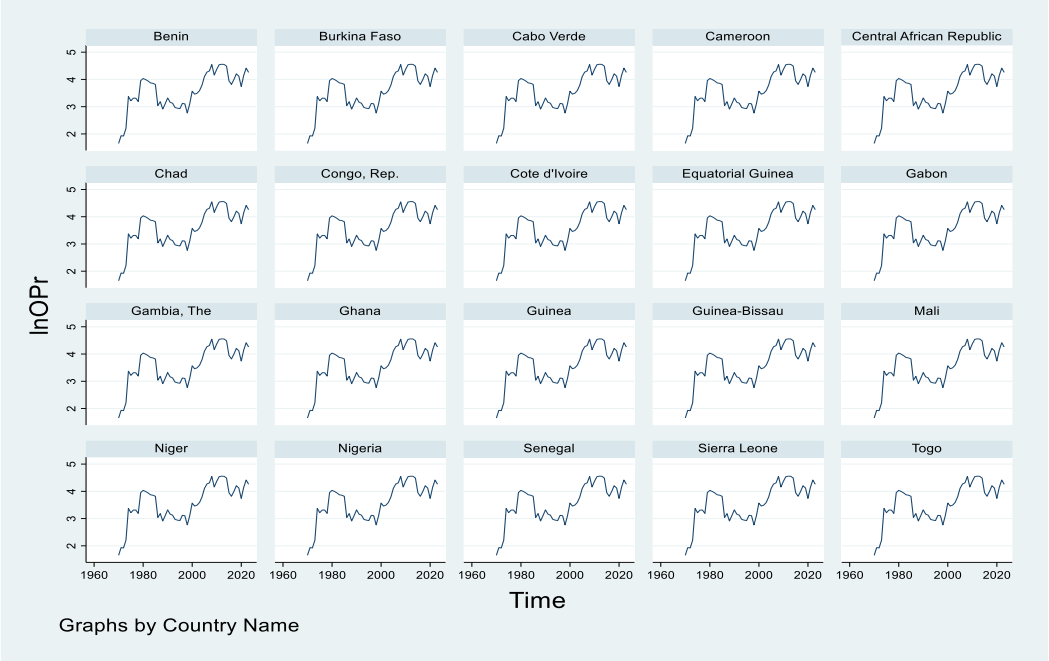
Source: Author's generation from Stata 17

2.1.2.9. Oil Price Plots



Graph 17: OPr

Source: Author's generation from Stata 17



Graph 18: lnOPr

Source: Author's generation from STATA 17.

2.1.3. Global Model Summary Statistics (n*T=20*54=1080 Observations)

Below (see Table 3) are summarized the mean, the standard deviation, the minimum and maximum values, and the number of observations for the level and log form of the variables considered in the model. For the subsequent estimations, the log forms of the variables are considered in line with the standard empirical literature. The country with the highest Per Capita GDP (14823,88 USD) was Gabon in 1976. The country with the least Per Capita GDP (274,1525 USD) was Burkina Faso in 1973. Cabo Verde had the best Life Expectancy at Birth (76,059 Years) in 2023 while Equatorial Guinea had the worst Life Expectancy of less than 31 Years observed in 1976.

Table 3: Descriptive-Summary statistics

	Variable	Obs	Mean	Std, dev,	Min	Max
			Level Form			
1	GDP	1060	1537,934	2039,68	274,1525	14823,88
2	DC	1004	13,86437	10,00782	0,383077	68,45603
3	BM	1003	21,98186	13,56118	4,903761	117,208
4	LE	1080	53,07994	7,813307	30,537	76,059
5	GEE	750	3,192098	1,606685	0,33494	9,442236
6	CPI	885	78,57903	63,23479	0,0017837	609,9726
7	GGE	970	12,98527	5,365294	0,9112346	45,95932
8	Trd	1017	59,83631	25,38598	6,320343	156,8618
9	OPr	1080	43,60079	25,27613	5,212236	95,26411
			Log form			
1	lnGDP	1060	6,907817	0,8079456	5,613685	9,603995
2	lnDC	1004	2,380959	0,7417649	-0,9595192	4,226192
3	lnBM	1003	2,956466	0,4978038	1,590002	4,76395
4	lnLE	1080	3,960713	0,1502412	3,418939	4,33151
5	lnGEE	750	1,029542	0,5429457	-1,093804	2,245193
6	lnCPI	885	3,845865	1,602557	-6,329083	6,413414
7	lnGGE	970	2,461377	0,5032374	-0,0929549	3,827757
8	lnTrd	1017	4,004032	0,4270451	1,843773	5,055365
9	lnOPr	1080	3,571389	0,6933371	1,651009	4,556653

Source: Author's compilation

2.2. (Global Model) Cross-Sectional Dependence and Stationarity Tests Results

2.2.1 Cross-Sectional Dependence (Global Model)

Table 4 provides evidence of cross–sectional dependence among individual countries, and as such, traditional unit root tests may not be robust when applied. Instead, 2nd generation unit root tests have been implemented.

Table 4: Cross-sectional Dependence CD-tests

Variable	CD(2004)	CD(2015, 2021)	CDw	CDw+
lnGDP	20,32	21,65	-3,84	690,77
	(0,000) ***	(0,000) ***	(0,000) ***	(0,000) ***
lnDC	36,05	51,89	-3,82	742,69
	(0,000) ***	(0,000) ***	(0,000) ***	(0,000) ***
lnBM	41,07	49,62	-2,08	720,14
	(0,000) ***	(0,000) ***	(0,038) **	(0,000) ***
lnLE	76,85	83,71	-2,55	1169,40
	(0,000) ***	(0,000) ***	(0,011) **	(0,000) ***
lnGEE	3,92	16,01	0,16	420,94
	(0,000)	(0,000) ***	(0,877)	(0,000) ***
lnCPI	64,72	96,24	-4,38	1322,14
	(0,000) ***	(0,000) ***	(0,000) ***	(0,000) ***
lnGGE	5,81	9,54	-2,40	458,69
	(0,000) ***	(0,000) ***	(0,016) **	(0,000) ***
lnTrd	2,41	3,72	0,32	534,88
	(0,016) **	(0,000) ***	(0,750)	(0,000) ***
lnOPr	101,29	101,29	-1,07	1395,14
	(0,000) ***	(0,000) ***	(0,286)	(0,000) ***

*: significant at 10%, **: significant at 5%, ***: significant at 1%

Source: Author's compilation

2.2.2 Unit Root Tests (Global Model)

Table 5: Panel unit root test under cross-sectional dependence

S/N	Variables	Pesaran's CADF test with Trend	Pesaran's CADF test with Constant	Im–Pesaran–Shin test, with trend option	Fisher-type test, with dfuller option	Fisher-type test, with pperron option	Decision
		Z[t-bar] (P-value)	Z[t-bar] (P-value)	W-t-bar (P-value)	Inverse normal Z (P-value)	Inverse normal Z (P-value)	
1	lnGDP, lags(1)	-2,036 (0,943)	-1,497 (0,914)	1,9035 (0,9715)	2,4723 (0,9933)	3,1614 (0,9992)	I(1)
	dlnGDP , lags(1)	-4,691 (0,000)***	-4,404 (0,000)***	-15,2828 (0,000)***	-16,3874 (0,0000)***	-24,1712 (0,0000)***	
2	lnDC , lags(1)	-5,178 (0,000)***	-3,509 (0,000)***	1,5978 (0,9450)	-0,3366 (0,3682)	-0,1021 (0,4594)	I(1)
	dlnDC , lags(1)	-14,284 (0,000)***	-15,904 (0,000)***	-14,0018 (0,0000)***	-16,7637 (0,0000)***	-24,7200 (0,0000)***	
3	lnBM , lags(1)	-3,636 (0,000)***	-2,456 (0,007)***	0,7171 (0,7634)	0,3335 (0,6306)	0,0916 (0,5365)	I(1)
	dlnBM , lags(1)	-16,750 (0,000)***	-18,143 (0,000)***	-17,5883 (0,000)***	-19,9037 (0,000)***	-28,1450 (0,000)***	
4	lnLE , lags(1)	-1,813 (0,997)	-1,835 (0,395)	0,3002 (0,6180)	-1,1430 (0,1265)	-5,2826 (0,000)***	I(1)
	dlnLE , lags(1)	-4,401 (0,000)***	-4,077 (0,000)***	-12,0977 (0,000)***	-12,2087 (0,000)***	-18,0457 (0,000)***	
5	lnGEE , lags(1)				-1,2037 (0,1144)	-2,1420 (0,0161)**	I(1)
	dlnGEE , lags(1)				-14,7373 (0,000)***	-22,0293 (0,000)***	
6	lnCPI , lags(1)	-0,934 (0,175)	-4,344 (0,175)	-2,6674 (0,0038)***	-4,0012 (0,0000)***	-7,0512 (0,0000)***	I(0)
	dlnCPI, lags(1)	-10,743 (0,000)***	-11,671 (0,000)***	-10,9856 (0,0000)***	-12,2703 (0,0000)***	-13,8222 (0,0000)***	
7	lnGGE , lags(1)	-1,200 (0,115)	-0,942 (0,173)	-2,0680 (0,0193)**	-3,0066 (0,0013)***	-3,6278 (0,0001)***	I(0)

	dlnGGE , lags(1)	-14,525 (0,000)***	-15,918 (0,000)***	-18,2998 (0,0000)***	-20,3247 (0,0000)***	-27,2874 (0,0000)***	
8	lnTrd , lags(1)	-2,998 (0,001)***	-0,606 (0,272)	-3,6069 (0,0002)***	-3,0687 (0,0011)***	-4,3291 (0,0000)***	I(0)
	dlnTrd , lags(1)	-14,525 (0,000)***	-16,773 (0,000)***	-20,8280 (0,000)***	-22,4286 (0,000)***	-30,0173 (0,000)***	
9	lnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-2,9784 (0,0014)***	-5,9890 (0,0000)***	-6,9730 (0,0000)***	I (0)
	dlnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-18,6668 (0,000)***	-20,3519 (0,000)***	-28,1243 (0,000)***	

*: significant at 10%, **: significant at 5%, ***: significant at 1%

Source: Author's computations from STATA 17.

Decision: All the endogenous variables are integrated of order one (I(1)) and the exogenous variable and the other control variables are integrated at level, that is, they are I(0).

2.3. Global Model Estimation Results

Table 6: Consistent Moment and Model Selection Criteria (Global Model)

Lags of endogenous variables	MBIC	MAIC	MQIC
1*	-1277,441	-224,8862	-635,8174
2	-865,8715	-164,1682	-438,1223
3	-442,9634	-92,11179	-229,0889

Source: Author's computations from STATA 17.

Based on Table 07 output, past realizations of GDP, BM, Life Expectancy at Birth, Trade openness, and Crude Oil Prices are associated with an increase of about 22,79%; 4,5%; 20,55%; 3,51%; and 0,87% in GDP on average ceteris paribus. Moreover, past realizations of DC, GEE, CPI, and GGE are statistically not significant in influencing real GDP.

GDP, and DC itself positively (LE, GGE, Trade and Oil Price negatively) impact Domestic Credit. The rest of the variables (BM, GEE, and CPI) do not significantly affect Domestic Credit.

A percentage increase in GEE, Trd and OPr is associated with a 3,11%; 6,11%; and 3,21% increase in Broad Money, respectively, and on average, ceteris paribus. However, BM, LE, and CPI negatively affect the money supply (GDP, DC, and GGE have no significant impact on BM).

Up to -39,38% of change in Life Expectancy (health human capital) is due to a percentage increase in past realization of life expectancy. GDP, DC, GEE and GGE have a positive impact (11,85%, 0,37%, 0,37%, 0,39%, respectively) on life expectancy. However, a percentage increase in Trade and CPI is found to exert a negative even though small effect (0,41% and 0,13% respectively) on life expectancy. BM and OPr had no significant effect on LE.

Only a percentage change in DC and LE has a statistically significant and positive impact of about 10,64% and 24,39% on the GEE. A percentage increase in GEE itself and GGE causes about a 18,47% and 5,16% decrease in GEE. GDP, BM, CPI, Trd and OPr impacts on GEE are insignificant.

The Consumer Price Index is affected positively by itself (a percentage increase in CPI causes about a 96,92% increase in CPI some period ahead), GDP (14,55%), and BM (4,63%); it is impacted negatively by LE and Trd. DC, GEE, GGE, and OPr effects on CPI are non-significant.

Domestic Credit, LE and GGE affect General Government Expenditure positively, but GDP, BM, and Oil Price negatively affect GGE. GEE, CPI and Trd influences are insignificant.

Finally, while money supply, life expectancy, consumer price index, and Trade itself positively impact trade openness, the past realization of GGE negatively affects current trade openness. A percentage increase in Trd causes about an 86,17% increase in Trade the next periods. GDP, DC, GEE, and OPr influences on trade are insignificant.

Table 7: Global Model Estimation Results

	Equation							
	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	lnGGE	lnTrd
L1. dlnGDP	0,2279*** (5,42)	0,4524*** (4,31)	-0,0100 (-0,15)	0,1185*** (9,64)	-0,0640 (-0,81)	0,1455*** (2,96)	-0,3758*** (-4,67)	0,0602 (0,69)
L1. dlnDC	-0,0049 (-0,9)	0,0848*** (3,22)	0,0344 (1,43)	0,0037*** (3,12)	0,1064*** (4,33)	-0,0061 (-0,54)	0,0649*** (3,61)	0,0193 (1,04)
L1. dlnBM	0,0450*** (4,27)	0,0295 (0,64)	-0,0672** (-2,18)	-0,0023 (-0,93)	-0,0511 (-1,38)	0,0463*** (2,7)	-0,0530* (-1,69)	0,0708** (2,25)
L1. dlnLE	0,2055*** (16,59)	-0,7045*** (-17,25)	-0,2752*** (-18,75)	-0,3938*** (-48,39)	0,2439*** (9,11)	-2,4173*** (-22,74)	1,2625*** (18,04)	1,6694*** (21,14)
L1. dlnGEE	-0,0032 (-0,6)	0,0088 (0,31)	0,0311** (2,11)	0,0037*** (2,78)	-0,1847*** (-3,57)	-0,0007 (-0,1)	-0,0181 (-1,42)	0,0014 (0,09)
L1. lnCPI	0,0015 (0,76)	0,0053 (0,77)	-0,0087** (-2,07)	-0,0013*** (-3,77)	-0,0033 (-0,88)	0,9692*** (248,59)	0,0059 (1,34)	0,0134*** (2,93)
L1. lnGGE	-0,0127 (-1,6)	-0,1674*** (-5,36)	0,0038 (0,2)	0,0039** (2,54)	-0,0516*** (-2,61)	0,0082 (0,58)	0,8760*** (23,31)	-0,0451* (-1,87)
L1. lnTrd	0,0351*** (3,88)	-0,0894** (-2,35)	0,0611** (2,44)	-0,0041** (-2,15)	0,0130 (0,48)	-0,0388** (-2,24)	0,0240 (0,84)	0,8617*** (30,81)
lnOPr	0,0087** (2,24)	-0,0307** (-2,11)	0,0321*** (3,19)	0,0012 (1,35)	-0,0050 (-0,54)	0,0030 (0,45)	-0,0250** (-2,25)	-0,0117 (-1,14)

Notes: *: significant at 10% level, **: significant at 5% level, ***: significant at 1% level
Instruments: l(1/4). (dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd) lnOPr
Test of overidentifying restriction: Hansen's J chi2(192) = 197,81966 (p = 0,371)
Final GMM Criterion Q(b) = 0,32
Initial weight matrix: Identity
GMM weight matrix: Robust

Source: Author's computations from STATA 17.

2.4. Eigenvalue Stability Condition (Global Model)

The Global Model is a stable model since its moduli are within the unit circle (see Figure 1 and Table 8).

Table 8: Stability Condition for Global Model

Eigenvalue		
Real	Imaginary	Modulus
0,9683051	0	0,9683051
0,8831495	0	0,8831495
0,8597731	0	0,8597731
-0,4371758	0	0,4371758
0,2305426	0	0,2305426
-0,167472	0	0,167472
0,0959068	0	0,0959068
-0,0591364	0	0,0591364

Source: Author's compilation

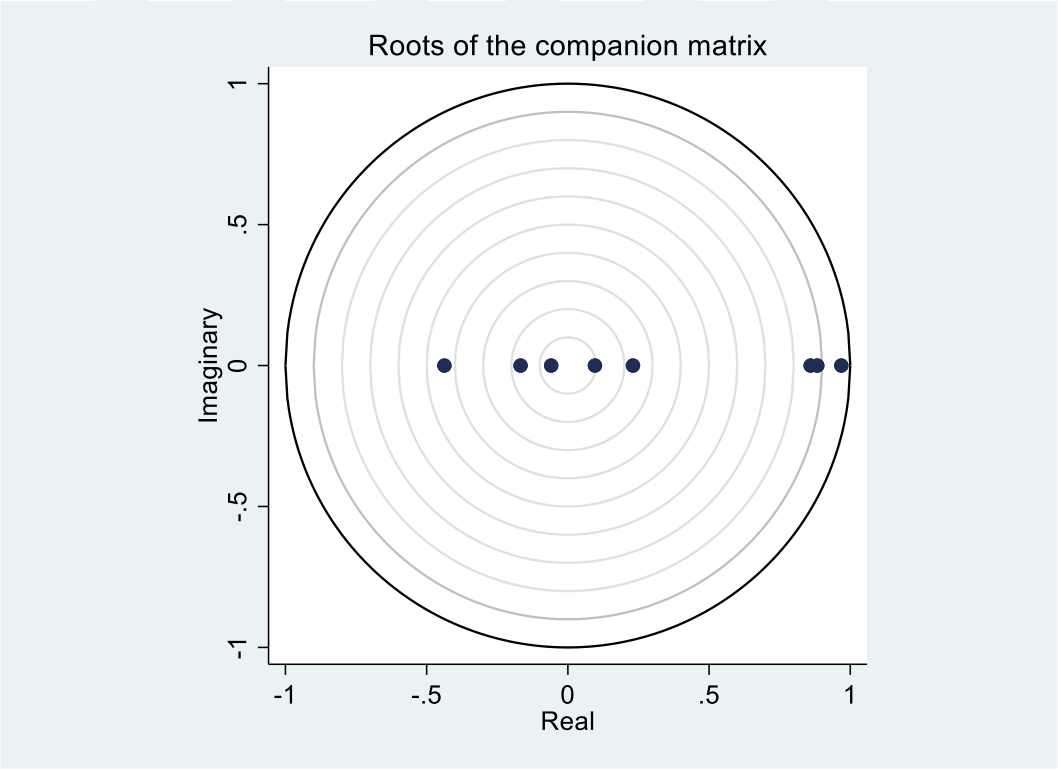


Figure 1: Unit Circle for Global Model Stability Condition

Source: Author's generation from Stata 17

2.5. Granger Causality Tests (Global Model)

From Table 09 results:

- GDP (per capita real income) is granger–caused by BM, LE, and Trd.
- DC (domestic credit) is granger–caused by GDP, LE, GGE, and Trd.
- BM (Broad Money/Money supply) is granger–caused by LE, GEE, CPI and Trd
- LE (Life Expectancy at Birth/health human capital) is granger–caused by all the variables, except BM.
- GEE (government expenditures on education/education human capital) is granger–caused by DC, LE, and GGE.
- CPI (Consumer Price Index/ Inflation Proxy) is granger–caused by GDP, BM, LE, and Trd.
- GGE (General Government Expenditure/ Final Government Consumption) is granger–caused by GDP, DC, BM, and LE.
- Trd (Trade openness) is granger–caused by BM, LE, CPI and GGE.

Overall, all the variables Granger–cause all the equation variables.

Thus, there is evidence of bidirectional causality between:

- health human capital and GDP (GDP↔LE);
- LE and trade openness (LE↔TRD);
- health human capital and DC (LE ↔ DC);
- DC and GGE (GGE ↔ DC);
- BM and Trd (Trd ↔ BM);
- CPI and BM (CPI ↔ BM);
- CPI and Trd (CPI ↔ Trd);
- GEE and LE (GEE ↔ LE);
- LE and CPI (LE ↔ CPI);
- LE and GGE (LE ↔ GGE).[1] .

Furthermore, there is also evidence of unidirectional causality running from:

- BM to GDP (BM→GDP);
- Trd to GDP (Trd→GDP);
- GDP to DC (GDP→DC);
- GEE to BM (GEE→BM);
- LE to BM (LE→BM);

[1] ↔: bidirectional causality among the variables.

- Trd to DC (Trd→DC);
- GDP to CPI (GDP→CPI);
- GDP to GGE (GDP→GGE);
- DC to GEE (DC→GEE);
- BM to GGE (BM→GGE);
- GGE to GEE (GGE→GEE);
- GGE to Trd (GGE→Trd). [2]

Table 09: Causality Test for Global Model

Equation Variable Global ➡	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	lnGGE	lnTrd
dlnGDP		18,587***	0,022	92,934***	0,651	8,755***	21,84***	0,472
dlnDC	0,816		2,037	9,72***	18,733***	0,293	13,04***	1,085
dlnBM	18,228***	0,411		0,872	1,893	7,263***	2,862*	5,075**
dlnLE	275,23***	297,73***	351,39***		83,015***	517,1***	325,49***	446,91***
dlnGEE	0,365	0,094	4,457**	7,755***		0,011	2,02	0,008
lnCPI	0,581	0,6	4,283**	14,223***	0,78		1,804	8,603***
lnGGE	2,563	28,744***	0,041	6,427**	6,788***	0,332		3,48*
lnTrd	15,088***	5,532**	5,933**	4,639**	0,23	4,996**	0,711	
Overall	386,25***	352,07***	375,48***	131,41***	120,02***	587,7***	353,17***	465,34***

Note: ***p < 0,01, **p < 0,05, *p < 0,1; p = Prob>chi2
Ho: The excluded variable does not Granger–cause equation variable
Ha: Excluded variable Granger–causes equation variable

Source: Author's compilation

[2] →: unidirectional causality running from left to right variable.

2.6. Orthogonalised IRFs (Global Model)

Based on Figure 2, we can observe a positive relationship between income and Trade, LE, BM, or GDP itself. One-unit increase in income due to shock leads to a 0,05-unit increase in income in the same period. This effect declines and falls to zero quickly in the 3rd period. The effect of shock to GGE, DC, GEE or CPI is statistically insignificant.

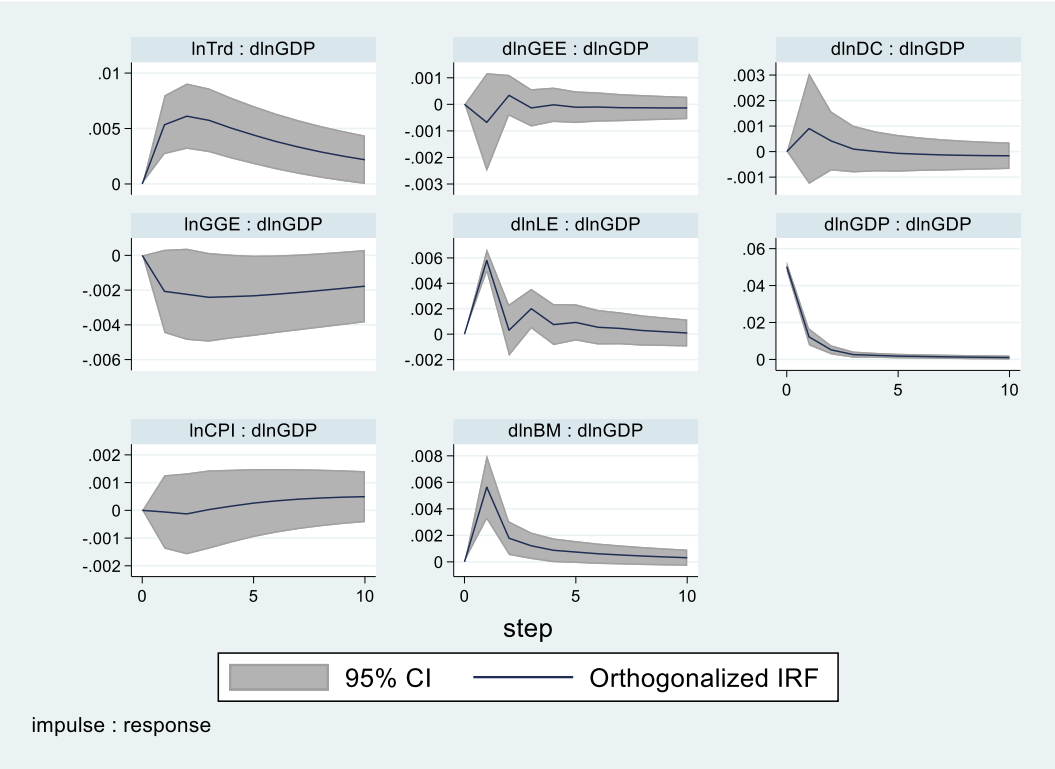


Figure 2: OIRF for GDP

Source: Author's generation from Stata 17

As illustrated in Figure 3, there is a significant negative relationship between DC and Trade, GGE or LE. A positive relationship exists between DC and GDP in the 2nd and 3rd period. DC responds positively to its own shocks. Moreover, a shock to CPI yields a positive response. The response to a BM or GEE shock is not significant.

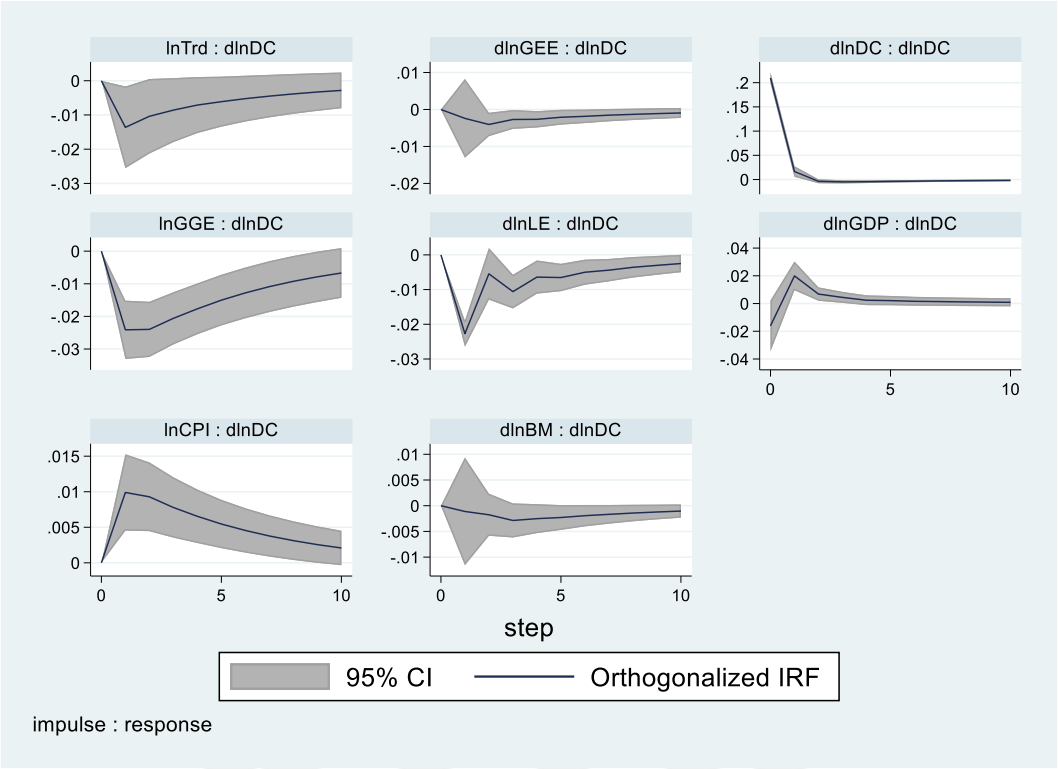


Figure 3: OIRF for DC

Source: Author's generation from Stata 17

As shown in Figure 4, the response to shock to CPI or GGE is not statistically different from zero. There is a positive relationship between BM and Trade, BM and GEE, and BM and DC. BM is negatively associated with income. The response to a standard deviation shock to LE is negative in the initial two periods and positive in the 3rd period, where it converges quickly to zero.

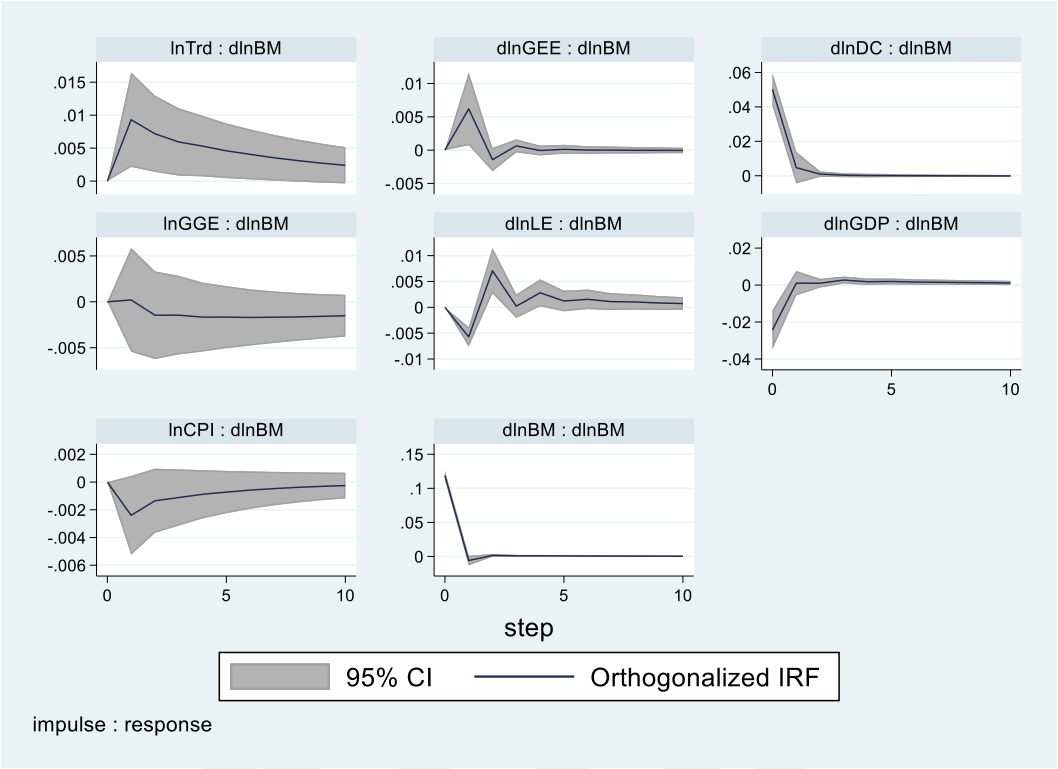


Figure 4: OIRF for BM

Source: Author's generation from Stata 17

Figure 5 reveals that, response to DC, CPI and BM shocks are not different from zero. It can be observed a brief positive association of LE with GDP, GEE, and GGE. One unit increase in Trade due to shock leads to a very small decrease in LE during only the first two-time intervals.

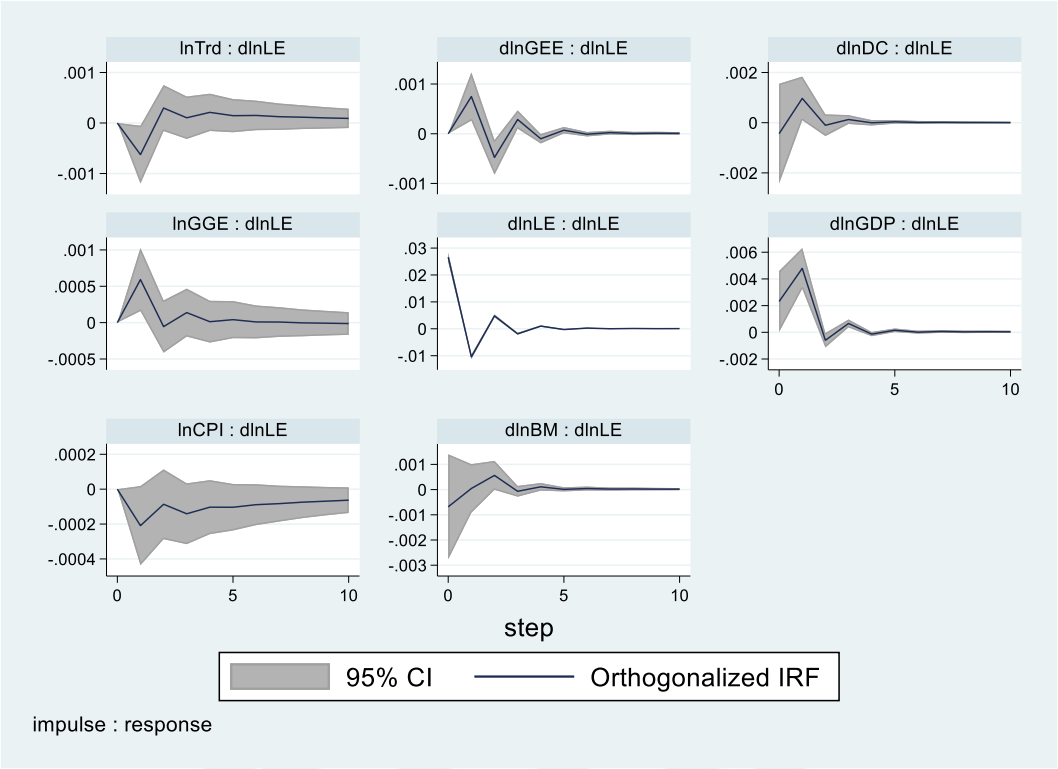


Figure 5: OIRF for LE

Source: Author's generation from Stata 17

Observing Figure 6, shocks to Trade, GDP, CPI and BM do not cause significant response from Government Expenditure on Education. Also, there is a negative relationship between GEE and GGE, and GEE and LE; while DC has a brief positive impact on GEE.

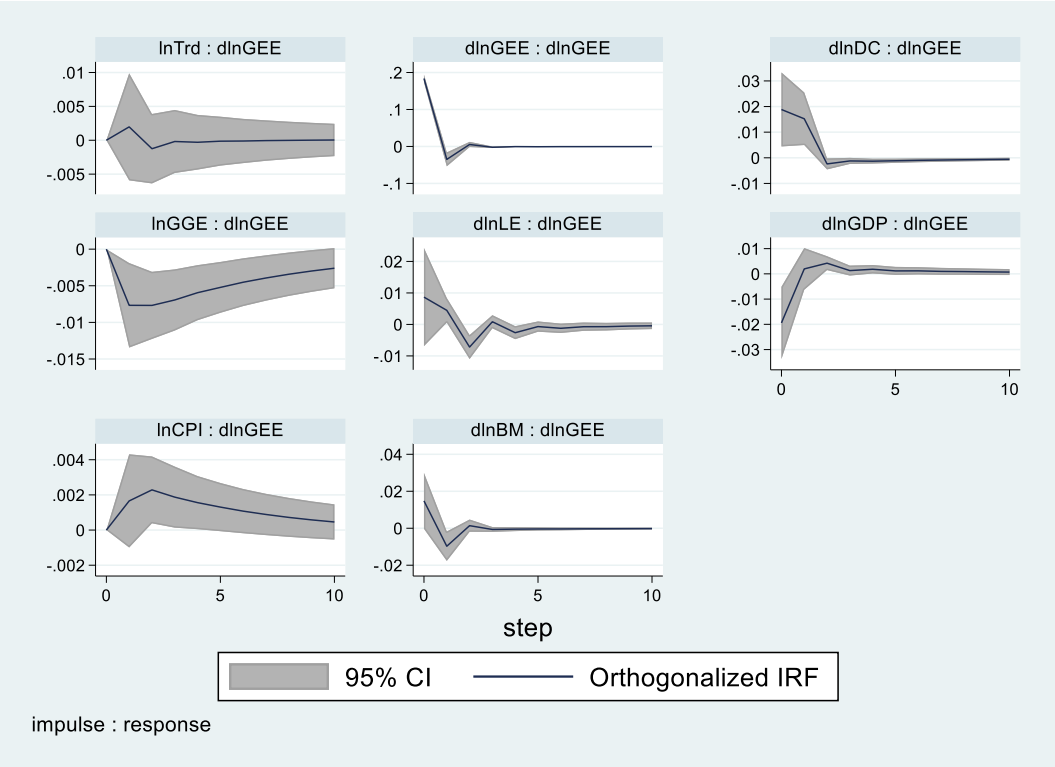


Figure 6: OIRF for GEE

Source: Author's generation from Stata 17

For more insights about the Global model OIRFs of CPI, GGE and Trade please refer to Appendix 1.

2.7. Forecast Error Variance Decomposition (Global Model)

Let's look at the FEVD of the main variables (Economic Growth: real GDP; Financial Development: DC and BM; Human Capital: LE and GEE):

Based on Table 10 (see Appendix 7) results, in the first year, hundred percent of the Forecast Error Variance (FEV) in real GDP is explained by the variable itself (GDP). This implies that other variables do not significantly influence GDP, meaning they are strongly exogenous in the initial year. From the short to the long run, GDP still predicts itself (around 90% in year 10). At the same year 10, Trade, GGE, health human capital and BM account for only 6,07%; 1,43%; 1,31% and 1,28% of FEV in real GDP, respectively. DC, GEE and CPI jointly account for only 1,1% of forecast error variance in GDP.

In year 1, up to 99,42% of FEV in domestic credit is explained by the variable itself (DC), while the remaining 0,58% is explained by real GDP. In the short run (first five years), about 92% of error variance in domestic credit is explained by the variable itself, and in

the long run (year 6 to 10), it is about 90%. When moving forward into the future, at year 10, GDP explains only about 1,5% of error variance in domestic credit, while GGE, LE and Trade explain, respectively, 5,15%; 1,63% and 1,07% of error variance in DC. BM, GEE and CPI jointly explain only 0,92% of forecast error variance in DC in year 10.

From year 1 through year 10, the change from 82,04% to around 80% of FEV in Broad Money is explained by BM itself, while Domestic Credit, GDP and Trade explain respectively about 14% and 3% of FEV in Broad Money throughout the 10 years period. Trade has explained 0,5% to 1,51% of FEV in broad money. Even at year 10, the contribution of life expectancy, GEE, CPI and GGE to changes in broad money has been less than 1% (exactly 0,96%).

Life expectancy remains a strong influencer in predicting itself, with around 99% to 96% from the short to the long run. GDP has been the main contributor of changes of FEV in LE from 0,75% in year 1 to 3,31% in year 10. DC, money supply, GEE, CPI, GGE and Trade joint-contribution to changes in health human capital has been less than 0,5% (exactly 0,44%) even in year 10.

At last, in year 1, GEE strongly predicts itself by almost 97% and 95% in year 10. The contributions of GDP, DC and BM are, respectively, 1,11%; 1,63% and 0,86% of error variance in education human capital in year 10, meaning the remaining variables (LE, CPI, GGE and Trd) jointly contribute to exactly 1,27% in error variance of GEE.

CHAPTER 3: THE ECOWAS ZONE MODEL (15 COUNTRIES)

3.1. Summary/Descriptive Statistics (n*T=15*54=810 Observations)

Table 11: Descriptive-Summary statistics ECO

Variable	Obs	Mean	Std, dev,	Min	Max
LEVEL FORM					
GDP	790	1222,69	1523,128	274,1525	13048,07
DC	745	14,50949	10,90815	0,383077	68,45603
BM	745	23,55451	15,16315	4,903761	117,208
LE	810	52,76877	8,138551	30,537	76,059
GEE	543	3,200889	1,660465	0,33494	9,442236
CPI	653	78,97934	70,34396	0,0017837	609,9726
GGE	700	12,90944	5,630391	0,9112346	45,95932
Trd	747	55,88021	22,30291	6,320343	144,6682
OPr	810	43,60079	25,28003	5,212236	95,26411
LOG FORM					
lnGDP	790	6,80063	0,6727588	5,613685	9,476396
lnDC	745	2,398831	0,7875243	-0,9595192	4,226192
lnBM	745	3,003818	0,5450135	1,590002	4,76395
lnLE	810	3,953785	0,1571175	3,418939	4,33151
lnGEE	543	1,015451	0,5868333	-1,093804	2,245193
lnCPI	653	3,721328	1,812322	-6,329083	6,413414
lnGGE	700	2,442566	0,5396421	-0,0929549	3,827757
lnTrd	747	3,943227	0,4133177	1,843773	4,974443
lnOPr	810	3,571389	0,6934442	1,651009	4,556653

Source: Author's compilation

3.2. ECOWAS Model Cross-Sectional Dependence Test and Unit Root Test Results

3.2.1 Cross-Sectional Dependence

There is evidence of cross–sectional dependence among individual countries (Table 12). Thus, instead of traditional unit root tests, 2nd generation unit root tests have been employed.

Table 12: Cross-sectional dependence CD-tests

Variable	CD (2004)	CD (2015, 2021)	CDw	CDw+
lnGDP	29,96***	35,68***	-2,53**	402,72***
lnDC	24,57***	40,59***	-3,09***	432,07***
lnBM	30,23***	42,23***	-3,85***	441,44***
lnLE	65,62***	70,81***	-2,04**	723,56***
lnGEE	2,52**	11,37***	-1,28	239,04***
lnCPI	45,39***	71,39***	-4,77***	726,81***
lnGGE	4,08***	9,01***	-2,87***	254,70***
lnTrd	1,79*	3,39***	0,27	267,01***
lnOPr	75,30***	75,30***	3,59***	775,17***

*: significant at 10% level, **: significant at 5% level, ***: significant at 1% level

Source: Author's compilation

3.2.2 Unit Root Tests (ECOWAS Model)

Table 13: Panel unit root test under cross-sectional dependence

S/N	Variables	Pesaran's CADF test with Trend	Pesaran's CADF test with Constant	Im–Pesaran–Shin test, with trend option	Fisher-type test, with dfuller option	Fisher-type test, with pperron option	Decision
		Z[t-bar] (P-value)	Z[t-bar] (P-value)	W-t-bar (P-value)	Inverse normal Z (P-value)	Inverse normal Z (P-value)	
1	lnGDP, lags(1)	2,828 (0,998)	2,020 (0,978)	3,4694 (0,9997)	3,7382 (0,9999)	4,2349 (1,0000)	I(1)
	dlnGDP , lags(1)	-11,709 (0,000)***	-11,825 (0,000)***	-14,0642 (0,000)***	-14,5540 (0,0000)***	-21,8959 (0,0000)***	
2	lnDC , lags(1)	-5,625 (0,000)***	-2,858 (0,002)***	0,9742 (0,8350)	-0,2526 (0,4003)	-0,0291 (0,4884)	I(1)
	dlnDC , lags(1)	-12,280 (0,000)***	-13,773 (0,000)***	-12,0231 (0,0000)***	-14,5260 (0,0000)***	-21,9479 (0,0000)***	
3	lnBM , lags(1)	-3,074 (0,001)***	-1,455 (0,073)***	0,4343 (0,6680)	0,5593 (0,7120)	0,3797 (0,6479)	I(1)
	dlnBM , lags(1)	-13,974 (0,000)***	-15,148 (0,000)***	-14,7725 (0,000)***	-16,8382 (0,000)***	-24,3654 (0,000)***	
4	lnLE , lags(1)	-1,369 (1,000)	-1,502 (0,879)	1,2848 (0,9006)	-2,1624 (0,0153)	-4,8734 (0,000)***	I(1)

	dlnLE , lags(1)	-3,662 (0,000)***	-3,143 (0,000)***	-7,9636 (0,000)***	-8,2739 (0,000)***	-13,8158 (0,000)***	
5	lnGEE , lags(1)				-0,7014 (0,2415)	-1,4407 (0,0748)*	I(1)
	dlnGEE , lags(1)				-11,6839 (0,000)***	-18,1214 (0,000)***	
6	lnCPI , lags(1)	0,082 (0,533)	-3,666 (0,000)	-2,4012 (0,0082)***	-4,2344 (0,0000)***	-7,5085 (0,0000)***	I(0)
	dlnCPI, lags(1)	-7,739 (0,000)***	-8,917 (0,000)***	-8,6094 (0,0000)***	-9,8091 (0,0000)***	-10,7579 (0,0000)***	
7	lnGGE , lags(1)	-0,186 (0,426)	-0,368 (0,356)	-0,2019 (0,4200)	-1,5362 (0,0622)*	-2,3963 (0,0083)***	I(1)
	dlnGGE , lags(1)	-11,561 (0,000)***	-12,531 (0,000)***	-14,8513 (0,0000)***	-16,6849 (0,0000)***	-23,7482 (0,0000)***	
8	lnTrd , lags(1)	-1,973 (0,024)**	-0,530 (0,298)	-3,0806 (0,0010)***	-2,1744 (0,0148)**	-3,3696 (0,0004)***	I(0)
	dlnTrd , lags(1)	-12,653 (0,000)***	-14,008 (0,000)***	-17,3789 (0,000)***	-18,8806 (0,000)***	-25,4732 (0,000)***	
9	lnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-2,5794 (0,0049)***	-5,1866 (0,0000)***	-6,0388 (0,0000)***	I (0)
	dlnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-16,1659 (0,000)***	-17,6252 (0,000)***	-24,3563 (0,000)***	

*: significant at 10%, **: significant at 5%, ***: significant at 1%

Source: Author's computations from STATA 17.

Decision: Based on Table 13 results, all the variables are integrated of order one (I (1)) except CPI, Trd and OPr which are I (0).

3.3. ECOWAS Model Estimation Results

Table 14: Consistent Moment and Model Selection Criteria (ECOWAS Model)

Lags of endogenous variables	MBIC	MAIC	MQIC
1*	-1208,849	-235,3056	-620,6151
2	-792,8061	-143,7769	-400,6499
3	-398,8223	-74,30767	-202,7441

*: optimum lag with minimal criteria values

Source: Author's computations from STATA 17

Based on Table 15 output, past realizations of GDP, Life Expectancy at Birth, Government Expenditure on Education, Trade openness, and Crude Oil Prices are associated with an increase of about 37,3%; 47,31%; 1,02%; 1,76%; and 1,2% in GDP on average ceteris paribus. Moreover, past realizations of DC, BM, CPI, and GGE are statistically not significant in influencing real GDP.

GDP, Life expectancy, and Inflation positively (Trade and Oil Price negatively) impact domestic credit. The rest of the variables (DC, BM, GEE, and GGE) do not significantly affect Domestic Credit.

A percentage increase in GDP, GGE, Trd and OPr is associated with a 16,39%; 6,33%; 6,76%; and 3,21% increase in Broad Money, respectively, and on average, ceteris paribus. However, BM and CPI negatively affect the money supply (DC, LE and GEE have no significant impact on the money supply).

Almost 60,1% of change in Life Expectancy (health human capital) is due to past realization of life expectancy. GDP, DC, Trd and OPr have a positive, even though very small impact (2,34%, 0,15%, 0,15%, 0,12%, respectively) on life expectancy. However, a percentage increase in Broad Money and CPI is found to exert a negative even though small effect (0,18% and 0,05% respectively) on life expectancy. GEE and GGE had no effect on LE.

Only a percentage change in DC and LE has a statistically significant and positive impact of about 6,33% and 266,46% on the GEE. A percentage increase in GEE causes about a 18,22% decrease in GEE itself. GDP, BM, CPI, GGE, Trd and OPr impacts on GEE are insignificant.

The Consumer Price Index is affected positively by itself (a percentage increase in CPI causes about a 96,21% increase in CPI a period ahead), and GDP (27,29%); it is impacted negatively by LE and Trd. DC, BM, GEE, GGE, and OPr effects on CPI are non-significant.

Domestic Credit, LE and CPI affect General Government Expenditure positively, but GDP, GEE, Trade and Oil Price negatively affect GGE. BM and GGE influences are insignificant.

Finally, while GDP, DC, money supply, life expectancy, consumer price index, and Trade itself positively impact trade openness, the past realization of GGE negatively affects

current trade openness. A percentage increase in Trd causes about a 88,43% increase in Trade the next period.

Table 15: ECOWAS Model Estimation Results

	Equation							
	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	lnGGE	lnTrd
L1. dlnGDP	0,3730*** (6,14)	0,8495*** (4,23)	0,1639* (1,95)	0,0234*** (4,69)	-0,0240 (-0,25)	0,2729*** (3,65)	-0,3639*** (-4,22)	0,3054*** (2,72)
L1. dlnDC	-0,0014 (-0,26)	0,0370 (1,39)	0,0105 (0,63)	0,0015*** (2,64)	0,0633** (2,48)	0,0067 (0,56)	0,0520*** (3,15)	0,0635*** (3,72)
L1. dlnBM	0,0159 (1,38)	-0,0375 (-0,75)	-0,0586* (-1,91)	-0,0018* (-1,92)	-0,0087 (-0,25)	0,0285 (1,43)	0,0308 (1,09)	0,0759** (2,36)
L1. dlnLE	0,4731* (1,66)	6,2109*** (3,81)	0,5559 (0,65)	0,6010*** (16,55)	2,6646*** (2,97)	-5,6777*** (-7,93)	5,8780*** (6,63)	4,7864*** (5,47)
L1. dlnGEE	0,0102** (2,37)	-0,0152 (-0,61)	0,0100 (0,9)	0,0009 (1,6)	-0,1822*** (-2,91)	0,0012 (0,14)	-0,0377*** (-3,78)	-0,0190 (-1,32)
L1. lnCPI	0,0004 (0,28)	0,0426*** (6,62)	-0,0068* (-1,81)	-0,0005*** (-5,53)	0,0051 (1,45)	0,9621*** (204,23)	0,0173*** (4,39)	0,0126*** (3,06)
L1. lnGGE	0,0025 (0,33)	0,0170 (0,36)	0,0633* (1,65)	0,0005 (0,72)	0,0328 (1,02)	0,0158 (0,9)	-0,0235 (-0,79)	-0,0580** (-2,23)
L1. lnTrd	0,0176** (2,24)	-0,2994*** (-9,01)	0,0676*** (3,27)	0,0015** (2,5)	-0,0119 (-0,46)	-0,0499** (-2,42)	-0,0500** (-2,31)	0,8843*** (35,02)
lnOPr	0,0120*** (3,24)	-0,0963*** (-6,75)	0,0321*** (3,28)	0,0012*** (3,56)	-0,0179 (-1,54)	-0,0047 (-0,52)	-0,0258** (-2,52)	-0,0037 (-0,29)

Notes: *: significant at 10%, **: significant at 5%, ***: significant at 1%.
Z statistics are in parentheses.
Instruments: l (1/4). (dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd) lnOPr
Test of overidentifying restriction: Hansen's J chi2(192) = 207,29397 (p = 0,213)
Final GMM Criterion Q(b) = 0,463
Initial weight matrix: Identity
GMM weight matrix: Robust

Source: Author's computations from STATA 17

3.4. Eigenvalue Stability Condition for ECOWAS Model

All the moduli (see Figure 10 and Table 16) are less than unity; the ECOAWS Zone Model is, thus, a stable model.

Table 16: Stability Condition

Eigenvalue		
Real	Imaginary	Modulus
0,9580508	0	0,9580508
0,9265614	0	0,9265614
0,6231956	0	0,6231956
0,3159543	0	0,3159543
-0,1607624	0	0,1607624
-0,1269054	0	0,1269054
0,0284737	-0,0293567	0,040897
0,0284737	0,0293567	0,04089

Source: Author's computation

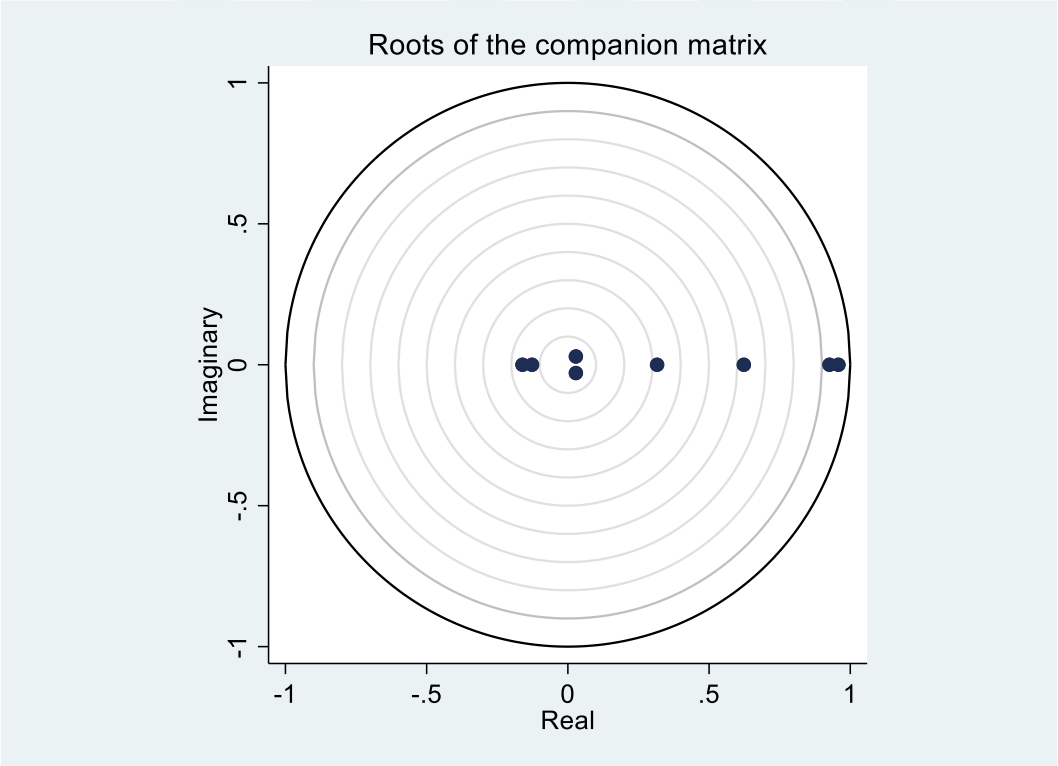


Figure 10: Unit Circle for Stability Condition

Source: Author's generation from Stata 17

3.5. ECOWAS Model Granger Causality Tests

Based on Table 17 results below:

- GDP (per capita real income) is granger–caused by LE, GEE, and Trd (trade openness).
- DC (domestic credit) is granger–caused by GDP, LE (Life Expectancy), CPI (Consumer Price Index), and Trd.
- BM (Broad Money/Money supply) is granger–caused by GDP, CPI, GGE, and Trd
- LE (health human capital) is granger–caused by GDP, DC, BM, CPI, and Trd
- GEE (government expenditures on education/education human capital) is granger–caused by DC and LE.
- CPI (Consumer Price Index/ Inflation Proxy) is granger–caused by GDP, LE, and Trd.
- GGE (General Government Expenditure/ Final Government Consumption) is granger–caused by GDP, DC, LE, GEE, CPI, and Trd.
- Trd (Trade openness) is granger–caused by all the variables except GEE.
- Overall, all the variables Granger–cause all the equation variables.

Thus, there is evidence of bidirectional causality between:

- health human capital and GDP (GDP↔LE);
- GDP and trade openness (GDP↔TRD);
- health human capital and DC (LE ↔ DC);
- DC and Trade (Trd ↔ DC);
- BM and Trd (Trd ↔ BM);
- CPI and LE (CPI ↔ LE);
- Trd and LE (Trd ↔ LE);
- Trade and CPI (Trd ↔ CPI);
- Trade and GGE (Trd ↔ GGE).[3]

Furthermore, there is also evidence of unidirectional causality running from:

- GEE to GDP (GEE→GDP);
- GDP to DC (GDP→DC);

[3] ↔: bidirectional causality among the variables.

- CPI to DC (CPI→DC);
- GDP to BM (GDP→BM);
- CPI to BM (CPI→BM);
- GGE to BM (GGE→BM);
- BM to LE (BM→LE);
- DC to GEE (DC→GEE);
- LE to GEE (LE→GEE);
- GDP to CPI (GDP→CPI);
- GDP to GGE (GDP→GGE);
- DC to GGE (DC→GGE);
- LE to GGE (LE→GGE);
- GEE to GGE (GEE→GGE);
- CPI to GGE (CPI→GGE). [4]

[4] →: unidirectional causality running from left to right variable.

Table 17: Granger Causality Wald Test (ECOWAS Model)

Equation Variable ECOWAS ➡	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	dlnGGE	lnTrd
dlnGDP		17,924***	3,82*	22,036***	0,064	13,35***	17,806***	7,391***
dlnDC	0,068		0,398	6,953***	6,171**	0,311	9,945***	13,828***
dlnBM	1,901	0,56		3,704*	0,063	2,042	1,197	5,574**
DlnLE	2,747*	14,539***	0,429		8,798***	62,91***	43,961***	29,875***
dlnGEE	5,625**	0,378	0,812	2,549		0,019	14,292***	1,756
lnCPI	0,076	43,812***	3,277*	30,593***	2,115		19,279***	9,369***
dlnGGE	0,106	0,127	2,719*	0,512	1,033	0,813		4,974**
lnTrd	5,006**	81,161***	10,722***	6,266**	0,212	5,848**	5,331**	
Overall	39,70***	114,309***	36,929***	52,237***	34,489***	70,76***	103,97***	97,517***

Note: ***p < 0,01, **p < 0,05, *p < 0,1; p = Prob>chi2
Ho: The excluded variable does not Granger–cause equation variable
Ha: Excluded variable Granger–causes equation variable

Source: Author's computation

3.6. ECOWAS Model Orthogonalised IRFs

Based on Figure 11, the responses of GDP to an impulse to DC, BM, CPI, and GGE are statistically insignificant (not different from zero), given that the 95% confidence intervals contain the zero line throughout the periods ahead.

The response of GDP to itself is contemporaneous and positive in the first period, then declines and converges to zero in the fifth period.

The responses to an impulse to GEE or Trd are positive, causing GDP to increase in the first and third periods, and then decrease and converge towards zero in the third and sixth periods, respectively.

The response to LE shock is only positive and significant between second and fifth period.

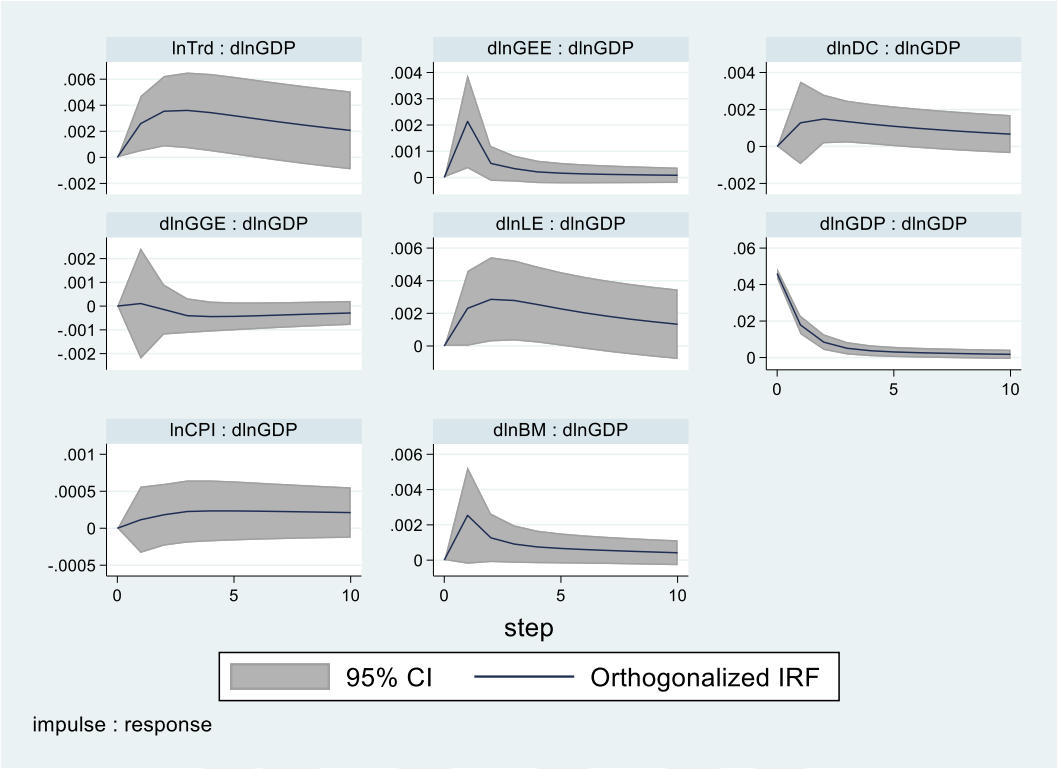


Figure 11: OIRF for GDP

Source: Author's computation

Based on Figure 12, the responses to BM, GGE, GEE and CPI shocks are statistically equal to zero.

One standard deviation shock to DC itself has an instant and positive effect, but the effect dies out quickly in the second period. One-unit positive shock to Trade causes DC to decrease by 0,042 unit in the second period, then the effect declines slowly and converges towards zero.

GDP (or LE) impact on DC is positive in the 2nd and 3rd period (or in the 1st and 2nd period), and negative from the 5th period, but the positive effect has a higher magnitude.

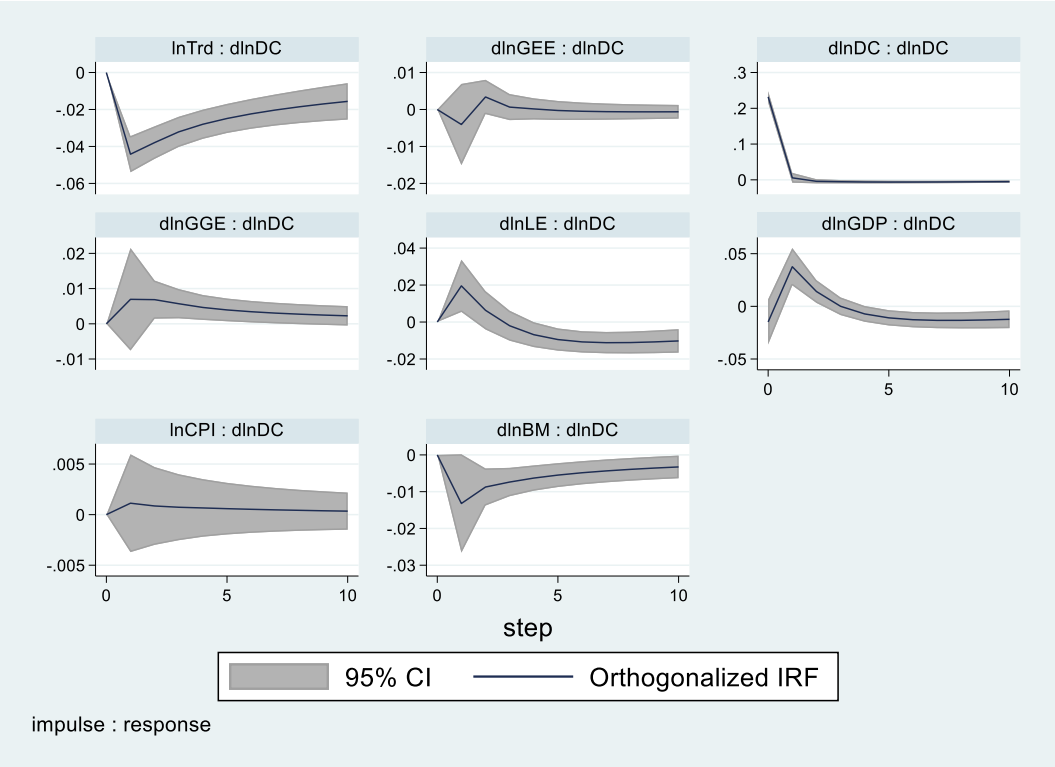


Figure 12: OIRF for DC

Source: Author's computation

According to Figure 13, the responses to LE, GGE, GEE and CPI shocks are not statistically significant.

One standard deviation shock to BM itself causes an instant and positive response, but the effect dies out quickly in the second period.

A one (1) unit positive shock to Trade causes BM to increase by 0,01 unit in the second period, then the effect declines slowly and seems to converge towards zero beyond 10 periods.

One standard deviation shock to DC causes an immediate and positive response, but the effect dies out quickly in the second period.

GDP exibits a delayed small positive impact on BM which persists up to the 6th period.

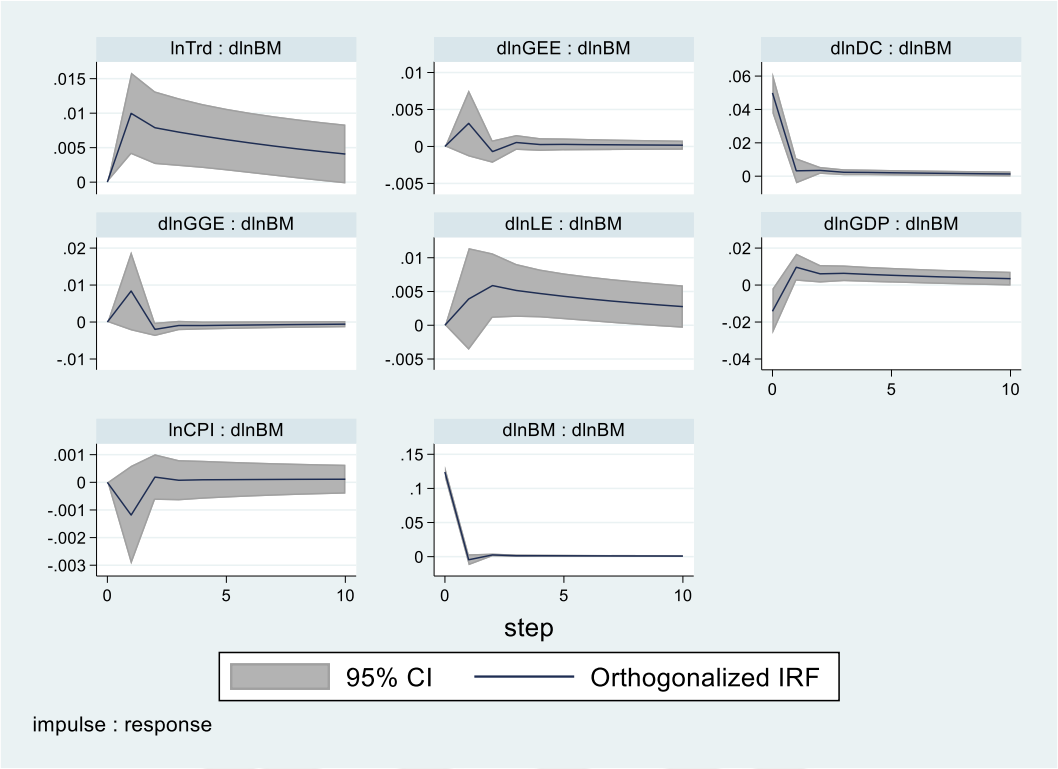


Figure 13: OIRF for BM

Source: Author's computation

Based on Figure 14, the response to one standard deviation shock to GEE, GGE, and BM is not statistically significant.

One standard deviation shock to CPI causes a very small negative effect on LE, which disappears after the second period.

A one (1) unit positive shock to LE itself, causes instantly a 0,004 unit increase then the effect declines and reaches the steady state around the 8th period.

One standard deviation shock to GDP or DC causes a positive response reaching a peak in the 2nd period, then the effect dies out slowly and reaches zero in the eighth period. Trade exibits a small positive impact on LE lasting through the sixth period.

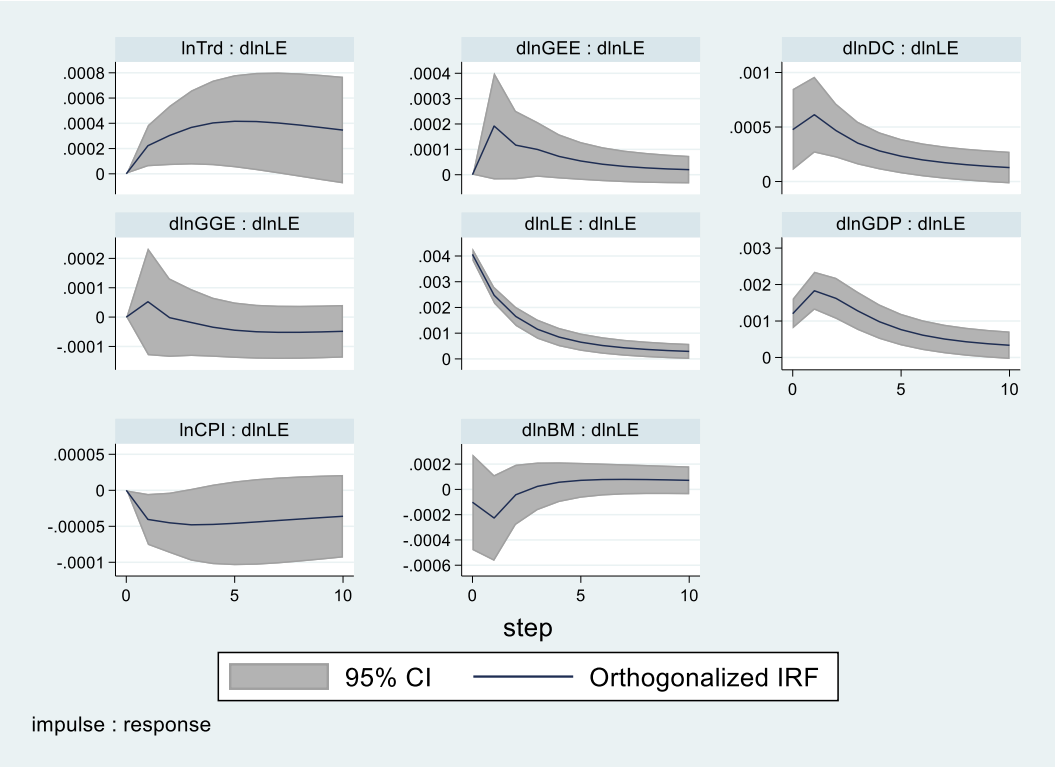


Figure 14: OIRF for LE

Source: Author's computation

According to Figure 15, the only significant responses are those from shock to LE, DC and GEE itself.

One standard deviation shock to GEE itself provokes a delayed negative impact in the 2nd and 3rd period, but dies out quickly after the third period.

A one (1) unit positive shock to DC causes GEE to increase by 0,025 unit instantly, then the effect declines and disappears in the 3rd period.

One standard deviation shock to LE causes a very small positive impact on GEE only in the 2nd and 3rd period.

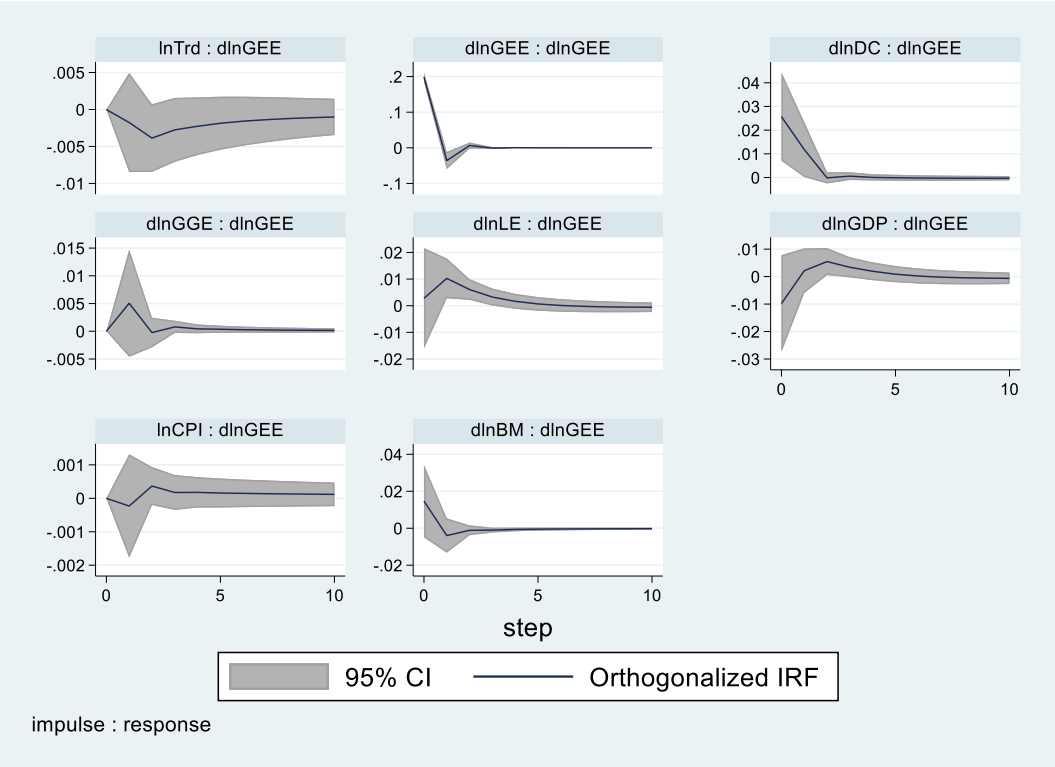


Figure 15: OIRF for GEE

Source: Author's computation

For more information on the ECOWAS model OIRFs of CPI, GGE and Trade please consult Appendix 2.

3.7. ECOWAS Model Forecast Error Variance Decomposition

Let's look at the FEVD of main variables (Economic growth: GDP; Financial Development: DC and BM; Human Capital: LE and GEE):

Based on Table 18 (see Appendix 8) results, in the first year, hundred percent of the Forecast Error Variance (FEV) in real GDP is explained by the variable itself (GDP). This implies that other variables do not significantly influence GDP, meaning they are strongly exogenous in the initial year. From the short to the long run, GDP still predicts itself (more than 94%). Trade and health human capital account for only 2,98%, and 1,58% of FEV in real GDP, respectively. DC and BM jointly account for only 0, 81%, and the remaining variables jointly account for less than 1% of forecast error variance in GDP.

In year 1, 99,59% of FEV in domestic credit is explained by the variable itself (DC), while the remaining 0,41% is explained by real GDP. In the short run (first four years), about 88 % of error variance in domestic credit is explained by the variable itself, and in

the long run (year 5 to 10), it is about 82%. When moving forward into the future, GDP explains about 4% of error variance in domestic credit, while Trade explains up to 7% in the short run and up to 11% in the long run. Life Expectancy explains 0,7% (of error variance in domestic credit) in year 4, which rises to 1,58% in year 10.

From year 1 through year 10, from 85% to 80% of FEV in broad money are explained by the variable itself (BM), while GDP, domestic credit and Trade explain respectively about 1,11% to 2,65%; 13,77% to 13,27%; and 0% to 2,09% of FEV in broad money. The contribution of life expectancy and GEE to changes in broad money has been less than 1% during the 10 years' period. The consumer price index and general government expenditure contribution to changes in broad money has been jointly less than 0,5%.

Life expectancy remains a strong influencer in predicting itself, with around 91% to 67% from the short to the long run. Government Expenditure on Education accounts for only 0,17%, while trade and DC account each one for around 3% of FEV in LE. money supply, CPI and GGE joint contribution to changes in LE has been less than 0,5% even in year 10.

Finally, in year 1, GEE strongly predicts itself by almost 98% and 97% in year 10. The contribution of DC alone is around 2% in error variance of education human capital in year 10, meaning the rest of the variables jointly contribute to only 1%.

CHAPTER 4: THE FCFA ZONE MODEL (14 COUNTRIES)

4.1. Descriptive Statistics for FCFA Zone Model (n*T=14*54=756 Observations)

Table 19: Descriptive-Summary statistics

Variable	Obs	Mean	Std, dev,	Min	Max
GDP	746	1674,326	2365,194	274,1525	14823,88
DC	714	14,40812	8,228589	,383077	42,2638
BM	713	19,92232	8,605651	4,903761	52,52127
LE	756	52,78031	7,173127	30,537	68,683
GEE	522	3,262645	1,426002	,54477	8,41331
CPI	644	74,2251	35,41032	1,188563	175,0058
GGE	719	13,96374	4,43062	2,736065	29,43804
Trd	721	60,58045	24,53945	20,0568	156,8618
OPr	756	43,60079	25,28115	5,212236	95,26411
lnGDP	746	6,894185	,8968589	5,613685	9,603995
lnDC	714	2,481335	,664653	-,9595192	3,743931
lnBM	713	2,90279	,428162	1,590002	3,961218
lnLE	756	3,956396	,141941	3,418939	4,229502
lnGEE	522	1,097112	,4104665	-,6073916	2,129815
lnCPI	644	4,132233	,6907805	,1727453	5,164819
lnGGE	719	2,582413	,3415528	1,006521	3,382288
lnTrd	721	4,033303	,3665822	2,998568	5,055365
lnOPr	756	3,571389	,6934748	1,651009	4,556653

Source: Author's compilation

4.2. FCFA Zone Cross-Sectional Dependence Test and Unit Root Test Results

4.2.1 Cross-Sectional Dependence

According to Table 20 results, cross–sectional dependence exists among individual countries. So, in place of traditional unit root tests, 2nd generation unit root tests were used.

Table 20: Cross-sectional dependence CD-tests

Variable	CD (2004)	CD (2015, 2021)	CDw	CDw+
lnGDP	7,31***	7,74***	1,80*	330,31***
lnDC	38,22***	42,82***	0,45	411,51***
lnBM	34,30***	34,86***	3,74***	338,29***
lnLE	50,74***	54,45***	-1,74*	527,47***
lnGEE	3,76 ***	12,59***	-1,44	198,69***
lnCPI	46,80 ***	68,26***	7,85***	658,98***
lnGGE	3,69 ***	12,70***	1,21	243,09***
lnTrd	6,25***	1,12	-4,42***	265,24***
lnOPr	70,10 ***	70,10***	-3,85***	664,86***

*: significant at 10% level, **: significant at 5% level, ***: significant at 1% level

Source: Author's compilation

4.2.2 Unit Root Tests (FCFA Model)

Table 21: Panel unit root test under cross-sectional dependence

		Pesaran's CADF test with Trend	Pesaran's CADF test with Constant	Im–Pesaran–Shin test, with trend option	Fisher-type test, with dfuller option	Fisher-type test, with pperron option	
S/N	Variables	Z[t-bar] (P-value)	Z[t-bar] (P-value)	W-t-bar (P-value)	Inverse normal Z (P-value)	Inverse normal Z (P-value)	Decision
1	lnGDP, lags(1)	2.122 (0.983)	1.721 (0,957)	0.8750 (0.8092)	1.5195 (0.9357)	2.0475 (0.9797)	I(1)
	dlnGDP , lags(1)	-10.208 (0.000)***	-10.611 (0,000)***	-13.3879 (0.000)***	-14.3158 (0,0000)***	-20.4107 (0,0000)***	
2	lnDC , lags(1)	-3.092 (0.001)***	-2.590 (0.001)***	2.2873 (0.9889)	-0.3370 (0.3680)	0.0518 (0.5207)	I(1)
	dlnDC , lags(1)	-5.193 (0.000)***	-5.125 (0,000)***	-10.5957 (0.0000)***	-13.0007 (0,0000)***	-19.6664 (0,0000)***	
3	lnBM , lags(1)	-2.706 (0.003)***	-2.439 (0.007)***	0.5848 (0.7207)	0.1890 (0.5750)	-0.1865 (0.4260)	I(1)
	dlnBM , lags(1)	-15.095 (0,000)***	-16,152 (0,000)***	-15.4010 (0,000)***	-17.1491 (0,000)***	-24.3252 (0.0000)***	
4	lnLE , lags(1)	-2.318 (0.538)	-1.988 (0,199)	-1.8021 (0,0358)**	-0.9281 (0.1767)	-5.5874 (0,000)***	I(1)

	dlnLE , lags(1)	-4.223 (0,000)***	-4.074 (0,000)***	-8.8695 (0,000)***	-9.6966 (0,000)***	-13.9064 (0,000)***	
5	lnGEE , lags(1)				-1.1281 (0.1296)	-2.0193 (0.0217)**	I(1)
	dlnGEE , lags(1)				-12.8575 (0,000)***	-18.5059 (0,000)***	
6	lnCPI , lags(1)	-2.719 (0,052)*	-2.851 (0.000)***	-4.2167 (0,0000)***	-4.7265 (0,0000)***	-5.8140 (0,0000)***	I(0)
	dlnCPI, lags(1)	-4.960 (0.000)***	-4.728 (0,000)***	-11.4668 (0,0000)***	-12.3514 (0,0000)***	-13.6694 (0,0000)***	
7	lnGGE , lags(1)	-1.644 (0,050)*	-1.986 (0.024)**	-1.6420 (0.0503)*	-3.0247 (0,0012)***	-3.7636 (0,0001)***	I(0)
	dlnGGE , lags(1)	-12,100 (0,000)***	-13.547 (0,000)***	-15.8000 (0,0000)***	-17.2207 (0,0000)***	-23.8828 (0,0000)***	
8	lnTrd , lags(1)	-3.134 (0,001)***	-0.710 (0,239)	-3.5830 (0,0002)***	-2.9393 (0,0016)***	-4.1229 (0,0000)***	I(0)
	dlnTrd , lags(1)	-13.791 (0,0000)***	-14,920 (0,000)***	-18.3342 (0,000)***	-19.4049 (0,000)***	-25.8097 (0,000)***	
9	lnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-2.4919 (0,0064)***	-5.0107 (0,0000)***	-5.8340 (0,0000)***	I (0)
	dlnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-15.6177 (0,000)***	-17.0276 (0,000)***	-23.5304 (0,000)***	

*: significant at 10%, **: significant at 5%, ***: significant at 1%

Source: Author's computations from STATA 17.

Decision: The endogenous variables (GDP, BM, DC, LE, GEE) are integrated of order one (I (1)) while the exogenous and control variables are I (0).

4.3. FCFA Zone Model Estimation Results

Table 22: Consistent Moment and Model Selection Criteria (FCFA Model)

Lags of endogenous variables	MBIC	MAIC	MQIC
1*	-1192,213	-216,2867	-602,3888
2	-824,098	-173,4806	-430,8819
3	-388,4446	-63,13586	-191,8366

*: optimum lag with minimal criteria values

Source: Author's computations

Based on Table 23 output, past realizations of GDP, BM, and Trade openness are associated with an increase of about 17,51%; 3,95%; and 3,41% in GDP on average ceteris paribus. On the contrary, past realizations of LE, GEE, and GGE are associated with a decrease of about 5,39%; 1,78%; and 3,79% in GDP on average ceteris paribus. Moreover, past realizations of DC, CPI, and OPr are statistically not significant in influencing real GDP.

GDP, GEE and OPr positively (LE, and CPI negatively) impact Domestic Credit. The rest of the variables (DC, BM, GGE, and Trd) do not significantly affect Domestic Credit.

A percentage increase in GDP, GEE, GGE and OPr is associated with a 15,63%; 5,73%; 7,7%; and 5,98% increase in Broad Money, respectively, and on average, ceteris paribus. However, a percentage increase in BM, LE, and CPI is associated with a 7,73%; 64,59%; and 1,88% decrease in Broad Money, respectively, and on average, ceteris paribus. DC, and Trade have no significant impact on BM.

Up to -62,24% of change in Life Expectancy is due to a percentage increase in past realization of life expectancy itself. GDP, BM, GEE and OPr have a positive impact (12,02%, 0,91%, 3,8%, 7,1%, respectively) on life expectancy. However, a percentage increase in CPI and Trade is found to exert a negative effect (0,92% and 2,01% respectively) on life expectancy. DC and GGE had no significant impact on LE.

Only a percentage change in GDP, DC and OPr has a statistically significant and positive impact of about 24,74%; 5,26% and 1,72% on the GEE. Contrariwise, a percentage increase in LE, and GEE itself causes about a 23,93% and 27,39% decrease in GEE. BM, CPI, GGE and Trade impacts on GEE are not significant.

The Consumer Price Index is affected positively by itself (a percentage increase in CPI causes about a 94,87% increase in CPI some period ahead), GDP (6,1%), GGE (5,72%), Trade (2,93%), and by OPr (3,03%); it is impacted negatively by DC, LE and GEE. Only, BM effect on CPI is not significant.

Domestic Credit, LE, CPI, GGE and Trd affect General Government Expenditure positively, but GDP and Oil Price negatively impact GGE. BM and GEE influences on GGE are statistically insignificant.

At last, while GGE, OPr, and Trade itself positively impact trade openness, the past realization of LE and CPI negatively affect current trade openness. A percentage increase

in Trd causes about an 85,99% increase in Trade the next periods. GDP, DC, BM, and GEE have no significant impact on trade.

Table 23: FCFA Model Estimation Results

	Equation							
	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	lnGGE	lnTrd
L1. dlnGDP	0,1751*** (5,26)	0,7599*** (6,81)	0,1563* (1,93)	0,1202*** (6,97)	0,2474*** (3,68)	0,0610* (1,89)	-0,2558*** (-3,27)	-0,0877 (-1,5)
L1. dlnDC	0,0019 (0,4)	0,0293 (1,45)	0,0348 (1,5)	-0,0003 (-0,18)	0,0526*** (3,22)	-0,0220*** (-2,89)	0,0381*** (2,56)	0,0158 (1,01)
L1. dlnBM	0,0395*** (3,83)	-0,0057 (-0,15)	-0,0773** (-2,53)	0,0091*** (3,21)	0,0135 (0,54)	-0,0046 (-0,38)	0,0100 (0,38)	-0,0102 (-0,47)
L1. dlnLE	-0,0539*** (-8,61)	-1,4682*** (-16,62)	-0,6459*** (-16,2)	-0,6224*** (-68,03)	-0,2393*** (-15,58)	-0,1768*** (-15,77)	0,1717*** (4,56)	-0,3512*** (-19,6)
L1. dlnGEE	-0,0178*** (-3,66)	0,0659*** (3,78)	0,0573*** (4,53)	0,0038*** (3,27)	-0,2739*** (-7,25)	-0,0065* (-1,73)	0,0040 (0,33)	0,0000 (0)
L1. lnCPI	0,0017 (0,45)	-0,0242* (-1,87)	-0,0188** (-2,14)	-0,0092*** (-8,67)	-0,0082 (-1,14)	0,9487*** (261,82)	0,0247*** (2,85)	-0,0496*** (-6,52)
L1. lnGGE	-0,0379*** (-3,36)	-0,0196 (-0,42)	0,0770** (2,34)	-0,0028 (-0,63)	0,0065 (0,23)	0,0572*** (4,3)	0,8585*** (27,18)	0,0960*** (3,77)
L1. lnTrd	0,0341*** (3,11)	0,0249 (0,55)	0,0147 (0,44)	-0,0201*** (-5,51)	-0,0056 (-0,17)	0,0293** (2,11)	0,1492*** (4,55)	0,8599*** (30,22)
lnOPr	0,0001 (0,03)	0,0664*** (4,61)	0,0598*** (6,42)	0,0071*** (6,18)	0,0172* (1,9)	0,0303*** (8,09)	-0,0313*** (-3,22)	0,0727*** (8,5)

Notes: *: significant at 10%, **: significant at 5%, ***: significant at 1%
Z statistics in parentheses
Final GMM Criterion Q(b) = 0,495
Instruments: l (1/4). (dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd) lnOPr
Test of overidentifying restriction: Hansen's J chi2(192) = 222,38015 (p = 0,066)
Initial weight matrix: Identity
GMM weight matrix: Robust

Source: Author's compilation

4.4. Eigenvalue Stability Condition (FCFA Model)

Table 24: Stability Condition

Eigenvalue		
Real	Imaginary	Modulus
0,9686543	-0,0340508	0,9692526
0,9686543	0,0340508	0,9692526
0,7419814	0	0,7419814
-0,6181616	0	0,6181616
-0,2805612	0	0,2805612
0,1935422	0	0,1935422
-0,0380858	0,0132919	0,0403386
-0,0380858	-0,0132919	0,0403386

Source: Author's compilation

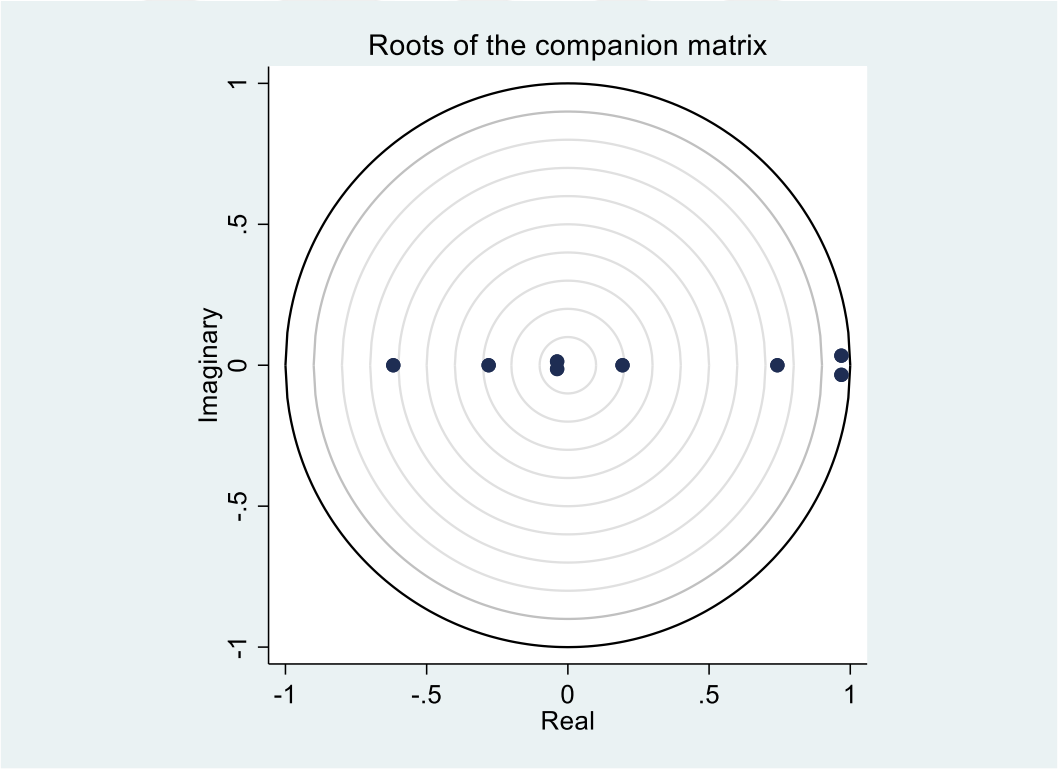


Figure 19: Unit Circle for Stability Condition

Source: Author's generation from Stata 17

The moduli are less than unity, so the FCFA Zone model is stable.

4.5. Granger Causality Tests FCFA

From Table 24 results:

- GDP (per capita real income) is granger–caused by BM, LE, GEE, GGE and Trd.
- DC (domestic credit) is granger–caused by GDP, LE, GEE, and CPI.
- BM (Broad Money/Money supply) is granger–caused by GDP, LE, GEE, CPI and GGE
- LE (Life Expectancy at Birth/health human capital) is granger–caused by all the variables, except DC and GGE.
- GEE (government expenditures on education/education human capital) is granger–caused by GDP, DC, and LE.
- CPI (Consumer Price Index/ Inflation Proxy) is granger–caused by all the variables, except BM.
- GGE (General Government Expenditure/ Final Government Consumption) is granger–caused by GDP, DC, LE, CPI and Trd.
- Trd (Trade openness) is granger–caused by LE, CPI and GGE.
- Overall, all the variables Granger–cause all the equation variables.

Consequently, there is evidence of bidirectional causality between:

- health human capital and GDP (GDP↔LE);
- Money supply and GDP (GDP↔BM);
- GEE and GDP (GDP↔GEE);
- GGE and trade openness (GGE↔TRD);
- health human capital and Trade (LE ↔ Trd);
- GDP and GGE (GGE ↔ GDP);
- CPI and Trd (Trd ↔ CPI);
- CPI and DC (CPI ↔ DC);
- GGE and CPI (CPI ↔ GGE);
- GEE and DC (GEE ↔ DC);
- LE and CPI (LE ↔ CPI);
- LE and GEE (LE ↔ GEE).[5]

[5] ↔: bidirectional causality among the variables.

Furthermore, there is also evidence of unidirectional causality running from:

- LE to GGE (LE→GGE);
- GDP to CPI (GDP→CPI);
- DC to GGE (DC→GGE).[6]

Table 25: Causality Test

Equation Variable FCFA ➞	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	lnGGE	lnTrd
dlnGDP		46,324***	3,724*	48,590***	13,548***	3,588*	10,711***	2,250
dlnDC	0,162		2,255	0,034	10,358***	8,347***	6,572**	1,024
dlnBM	14,675***	0,021		10,278***	0,288	0,144	0,143	0,220
DlnLE	74,169***	276,35***	262,37***		242,67***	248,7***	20,809***	384,28***
dlnGEE	13,361***	14,266***	20,512***	10,672***		3,01*	0,109	0,000
lnCPI	0,200	3,490*	4,559**	75,255***	1,294		8,125***	42,555***
lnGGE	11,295***	0,176	5,475**	0,402	0,053	18,5***		14,220***
lnTrd	9,695***	0,300	0,190	30,389***	0,030	4,456**	20,675***	
Overall	171,89***	363,61***	523,49***	265,16***	325,46***	378,5***	51,423***	521,53***

Note: ***p < 0,01, **p < 0,05, *p < 0,1; p = Prob>chi2
Ho: The excluded variable does not Granger–cause equation variable
Ha: Excluded variable Granger–causes equation variable

Source: Author's compilation

[6] →: unidirectional causality running from left to right variable.

4.6. Orthogonalised Impulse Response Functions (FCFA Model)

From the data presented in Figure 20, DC impact on GDP is insignificant. Though brief, the effects of Trade, CPI, BM, and GDP itself, are positive, while those of GEE, GGE and LE are negative.

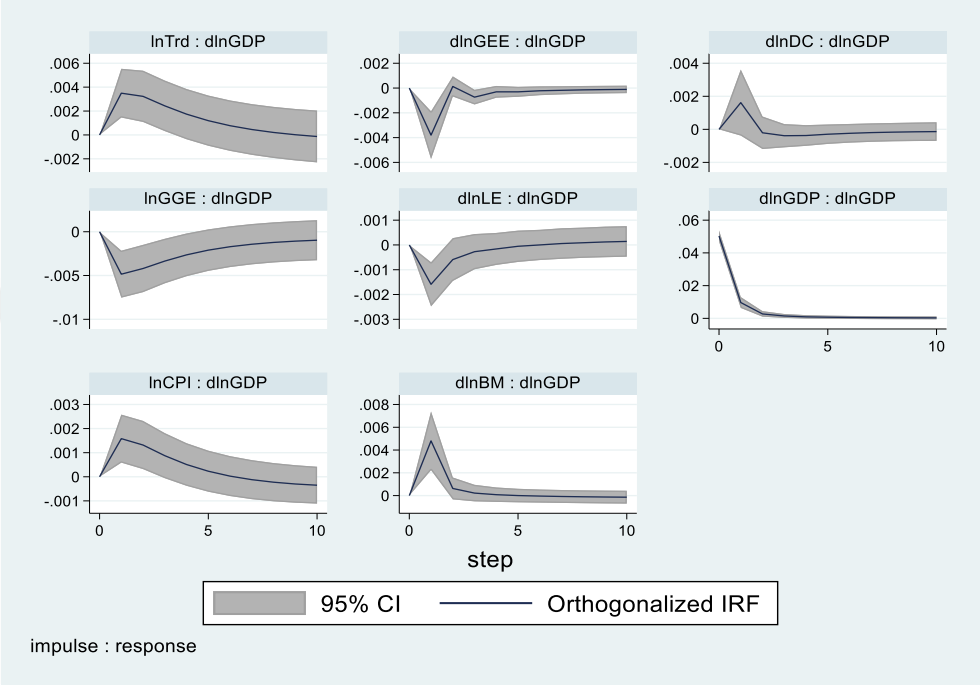


Figure 20: OIRF for GDP

Source: Author's generation from Stata 17

As seemingly presented in Table 22, in Figure 21 too GGE, Trade, and financial development proxied by BM, have no statistically significant impact on DC. However, overall, GDP and GEE influence DC positively, while LE impact is negative.

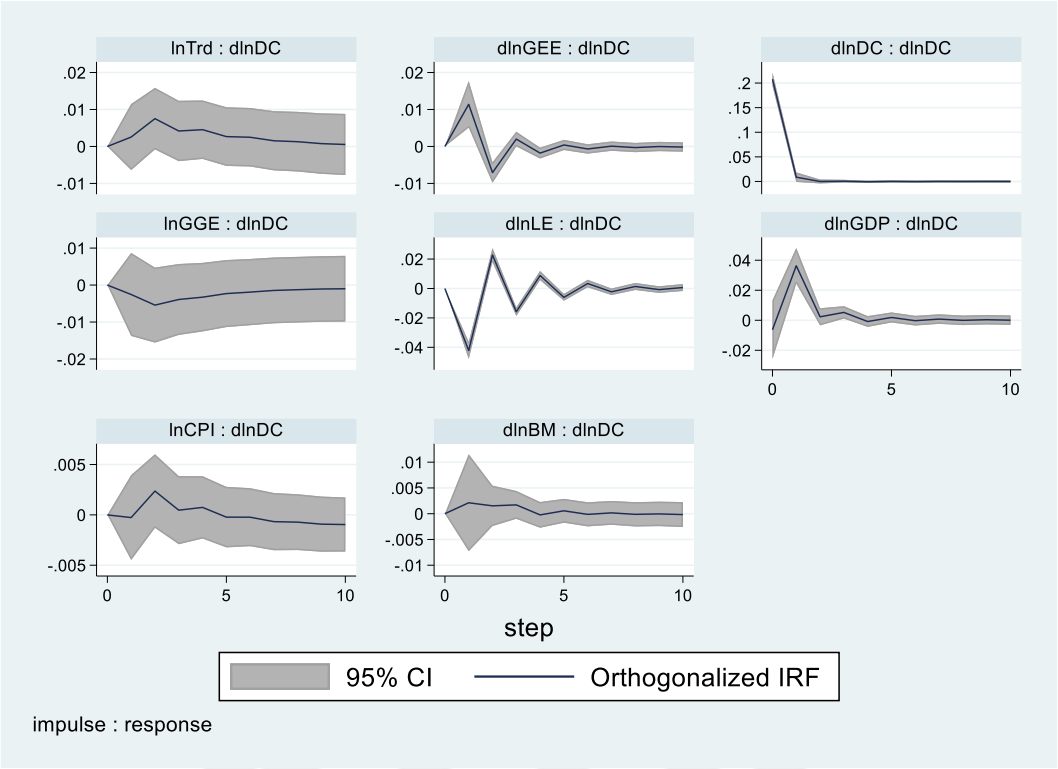


Figure 21: OIRF for DC

Source: Author's generation from Stata 17

According to Figure 22, shocks to Trade and CPI do not produce any significant response from BM. Nevertheless, GGE shock causes a small positive response from BM only in the early two periods. GDP and LE seem to be associated negatively with BM, whereas GEE and DC have positive impact on BM.

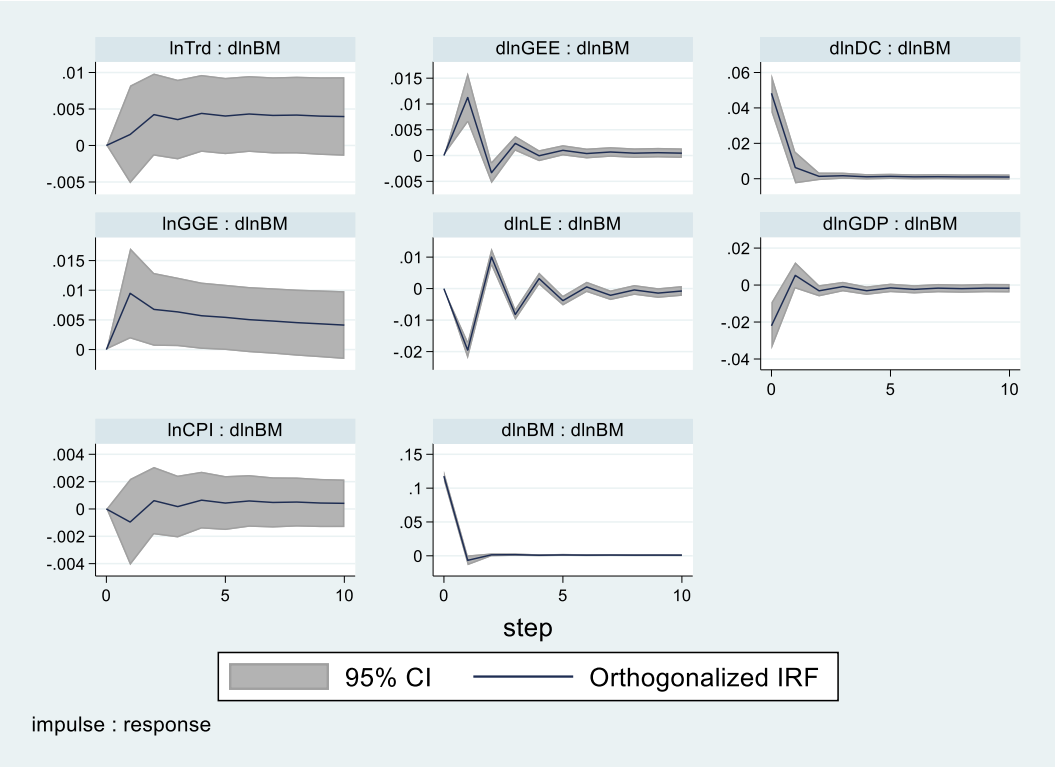


Figure 22: OIRF for BM

Source: Author's generation from Stata 17

As shown in Figure 23, GGE, and financial development proxied by either DC or BM, do not have any statistically significant influence on health human capital. However, shocks to Trade and CPI produce negative response from BM, while GEE and GDP shocks overall yield positive response.

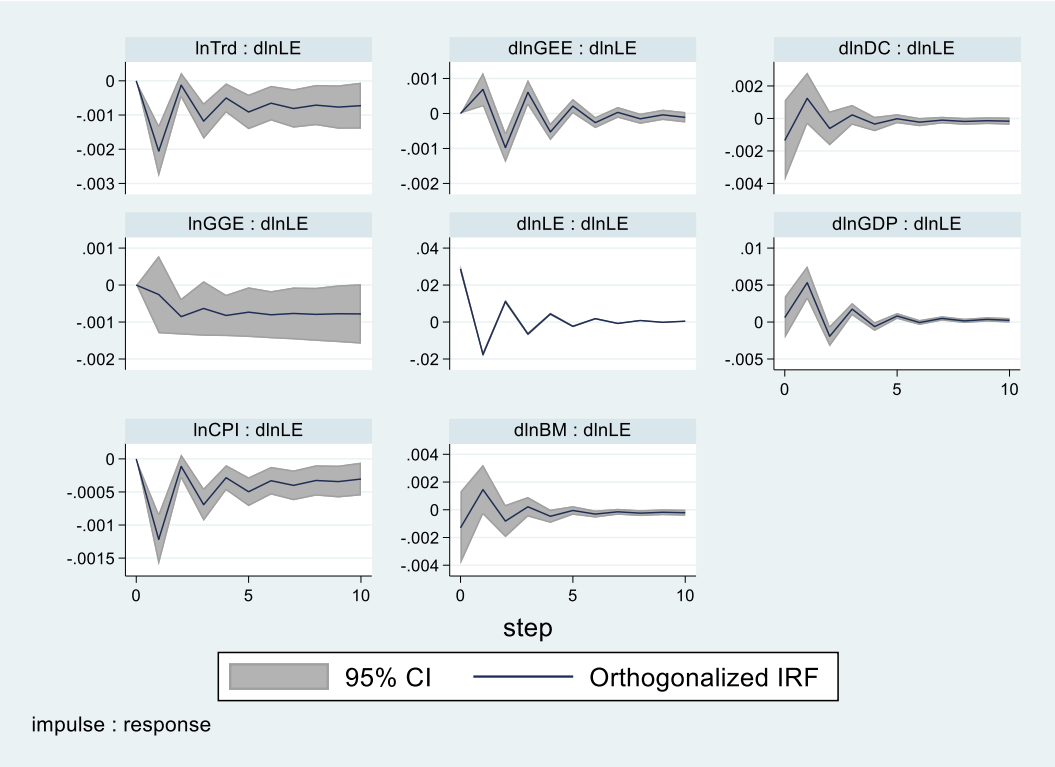


Figure 23: OIRF for LE

Source: Author's generation from Stata 17

As demonstrated in Figure 24, shock to LE does produce very brief negative response from education human capital visible only in the 2nd period. But shock to GDP produces a delayed positive impact on GEE. No significant relationship was found between GEE and Trade, DC, GGE, CPI, or BM.

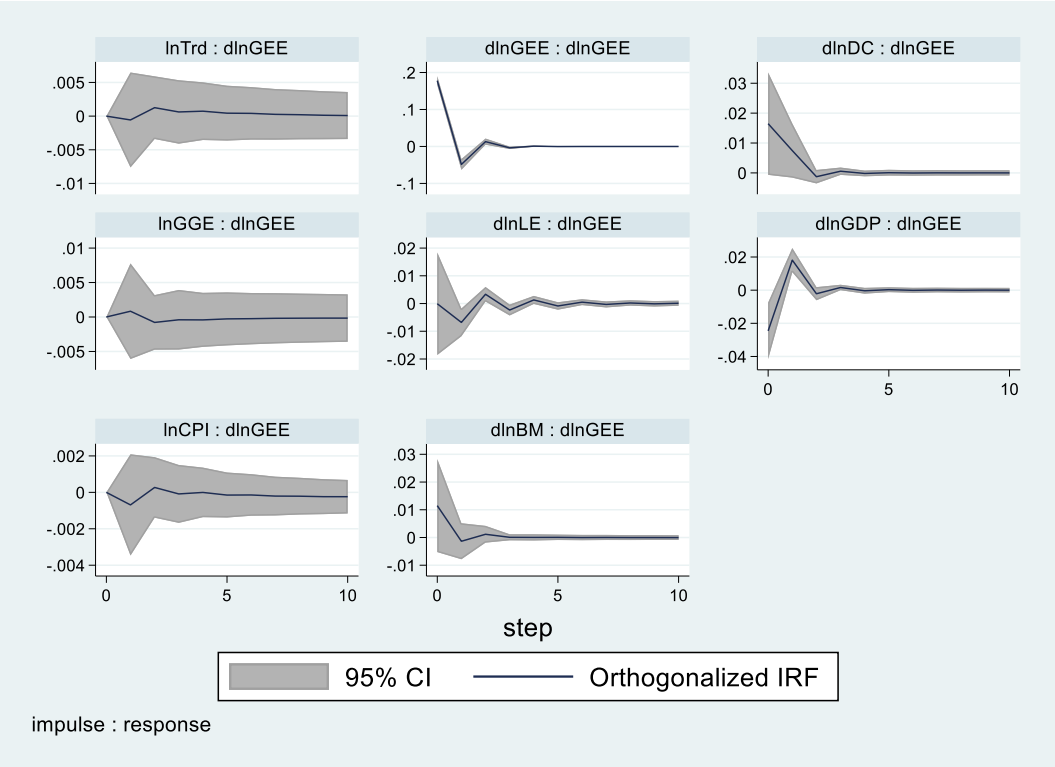


Figure 24: OIRF for GEE

Source: Author's generation from Stata 17

For control variables OIRFs, please look at Appendix 3.

4.7. Forecast Error Variance Decomposition (FCFA Model)

We can conclude about the forecast error variances of the Economic Growth, Financial Development and Human Capital variables that (see Table 26 in Appendix 9):

In the first year, 100% of the Forecast Error Variance (FEV) in real GDP is explained by shocks to GDP itself. Even in the long run (at year 10), GDP still predicts itself by around 94%. The influencers of GDP are GGE, Trade, and BM explaining in year 10, respectively, 2,55%; 1,21% and 0,84% of Error Variance in real GDP. The other variables jointly account for only 0,97% of forecast error variance in GDP in the same year.

In year 1, almost 100% of FEV in domestic credit is explained by its own shocks. In the long run (year 5 to 10), around 90% of error variance of DC is explained by shocks to DC itself, while about 6% and 3% are respectively due to shocks in LE and GDP. Shocks to other variables, jointly, explain less than 1% of forecast error variance in DC.

In year 1, approximately 83% of FEV in Broad Money is explained by its own shocks, while the remaining 14% and 3% are due to Domestic Credit and GDP, respectively. At

year 10, about only 77% of FEV in Broad Money is due to its own shocks, whereas about 13%, 3%, 3%, 2%, and 1% of Broad Money error variance are due to shocks in DC, GDP, life expectancy, GGE, and GGE, respectively. The remaining 1% is due to shocks in CPI and Trade jointly.

Life expectancy remains a strong influencer in predicting itself, with almost 100% to 95% from the short to the long run. In the tenth year, shocks to GDP as the main influencer in predicting LE, explain about 3% of forecast error of LE, whereas the other variables shocks, jointly, account for only the remaining 2%.

From short to long term, 97% to 96% of error variance in GEE is due to its own shocks, whereas shocks to GDP and DC explain, respectively, about 2,5% and 1% of education human capital error variance; the remaining variables jointly contribute to around only 0,5% of error variance of GEE.

CHAPTER 5: BCEAO ZONE MODEL (8 COUNTRIES)

5.1. Summary Statistics BCEAO zone model *(n*T=8*54=432 Observations)*

Table 27: Summary Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
GDP	432	842,3202	514,056	274,1525	3055,94
DC	416	16,21878	8,624007	0,383077	42,2638
BM	416	22,08555	9,716269	4,903761	52,52127
LE	432	52,06025	7,309238	33,396	68,683
GEE	314	3,327778	1,403067	0,54477	8,23139
CPI	374	72,14171	34,47817	1,188563	136,725
GGE	430	14,31786	3,978769	6,407648	29,43804
Trd	432	52,21152	14,28424	21,59701	118,6504
OPr	432	43,60079	25,29372	5,212236	95,26411
lnGDP	432	6,595534	0,5061193	5,613685	8,024842
lnDC	416	2,613742	0,6608757	-0,9595192	3,743931
lnBM	416	2,995182	0,4624755	1,590002	3,961218
lnLE	432	3,941992	0,1467882	3,508436	4,229502
lnGEE	314	1,118287	0,4137782	-0,6073916	2,107955
lnCPI	374	4,087648	0,7385206	0,1727453	4,917972
lnGGE	430	2,623188	0,2790778	1,857492	3,382288
lnTrd	432	3,919745	0,2666695	3,072555	4,776181
lnOPr	432	3,571389	0,6938195	1,651009	4,556653

Source: Author's compilation

5.2. WAEMU Zone Cross-Sectional Dependence Test and Unit Root Test Results

5.2.1 Cross-Sectional Dependence in WAEMU/BCEAO Zone

Based on Table 28 results, there is cross–sectional dependence among individual countries. Because 1st generation unit root tests may not be robust, 2nd generation unit root tests were utilized.

Table 28: Cross-sectional dependence CD-tests

Variable	CD(2004)	CD(2015, 2021)	CDw	CDw+
lnGDP	13,29***	11,33***	-0,17	110,72 ***
lnDC	23,04***	-	-	-
lnBM	23,11***	-	-	-
lnLE	35,29***	36,85 ***	-2,11**	192,87***
lnGEE	4,40***	-	-	-
lnCPI	27,44***	-	-	-
lnGGE	1,51	-	-	-
lnTrd	5,49***	7,61***	4,03***	67,04***
lnOPr	38,88***	38,88***	-5,55***	200,20 ***

*: significant at 10% level, **: significant at 5% level, ***: significant at 1% level

Source: Author's compilation

5.2.2 2nd Generation Unit Root Tests (WAEMU Model)

Table 29: Panel unit root test under cross-sectional dependence

		Pesaran's CADF test (Trend)	Pesaran's CADF test (Constan)	Im–Pesaran–Shin test (trend)	Fisher-type test (dfuller)	Fisher-type test (pperron)	
S/N	Variables	Z[t-bar] (P-value)	Z[t-bar] (P-value)	W-t-bar (P-value)	Inverse normal Z (P-value)	Inverse normal Z (P-value)	Decision
1	lnGDP, lags(1)	-3,139 (0,005)***	-1,357 (0,903)	2,2907 (0,9890)	3,0848 (0,9990)	3,3049 (0,9995)	I(1)
	dlnGDP , lags(1)	-5,335 (0,000)***	-5,281 (0,000)***	-12,5424 (0,000)***	-12,4637 (0,0000)***	-17,9774 (0,0000)***	
2	lnDC , lags(1)	-2,956 (0,023)**	-2,105 (0,159)	1,8645 (0,9689)	0,1176 (0,5468)	0,2751 (0,6084)	I(1)
	dlnDC , lags(1)	-5,203 (0,000)***	-5,144 (0,000)***	-7,4000 (0,0000)***	-9,3789 (0,0000)***	-15,7814 (0,0000)***	
3	lnBM , lags(1)	-2,934 (0,027)**	-2,031 (0,221)	0,4478 (0,6728)	1,1820 (0,8814)	0,6317 (0,7362)	I(1)
	dlnBM , lags(1)	-5,720 (0,000)***	-5,672 (0,000)***	-11,0024 (0,000)***	-12,5618 (0,000)***	-18,7506 (0,0000)***	
4	lnLE , lags(1)	-1,515 (0,997)	-1,338 (0,913)	-0,2033 (0,4195)	-2,1189 (0,0171)**	-5,0285 (0,000)***	I(1)

	dlnLE , lags(1)	-2,859 (0,047)**	-2,407 (0,027)**	-1,4090 (0,0794)*	-2,6792 (0,0037)***	-6,4191 (0,000)***	
5	lnGEE , lags(1)	-1,626 (0,052)*	-1,195 (0,116)	-1,5836 (0,0566)*	-0,5109 (0,3047)	-1,1789 (0,1192)	I(1)
	dlnGEE , lags(1)	-6,627 (0,000)	-7,937 (0,000)***	-7,2937 (0,0000)***	-9,1349 (0,000)***	-13,6133 (0,000)***	
6	lnCPI , lags(1)	-0,361 (0,359)	-2,593 (0,005)***	-4,5025 (0,0000)***	-5,8951 (0,0000)***	-7,3505 (0,0000)***	I(0)
	dlnCPI, lags(1)	-6,250 (0,000)***	-6,730 (0,000)***	-8,1038 (0,0000)***	-8,6770 (0,0000)***	-9,7775 (0,0000)***	
7	lnGGE , lags(1)	-0,275 (0,391)	-1,083 (0,139)	0,4860 (0,6865)	-1,2984 (0,0971)*	-1,6040 (0,0544)*	I(1)
	dlnGGE , lags(1)	-7,796 (0,000)***	-9,123 (0,000)***	-10,6930 (0,0000)***	-12,1543 (0,0000)***	-18,7102 (0,0000)***	
8	lnTrd , lags(1)	-2,982 (0,019)**	-1,967 (0,282)	-3,2297 (0,0006)***	-2,8406 (0,0023)***	-3,9954 (0,0000)***	I(0)
	dlnTrd , lags(1)	-5,867 (0,000)***	-5,791 (0,000)***	-14,4919 (0,000)***	-15,0718 (0,000)***	-19,9170 (0,000)***	
9	lnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-1,8837 (0,0298)**	-3,7878 (0,0001)***	-4,4101 (0,0000)***	I (0)
	dlnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-11,8059 (0,000)***	-12,8717 (0,000)***	-17,7873 (0,000)***	

*: significant at 10%, **: significant at 5%, ***: significant at 1%

Source: Author's computations from STATA 17.

Decision: GDP, BM, DC, LE, GEE and GGE variables are integrated of order one (I (1)) while CPI, TrD and OPr variables are I (0).

5.3. BCEAO Model Estimation Results

Table 30: Consistent Moment and Model Selection Criteria (WAEMU Model)

Lags of endogenous variables	MBIC	MAIC	MQIC
1*	-790,509	-155,9222	-411,1506
2	-469,1814	-86,30225	-240,2948
3	-127,5916	,0347774	-51,29608

*: optimum lag with minimal criteria values

Source: Author's computations

Based on Table 31 results, past realizations of GDP, GEE, CPI, GGE and Trade openness are associated with an increase of about 31,96%; 0,8%; 0,98%; 3,1%; and 2,41% in GDP on average ceteris paribus. On the contrary, past realizations of DC, BM, LE, and OPr are statistically not significant in influencing real GDP.

GDP, GGE and OPr positively (DC, BM, LE, CPI and Trade negatively) impact Domestic Credit. Only GEE does not exert any significant effect on Domestic Credit.

A percentage increase in GDP, GGE and OPr is associated with a 57,38%; 9,28%; and 8,49% increase in Broad Money, respectively, and on average, ceteris paribus. However, a percentage increase in BM, LE, or CPI causes a decrease in Broad Money, on average, ceteris paribus. DC, GEE, and Trade have no significant impact on BM.

Up to 63,58% increase in Life Expectancy is due to a percentage increase in past realization of life expectancy itself. GDP, DC, GGE and OPr have a positive impact (5,04%; 0,06%; 0,22%; and 0,24%, respectively) on life expectancy. However, a percentage increase in BM, CPI and Trade is found to exert a negative effect (of 3,6%; 1,9% and 3,2% respectively) on life expectancy. GGE exerts no significant impact on LE.

A percentage increase in GDP, DC and LE has a statistically significant and positive impact on GEE. In fact, a percentage increase in GDP causes GEE to rise by 99,22%. Contrariwise, a percentage increase in BM, and GEE itself causes about a 7,46% and 28,08% decrease in GEE. CPI, GGE, Trade and OPr effects on GEE are not statistically significant.

The Consumer Price Index is affected positively by itself (a percentage increase in CPI causes about a 93,51% increase in CPI some period ahead), BM (2,8%), Trade (1,5%), and by OPr (3,43%); it is impacted negatively by DC, LE and GEE. GDP and GGE effects on CPI are not statistically significant.

Domestic Credit, BM, LE, CPI, and Trd affect General Government Expenditure positively, while GDP, GEE, GGE itself and Oil Price negatively impact GGE.

After all, while GDP, DC, BM, OPr, and Trade itself positively impact trade openness, the past realization of LE and CPI negatively affect current trade openness. A percentage increase in Trd causes about an 81,81% increase in Trade the next periods. GEE and GGE have no significant impact on trade.

Table 31: BCEAO Model Estimation Results

	Equation							
	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	lnGGE	lnTrd
L1. dlnGDP	0,3196*** (10,03)	3,5152*** (19,89)	0,5738*** (8,44)	0,0504*** (17,58)	0,9922*** (13,35)	-0,0158 (-0,47)	-0,2909*** (-5,23)	0,3280*** (6,33)
L1. dlnDC	0,0001 (0,05)	-0,0233* (-1,72)	-0,0096 (-0,82)	0,0006** (2,16)	0,0623*** (5,12)	-0,0144*** (-3,12)	0,0368*** (4,87)	0,0450*** (5,71)
L1. dlnBM	0,0069 (0,97)	-0,2905*** (-8,88)	-0,1565*** (-6,86)	-0,0036*** (-5,09)	-0,0746*** (-3,57)	0,0280*** (3,88)	0,0545*** (3,35)	0,0542** (2,59)
L1. dlnLE	0,3163 (1,56)	-14,044*** (-9,12)	-2,8161*** (-3,52)	0,6358*** (24,22)	4,7606*** (6,55)	-2,5371*** (-7,62)	2,8573*** (5,29)	-7,0052*** (-11,55)
L1. dlnGEE	0,0080*** (3,21)	0,0183 (1,62)	-0,0060 (-0,79)	0,0001 (0,22)	-0,2808*** (-4,77)	-0,0123*** (-5,67)	-0,0129*** (-2,69)	-0,0047 (-0,79)
L1. lnCPI	0,0098*** (3,26)	-0,2528*** (-15,29)	-0,0504*** (-5,64)	-0,0019*** (-6,22)	-0,0084 (-0,88)	0,9351*** (264,2)	0,0313*** (4,12)	-0,1014*** (-14,43)
L1. lnGGE	0,0310*** (2,99)	0,0897** (1,93)	0,0928*** (2,77)	0,0022*** (2,67)	0,0600 (1,44)	-0,0100 (-0,77)	-0,1046*** (-3,56)	-0,0294 (-1,36)
L1. lnTrd	0,0241*** (3,21)	-0,4591*** (-10,24)	-0,0101 (-0,43)	-0,0032*** (-4,28)	0,0247 (1,06)	0,0150* (1,65)	0,1060*** (4,91)	0,8181*** (34,36)
lnOPr	0,0026 (0,96)	0,2175*** (13,39)	0,0849*** (9,64)	0,0024*** (7,97)	0,0134 (1,6)	0,0343*** (10,69)	-0,0182** (-2,54)	0,0975*** (13,53)

Notes: *: significant at 10%, **: significant at 5%, ***: significant at 1%
Z statistics in parentheses
Instruments: l (1/4). (dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd) lnOPr
Test of overidentifying restriction: Hansen's J chi2(192) = 206,88294 (p = 0,219)
Final GMM Criterion Q(b) = 0,739
Initial weight matrix: Identity
GMM weight matrix: Robust

Source: Author's compilation

5.4. Eigenvalue Stability Condition (WAEMU/BCEAO Model)

Table 32: Stability Condition

Eigenvalue		
Real	Imaginary	Modulus
0,912326	0	0,912326
0,8842041	0	0,8842041
0,7077272	0	0,7077272
-0,2829015	0	0,2829015
-0,2215205	0	0,2215205
0,191317	0	0,191317
-0,0239513	-0,0902199	0,093345
-0,0239513	0,0902199	0,093345

Source: Author's compilation

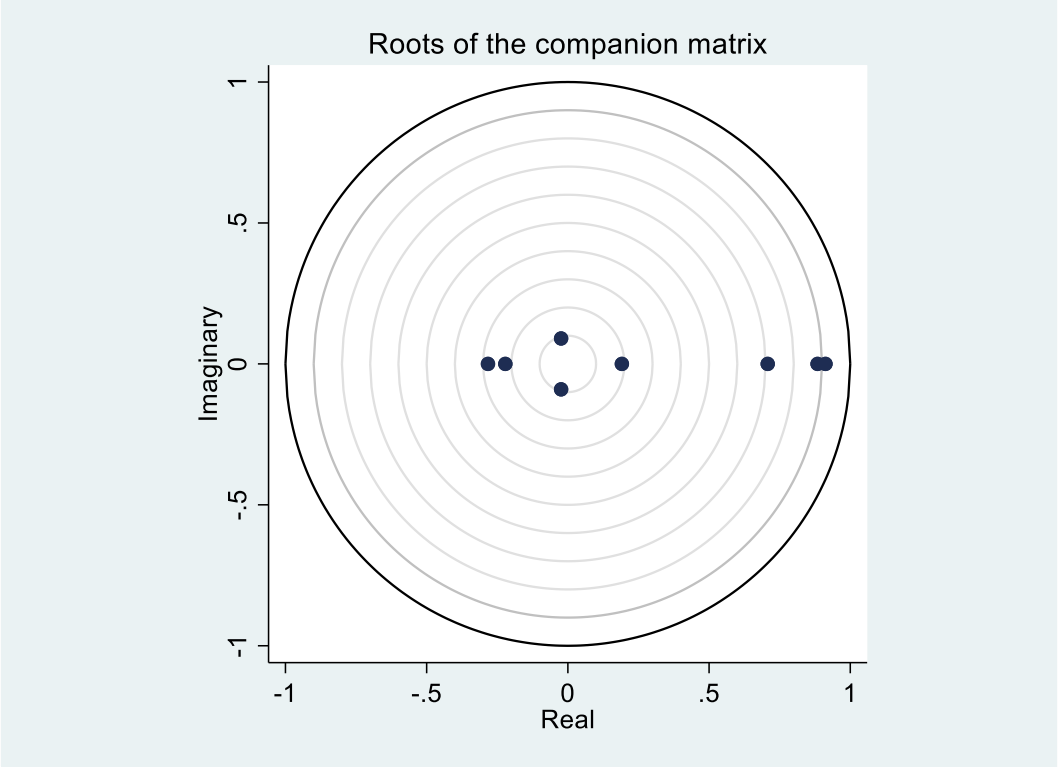


Figure 28: Unit Circle for Stability Condition

Source: Author's generation from Stata 17

All the eigenvalues are inside the unit circle. WAEMU/BCEAO Model satisfies stability condition.

5.5. Granger Causality Tests (WAEMU/BCEAO Model)

From the results of Table 33:

- GDP (per capita real income) is granger–caused by GEE, CPI, GGE and Trd.
- DC (domestic credit) is granger–caused by all the variable, except by GEE.
- BM (Broad Money/Money supply) is granger–caused by GDP, LE, CPI and GGE
- LE (Life Expectancy at Birth/health human capital) is granger–caused by all the variables, except by GEE.
- GEE (government expenditures on education/education human capital) is granger–caused by GDP, DC, BM and LE.
- CPI (Consumer Price Index/ Inflation Proxy) is granger–caused by all the variables, except by GDP and GGE.
- GGE (General Government Expenditure/ Final Government Consumption) is granger–caused by GDP, DC, CPI and Trd.
- Trd (Trade openness) is granger–caused by GDP, DC, BM, LE, and CPI.
- Overall, all the variables Granger–cause all the equation variables.

Consequently, there is evidence of bidirectional causality between:

- Health human capital and DC (DC↔LE);
- Money supply and LE (LE↔BM);
- GEE and GDP (GDP↔GEE);
- GDP and trade openness (GDP↔Trd);
- Health human capital and Trade (LE ↔ Trd);
- GDP and GGE (GGE ↔ GDP);
- DC and Trd (Trd ↔ DC);
- CPI and DC (CPI ↔ DC);
- LE and CPI (CPI ↔ LE);
- GGE and DC (GGE ↔ DC);
- BM and CPI (BM ↔ CPI);
- Trd and CPI (Trd ↔ CPI).[7]

Furthermore, there is also evidence of unidirectional causality running from:

[7] ↔: bidirectional causality among the variables.

- CPI to GDP (CPI→GDP);
- CPI to GGE (CPI→GGE);
- GDP to DC (GDP→DC);
- BM to GEE (BM→GEE);
- BM to Trd (BM→Trd);
- LE to GEE (LE→GEE);
- GEE to CPI (GEE→CPI);
- GDP to BM (GDP→BM);
- GDP to LE (GDP→LE);
- DC to GEE (DC→GEE);
- BM to DC (BM→DC);
- GGE to LE (GGE→LE);
- Trd to GGE (Trd→GGE);
- GGE to BM (GGE→BM). [8]

[8] →: unidirectional causality running from left to right variable.

Table 33: Causality Test

Equation Variable WAEMU ➡	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	dlnGGE	lnTrd
dlnGDP		395,51***	71,23***	309,17***	178,22***	0,222	27,404***	40,049***
dlnDC	0,002		0,679	4,685***	26,214***	9,759***	23,73***	32,644***
dlnBM	0,944	78,872***		25,913***	12,761***	15,05***	11,244	6,717**
dlnLE	2,427	83,194***	12,377***		42,867***	58,1***	28,018	133,3***
dlnGEE	10,31***	2,628	0,623	0,049		32,2***	7,237	0,626
lnCPI	10,64***	233,66***	31,754***	38,656***	0,778		16,983***	208,14***
dlnGGE	8,952***	3,738**	7,684***	7,114***	2,076	0,59		1,863
lnTrd	10,29***	104,82***	0,183	18,351***	1,123	2,726*	24,094***	
Overall	31,63***	558,6***	95,497***	339,72***	243,5***	150,1***	184,28***	315,92***

Note: ***p < 0,01, **p < 0,05, *p < 0,1; p = Prob>chi2
Ho: The excluded variable does not Granger–cause equation variable
Ha: Excluded variable Granger–causes equation variable

Source: Author's compilation

5.6. Orthogonalised Impulse Response Functions (WAEMU/BCEAO Model)

Based on the results of figure 29, Trade, GGE, CPI, GEE, DC and GDP itself are positively related to GDP. A one-unit positive shock to GDP causes 0,04 units increase in GDP contemporaneously. LE and BM do not significantly affect GDP.

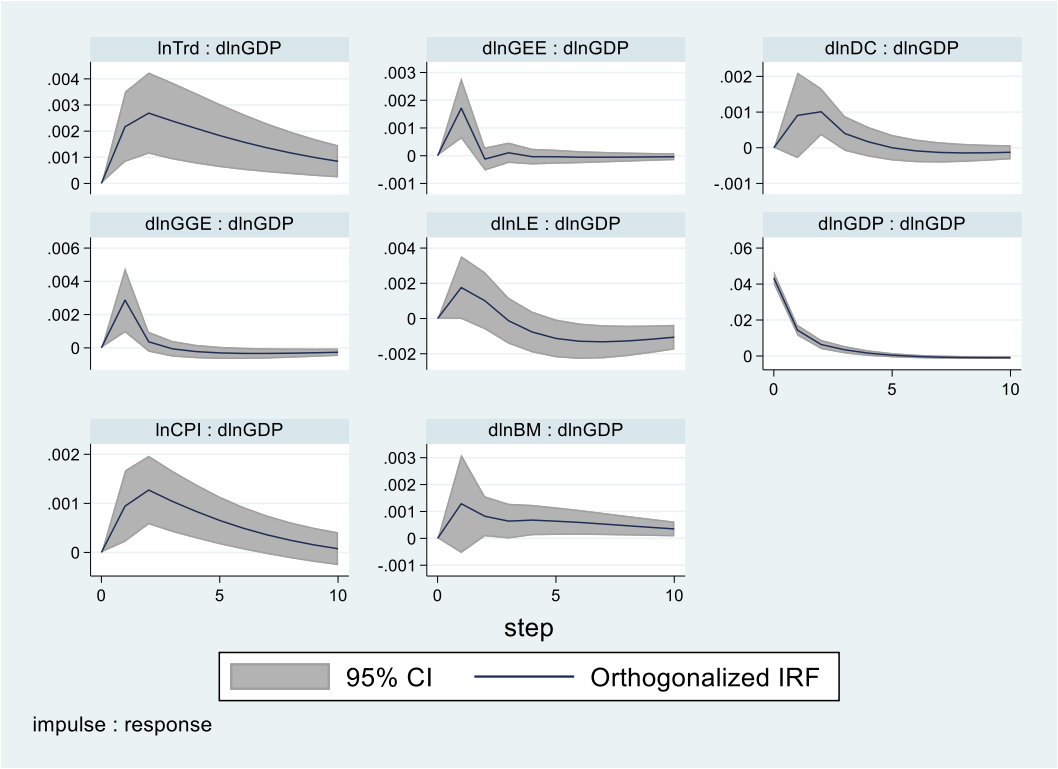


Figure 29: OIRF for GDP

Source: Author's generation from Stata 17

According to the figure 30 results, innovations to GDP or GGE have a positive impact on DC, while Trade, LE, CPI, and BM exert a negative effect. GEE has no significant influence.

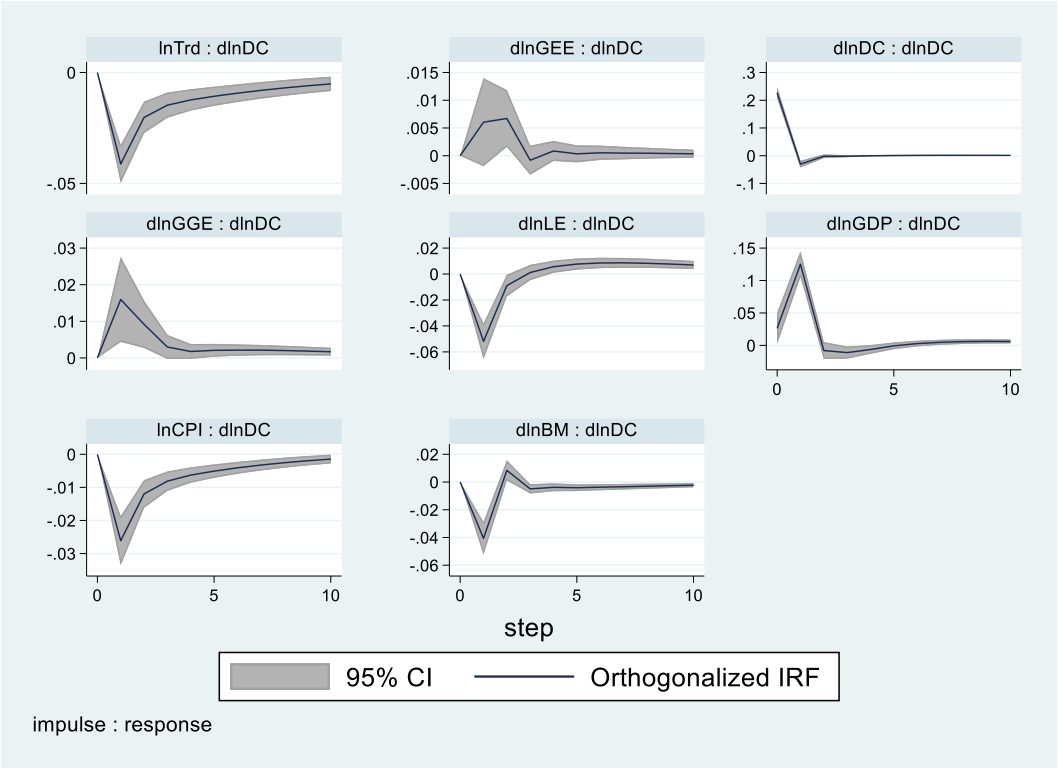


Figure 30: OIRF for DC

Source: Author's generation from Stata 17

Results of Figure 31 suggest that CPI, DC and LE exert a negative impact on BM, whereas GGE and GDP impact is positive. Trade and GEE impacts are not different from zero.

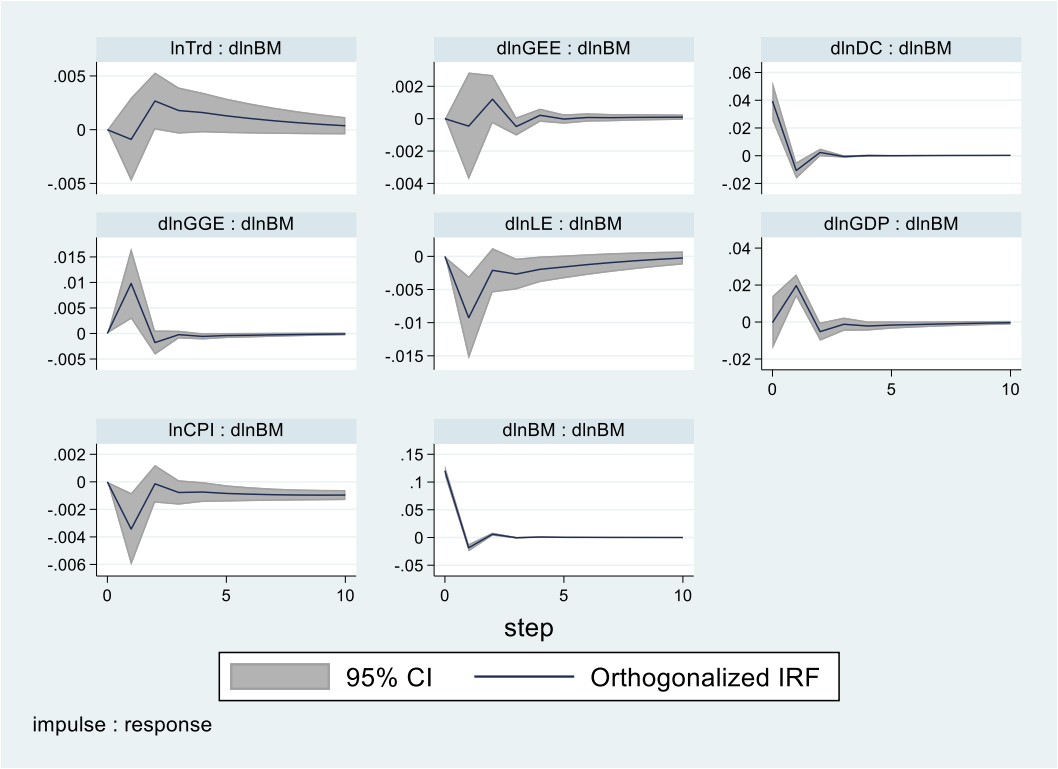


Figure 31: OIRF for BM

Source: Author's generation from Stata 17

Figure 32 demonstrates that innovations to CPI, Trade, or BM produce a negative response from health human capital, but innovations to GGE, GDP, DC, and GEE produce a positive response.

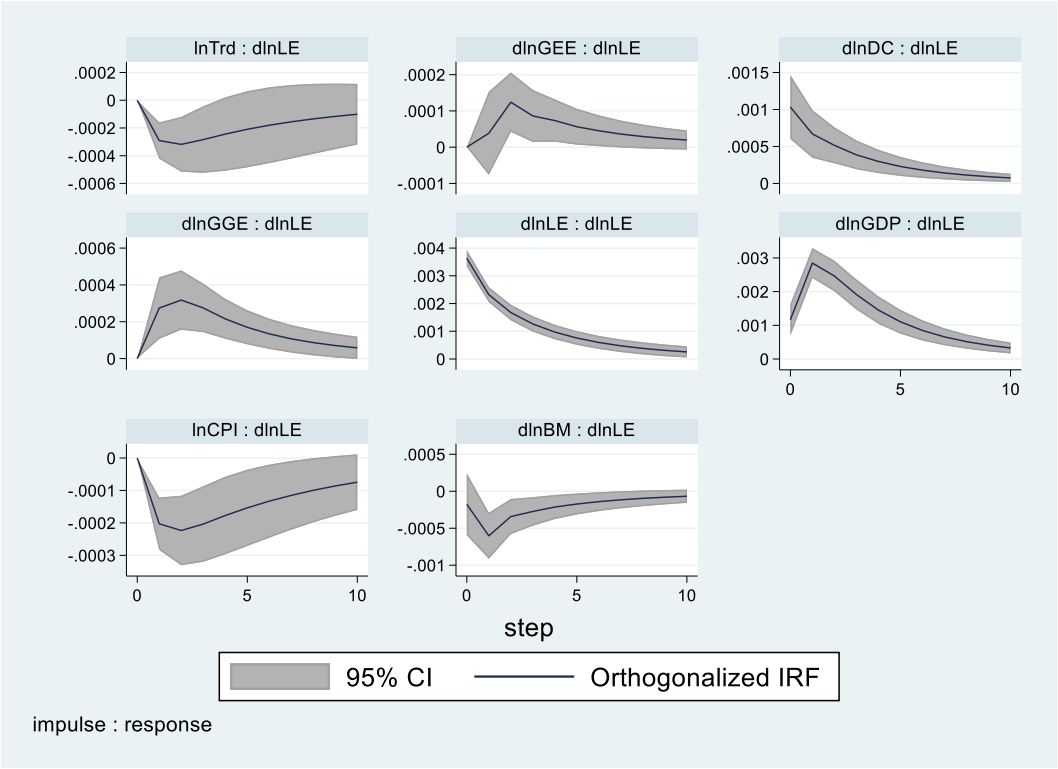


Figure 32: OIRF for LE

Source: Author's generation from Stata 17

Figure 33 shows that GEE response to innovations to Trade, GGE, or CPI is not different from zero. Nonetheless, while shocks to BM decrease slightly GEE, shocks to LE, DC and GDP increase it.

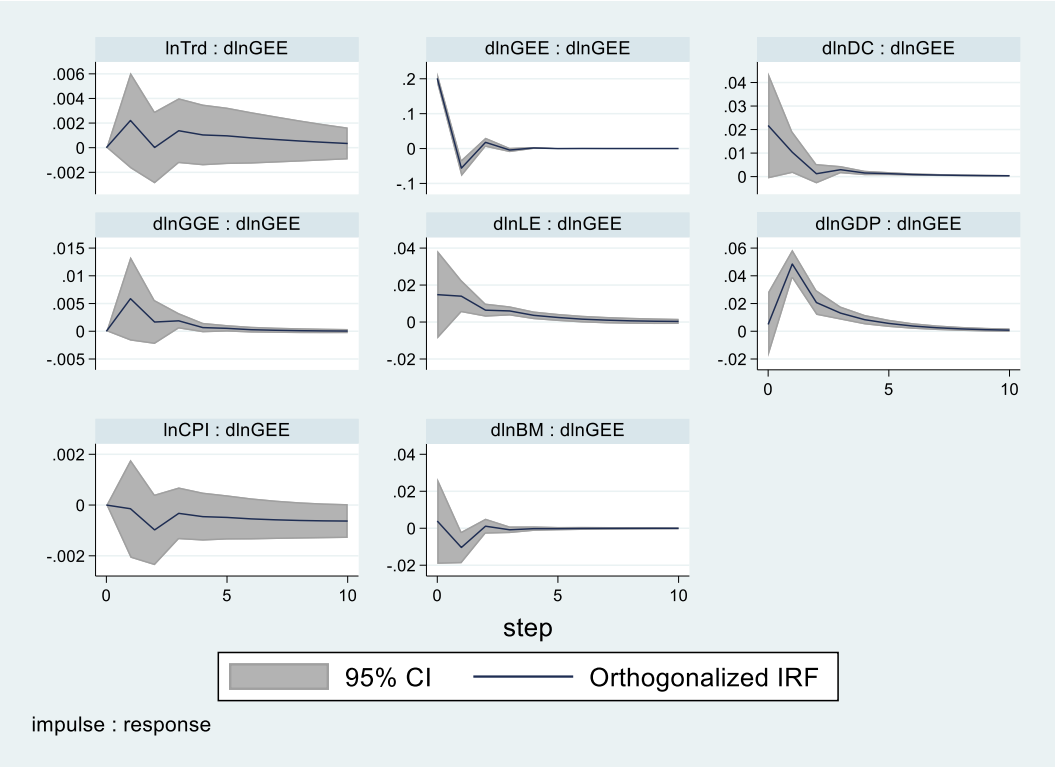


Figure 33: OIRF for GEE

Source: Author's generation from Stata 17

Appendix 4 presents the OIRFs of the remaining (control) variables.

5.7. Forecast Error Variance Decomposition (WAEMU Model)

Looking at the FEVD of the main variables (Economic Growth proxy: real GDP; Financial Development proxies: DC and BM; Human Capital proxies: LE and GEE), it can be concluded that (see Table 34 in Appendix 10):

In the first year, 100% of the Forecast Error Variance (FEV) in real GDP is explained by GDP itself. This implies that other variables are strongly exogenous in the initial year. From the short to the long run, GDP still predicts itself (around 97% in year 10). At the same year 10, Trade and health human capital account for only 1,45%; and 0,56% of FEV in real GDP, respectively. DC, BM, GEE, CPI and GGE jointly account for only 1,06% of forecast error variance in GDP.

In year 1, up to 98,68% of FEV in domestic credit is explained by DC itself, while the remaining 1,32% is explained by real GDP. In the short run (first 4 years), about 68% of error variance in domestic credit is explained by DC itself, and in the long run (year 5 to 10), it is still about 67%. From year 2 to 10, GDP explains more than 21% of changes in

domestic credit, while, even at year 10, LE, Trade, BM, CPI, GGE, and GEE only account for, respectively, 4,01%; 3,61%; 2,32%; 1,27%; 0,48% and 0,11% of error variance in DC.

From year 1 through year 10, the change of FEV in Broad Money from around 90% to around 86% is explained by BM itself, while Domestic Credit and GDP account for respectively about 10% and 2% of FEV in Broad Money throughout the 10 years period. Even at year 10, the contribution of the other variables to changes in broad money has been only 1,41%.

Life expectancy remains a strong influencer in predicting itself, with around 84% in the short run; but this drops quickly to 47% in the long run. GDP has been the main contributor of changes of FEV in LE from 8,67% in year 1 up to 45% in year 10. DC and money supply contributed to, respectively, about 4% and 1,32% of FEV in LE at year 10. The other variables' joint-contribution to changes in health human capital has been around 2% at year 10.

Lasty, in year 1 GEE strongly predicts itself by almost 98%, and up to 91% in year 10. As the main predictors, GDP, DC and LE explain, respectively, 6,42%; 1,23% and 1,07% of error variance in education human capital in year 10, meaning the remaining variables (BM, CPI, GGE and Trd) jointly contribute to exactly 0,38% in error variance of GEE in the same year 10.

CHAPTER 6: BEAC ZONE MODEL (6 COUNTRIES)

6.1. Summary Statistics CEMAC Model *(n*T=6*54=324 Observations)*

Table 35: Summary Statistics ***(n*T=6*54=324 Observations)***

Variable	Obs	Mean	Std, dev,	Min	Max
GDP	314	2818,996	3268,239	333,0859	14823,88
DC	298	11,88049	6,900991	2,01042	38,2327
BM	297	16,89235	5,476278	5,735473	39,81431
LE	324	53,74039	6,8822	30,537	68,337
GEE	208	3,164319	1,457829	1,10792	8,41331
CPI	270	77,11099	36,5307	7,877862	175,0058
GGE	289	13,43685	4,989273	2,736065	28,43493
Trd	289	73,09041	30,62694	20,0568	156,8618
OPr	324	43,60079	25,3035	5,212236	95,26411
lnGDP	314	7,305068	1,126644	5,808401	9,603995
lnDC	298	2,296497	0,6256284	0,6983435	3,643691
lnBM	297	2,77338	0,3351038	1,74667	3,684227
lnLE	324	3,9756	0,1330217	3,418939	4,224452
lnGEE	208	1,065145	0,4043046	0,1024844	2,129815
lnCPI	270	4,193991	0,6146087	2,064056	5,164819
lnGGE	289	2,521743	0,4106633	1,006521	3,347618
lnTrd	289	4,203051	0,425766	2,998568	5,055365
lnOPr	324	3,571389	0,694088	1,651009	4,556653

Source: Author's compilation

6.2. CEMAC Zone Cross-Sectional Dependence Test and Unit Root Test Results

6.2.1 Cross-Sectional Dependence in CEMAC Zone

Based on Table 36 results, there is cross–sectional dependence accross individual countries. For test robustness, 2nd generation unit root tests were utilized.

Table 36: Cross-sectional dependence CD-tests

Variable	CD (2004)	CD (2015, 2021)	CDw	CDw+
lnGDP	-2,33**	-	-	-
lnDC	18,76***	-	-	-
lnBM	11,43 ***	-	-	-
lnLE	14,14***	15,90***	16,88***	82,08***
lnGEE	2,21**	-	-	-
lnCPI	17,20***	-	-	-
lnGGE	4,31***	-	-	-
lnTrd	2,22**	-	-	-
lnOPr	28,46***	28,46***	-1,90*	108,33***

*: significant at 10% level, **: significant at 5% level, ***: significant at 1% level

Source: Author's compilation

6.2.2. Second Generation Unit Root Tests for BEAC Model

Table 37: Panel unit root test under cross-sectional dependence

		Pesaran's CADF test (Trend)	Pesaran's CADF test (Constan)	Im–Pesaran–Shin test (trend)	Fisher-type test (dfuller)	Fisher-type test (pperron)	
S/N	Variables	Z[t-bar] (P-value)	Z[t-bar] (P-value)	W-t-bar (P-value)	Inverse normal Z (P-value)	Inverse normal Z (P-value)	Decision
1	lnGDP, lags(1)	0,160 (0,564)	-0,416 (0,339)	-1,3024 (0,0964)*	-1,2410 (0,1073)	-0,6886 (0,2456)	I(1)
	dlnGDP , lags(1)	-4,418 (0,000)***	-5,463 (0,000)***	-5,9772 (0,000)***	-7,4758 (0,0000)***	-10,4195 (0,0000)***	
2	lnDC , lags(1)	-1,270 (0,102)	-1,813 (0,035)**	1,3414 (0,9101)	-0,6506 (0,2577)	-0,2385 (0,4057)	I(1)
	dlnDC , lags(1)	-6,943 (0,000)***	-7,683 (0,000)***	-7,6381 (0,0000)***	-9,0290 (0,0000)***	-15,7814 (0,0000)***	
3	lnBM , lags(1)	-2,012 (0,022)**	-1,397 (0,081)*	0,3763 (0,6466)	-1,0762 (0,1409)	-1,0143 (0,1552)	I(1)
	dlnBM , lags(1)	-9,448 (0,000)***	-10,192 (0,000)***	-10,8182 (0,000)***	-11,6906 (0,000)***	-15,5061 (0,0000)***	
4	lnLE , lags(1)	-3,016 (0,029)**	-1,968 (0,309)	-2,5181 (0,0059)***	1,0290 (0,8483)	-2,7285 (0,0032)***	I(0)

	dlnLE , lags(1)	-5,381 (0,000)**	-5,311 (0,027)**	-11,9214 (0,0000)***	-11,7181 (0,0000)***	-13,8303 (0,000)***	
5	lnGEE , lags(1)				-1,1727 (0,1204)	-1,7647 (0,0388)**	I(1)
	dlnGEE , lags(1)				-9,1773 (0,000)***	-12,6202 (0,000)***	
6	lnCPI , lags(1)	-2,566 (0,266)	-2,028 (0,258)	-1,2436 (0,1068)	-0,4127 (0,3399)	-0,3933 (0,3470)	I(1)
	dlnCPI, lags(1)	-5,683 (0,000)***	5,269 (0,000)***	-8,1574 (0,0000)***	-8,8477 (0,0000)***	-9,5903 (0,0000)***	
7	lnGGE , lags(1)	-2,419 (0,008)***	-2,271 (0,012)**	-3,0155 (0,0013)***	-3,1210 (0,0009)***	-3,8969 (0,0000)***	I(0)
	dlnGGE , lags(1)	-8,575 (0,000)***	-9,400 (0,000)***	-11,7470 (0,0000)***	-12,2704 (0,0000)***	-14,8770 (0,0000)***	
8	lnTrd , lags(1)	-1,365 (0,086)*	-0,888 (0,187)	-1,7608 (0,0391)**	-1,2098 (0,1132)	-1,6844 (0,0461)**	I(0)
	dlnTrd , lags(1)	-8,291 (0,000)***	-9,008 (0,000)***	-14,4919 (0,000)***	-12,2381 (0,000)***	-16,4268 (0,000)***	
9	lnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-1,6313 (0,0514)*	-3,2803 (0,0005)***	-3,8192 (0,0001)***	I (0)
	dlnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-10,2242 (0,000)***	-11,1472 (0,000)***	-15,4043 (0,000)***	

*: significant at 10%, **: significant at 5%, ***: significant at 1%

Source: Author's computations from STATA 17.

Decision: GDP, BM, DC, GEE and CPI are integrated of order one (I(1)) while LE, GGE, Trd and Opr variables are stationary at level.

6.3. BEAC Model Estimation Results

Table 38: Consistent Moment and Model Selection Criteria (BEAC Model)

Lags of endogenous variables	MBIC	MAIC	MQIC
1*	-328,831	-96,55636	-190,8913
2	,	,	,
3	,	,	,

*: optimum lag with minimal criteria values

Source: Author's computations

According to Table 39 results, only past realizations of Trade Openness are associated with an increase of about 5,19% in GDP on average ceteris paribus. Contrariwise, past realizations of GDP, LE, and GEE, are associated with a decrease of 24,06%; 27,32%; and 13,66% in GDP on average, ceteris paribus. DC, BM, CPI, GGE and OPr do not exert any statistically significant influence in real GDP.

BM, GEE, CPI and Trd positively (DC and GGE negatively) impact Domestic Credit. GDP, LE and OPr do not exert any significant effect on Domestic Credit.

A percentage increase in DC, LE, GEE and CPI is associated with a 6,69%; 45,34%; 37%; and 74,57% increase in Broad Money, respectively, and on average, ceteris paribus. However, a percentage increase in GDP, BM itself, GGE, or Trd causes a decrease in Broad Money, on average, ceteris paribus. Only OPr has no significant impact on BM.

A statistically not significant 9,86% decrease in Life Expectancy is due to a percentage increase in past realization of life expectancy itself. GDP and OPr have a positive impact (of 35,40%; and 11,09%, respectively) on life expectancy. However, a percentage increase in CPI exerts a negative effect of 48,14% on life expectancy. DC, BM, LE, GEE, GGE and Trd exert no significant impact on LE.

Only a percentage increase in BM has a statistically significant and positive impact on GEE. Contrariwise, an increase in GEE itself, CPI, GGE, Trd, and OPr causes GEE to decrease. GDP, DC, and LE effects on GEE are not statistically significant.

The Consumer Price Index is affected negatively by GDP, DC, BM, LE and Trd. GEE, CPI itself, GGE and OPr effects on CPI are not statistically significant.

Domestic Credit, BM, LE, and GEE affect General Government Expenditure positively, whereas GDP, CPI, Trd and Crude Oil Price negatively impact GGE. Surprisingly, GGE has no significant impact on itself.

After all, while CPI and GGE positively impact trade openness, the past realization of GDP, BM and LE negatively affect current trade openness. Surprisingly, Trade effect on itself is not statistically significant. Also, DC, GEE and OPr have no significant impact on trade.

Table 39: BEAC Model Estimation Results

	Equation							
	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	lnGGE	lnTrd
L1. dlnGDP	-0,2406*** (-3,06)	-0,0401 (-0,33)	-0,8199 (-8,83) ***	0,3540 (2,74) ***	-0,0269 (-0,23)	-0,5099 (-5,06) ***	-0,3241 (-3,65) ***	-0,2038 (-2,43) **
L1. dlnDC	0,0139 (1,56)	-0,4603 (-9,99) ***	0,0669 (2,57) **	0,0057 (0,49)	-0,0036 (-0,16)	-0,0252 (-2,13) **	0,0681 (2,6) ***	-0,0150 (-0,5)
L1. dlnBM	0,0079 (0,37)	0,2233 (3,56) ***	-0,5525 (-11,84) ***	0,0217 (0,85)	0,0898 (2,17) **	-0,1459 (-6,5) ***	0,2214 (5,51) ***	-0,1800 (-4,62) ***
L1. dlnLE	-0,2732* (-1,7)	-0,1874 (-1,17)	0,4534 (2,28) **	-0,0986 (-0,44)	0,0884 (0,62)	-0,2405 (-1,75) *	0,5392 (2,72) ***	-0,4306 (-4,13) ***
L1. dlnGEE	-0,1366*** (-7,07)	0,3766 (9,18) ***	0,3700 (10,79) ***	0,0073 (0,61)	-0,3923 (-7,85) ***	-0,0021 (-0,16)	0,2505 (7,35) ***	0,0286 (0,98)
L1. lnCPI	0,1481 (1,28)	0,9255 (6,66) ***	0,7457 (7,37) ***	-0,4814 (-1,74) *	-0,4930 (-4,77) ***	-0,0538 (-0,74)	-1,0099 (-7,43) ***	0,8249 (7,11) ***
L1. lnGGE	-0,0283 (-0,97)	-0,2391*** (-3,81)	-0,2663 (-4,89) ***	0,0537 (1,25)	-0,2997 (-7,09) ***	0,0352 (1,49)	0,0145 (0,37)	0,1240 (3,53) ***
L1. lnTrd	0,0518** (2)	0,1423 (2) *	-0,2479 (-5,06) ***	0,1466 (1,15)	-0,2084 (-3,79) ***	-0,1054 (-3,58) ***	-0,0974 (-2,46) ***	-0,0629 (-1,02)
lnOPr	-0,0291 (-0,81)	-0,0132 (-0,13)	0,0170 (0,26)	0,1109 (2,88) ***	-0,2555 (-3,71) ***	-0,0062 (-0,18)	-0,2856 (-3,3) ***	0,0915 (1,52)

Notes: *: significant at 10%, **: significant at 5%, ***: significant at 1%
Z statistics in parentheses
Instruments: l (1/3). (dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd) lnOPr
Test of overidentifying restriction: Hansen's J chi2(95) = 117,49119 (p = 0,059)
Final GMM Criterion Q(b) = 0,704
Initial weight matrix: Identity
GMM weight matrix: Robust

Source: Author's compilation

6.4. Eigenvalue Stability Condition (CEMAC Model)

Table 40: Stability Condition

Eigenvalue		
Real	Imaginary	Modulus
-,6182721	0	,6182721
,0970181	-,6015038	,6092777
,0970181	,6015038	,6092777
-,3940737	,0468221	,3968456
-,3940737	-,0468221	,3968456
-,2047106	,3238309	,3831095
-,2047106	-,3238309	,3831095
-,2246362	0	,2246362

Source: Author's compilation

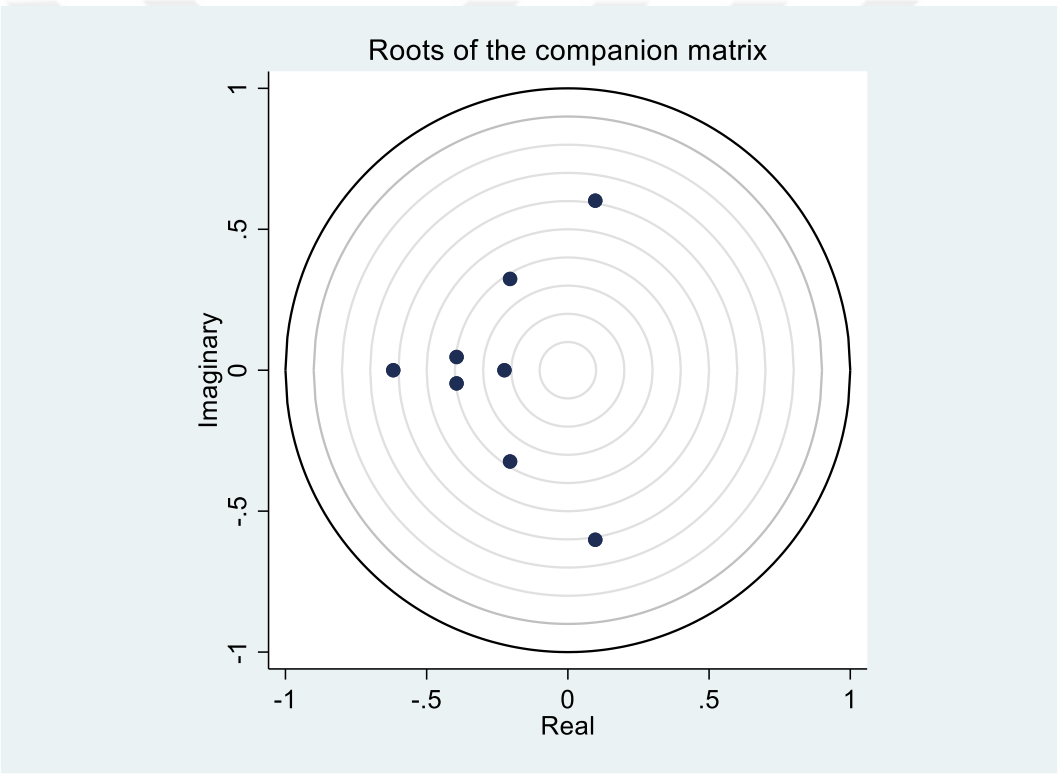


Figure 37: Unit Circle for Stability Condition

Source: Author's generation from Stata 17

Based on Figure 37 and Table 40, all the eigenvalues are less than one. The BEAC/CEMAC model is, then, stable.

6.5. Granger Causality Tests

From the results of Table 41:

– GDP (per capita real income) is granger–caused by LE, GEE and Trd.

– DC (domestic credit) is granger–caused by all the variables, except by GDP and LE.

– BM (Broad Money/Money supply) is granger–caused by all the variables.

– LE (Life Expectancy at Birth/health human capital) is only granger–caused by GDP and CPI.

– GEE (government expenditures on education/education human capital) is granger–caused by BM, CPI, GGE and Trd.

– CPI (Consumer Price Index/ Inflation Proxy) is granger–caused by all the variables, except by GEE and GGE.

– GGE (General Government Expenditure/ Final Government Consumption) is granger–caused by all the variables, without exception.

– Trd (Trade openness) is granger–caused by GDP, BM, LE, CPI and GGE.

– Overall, all the variables Granger–cause all the equation variables.

Consequently, there is evidence of bidirectional causality between:

– Health human capital and GDP (GDP↔LE);

– Money supply and DC (DC↔BM);

– GEE and BM (BM↔GEE);

– GDP and trade openness (GDP↔Trd);

– CPI and Trade (CPI ↔ Trd);

– BM and GGE (GGE ↔ BM);

– GGE and GEE (GGE ↔ GEE);

– CPI and DC (CPI ↔ DC);

– LE and CPI (CPI ↔ LE);

– GGE and DC (GGE ↔ DC);

– BM and CPI (BM ↔ CPI);

– Trd and GGE (Trd ↔ GGE);

– Trd and BM (Trd ↔ BM).[9]

Furthermore, there is also evidence of unidirectional causality running from:

– GDP to CPI (GDP→CPI);

– CPI to GEE (CPI→GEE);

[9] ↔: bidirectional causality among the variables.

- GEE to DC (GEE→DC);
- LE to Trd (LE→Trd);
- LE to BM (LE→BM);
- GEE to GDP (GEE→GDP);
- GDP to BM (GDP→BM);
- GDP to GGE (GDP→GGE);
- LE to GGE (LE→GGE);
- Trd to DC (Trd→DC);
- CPI to GGE (CPI→GGE);
- Trd to GEE (Trd→GEE). [10]

Table 41: Causality Test

Equation Variable CEMAC ➞	dlnGDP	dlnDC	dlnBM	lnLE	dlnGEE	dlnCPI	lnGGE	lnTrd
dlnGDP		0,109	77,93***	7,521***	0,055	25,59***	13,337***	5,926**
dlnDC	2,423		6,606**	0,236	0,026	4,535**	6,761***	0,249
dlnBM	0,139	12,697***		0,722	4,699**	42,23***	30,392***	21,349***
lnLE	2,898*	1,374	5,213**		0,379	3,061*	7,418***	17,095***
dlnGEE	50,01***	84,330***	116,45***	0,373		0,025	53,996***	0,966
dlnCPI	1,630	44,294***	54,324***	3,033*	22,718***		55,210***	50,599***
lnGGE	0,947	14,511***	23,960***	1,555	50,264***	2,228		12,481***
lnTrd	3,982**	4,002**	25,646***	1,316	14,382***	12,79***	6,050**	
Overall	107,0***	183,640***	302,12***	18,149**	136,43***	82,23***	194,41***	75,624***

Note: ***p < 0,01, **p < 0,05, *p < 0,1; p = Prob>chi2
Ho: The excluded variable does not Granger–cause equation variable
Ha: Excluded variable Granger–causes equation variable

Source: Author's compilation

[10] →: unidirectional causality running from left to right variable.

6.6. Orthogonalised Impulse Response Functions

From Figure 38 output, innovations to Trade, DC, LE, GGE, or BM have no significant effects on income. However, GEE and CPI exert a negative impact on income in the first two time periods and in the fourth time period, respectively.

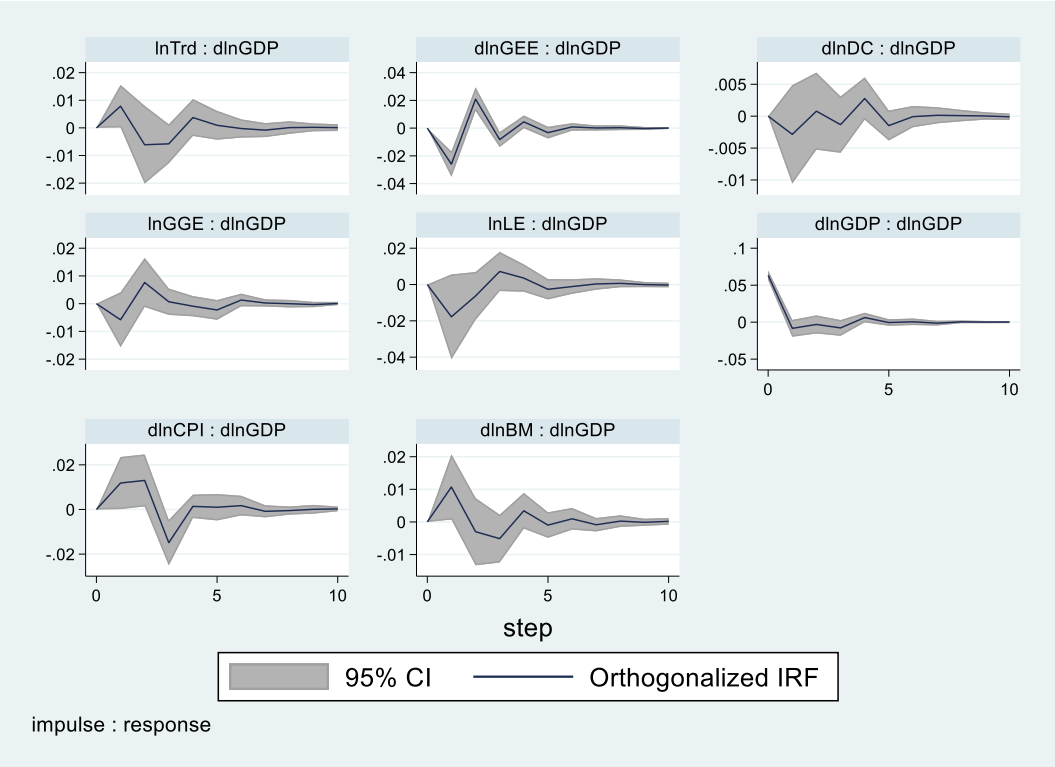


Figure 38: OIRF for GDP

Source: Author's generation from Stata 17

From Figure 39, it can be concluded that CPI, GEE, or BM are positively associated with income in the first two time periods, while GGE and LE are negatively related to income. Trade has a significant and negative impact only in the 3rd time period, otherwise it is insignificant. GDP is not significantly associated with DC.

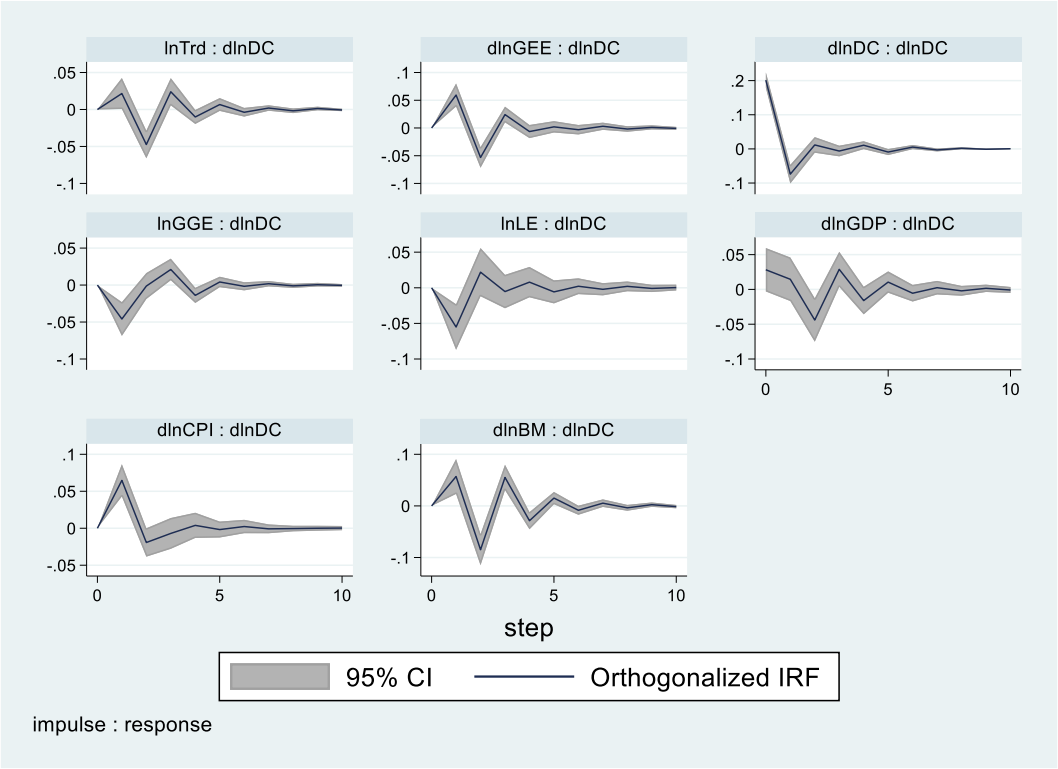


Figure 39: OIRF for DC

Source: Author's generation from Stata 17

From the observation of the Figure 40, it can be concluded that shocks to Trade, GGE, and GDP yield negative impact on BM, whereas CPI, GEE, and DC effects on BM are positive in the initial periods. LE impact is not different from zero.

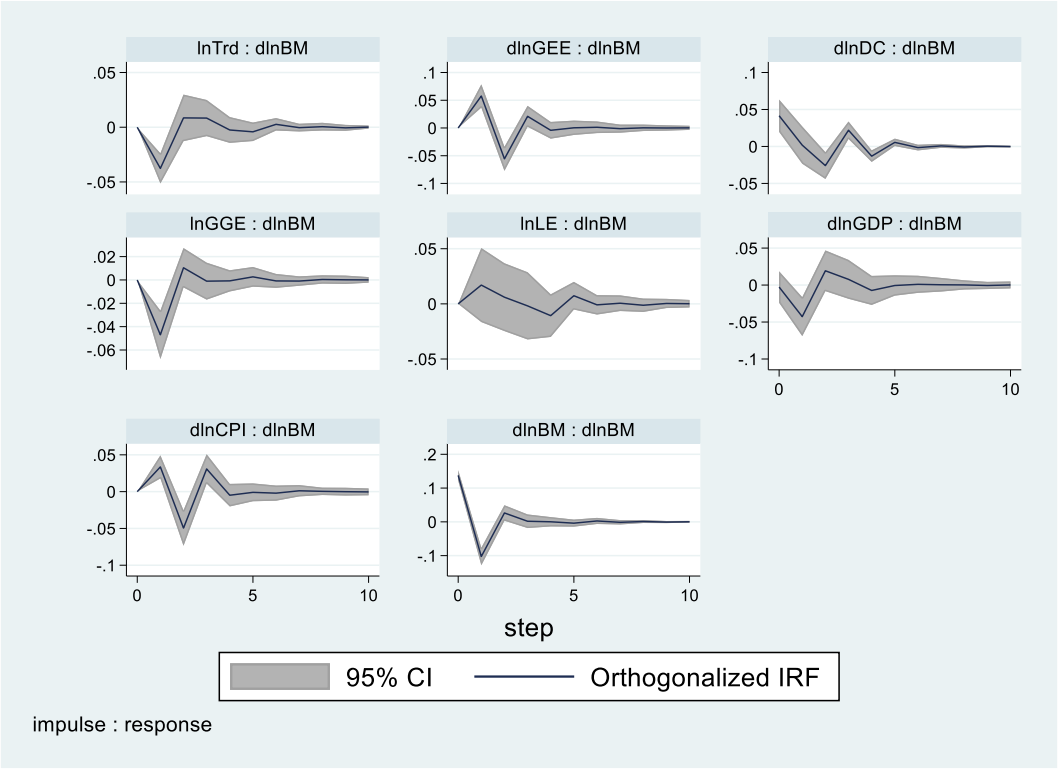


Figure 40: OIRF for BM

Source: Author's generation from Stata 17

Figure 41 shows that only income has a delayed (in the second time period) positive impact on health human capital. Responses to other variables shocks are statistically not different from zero.

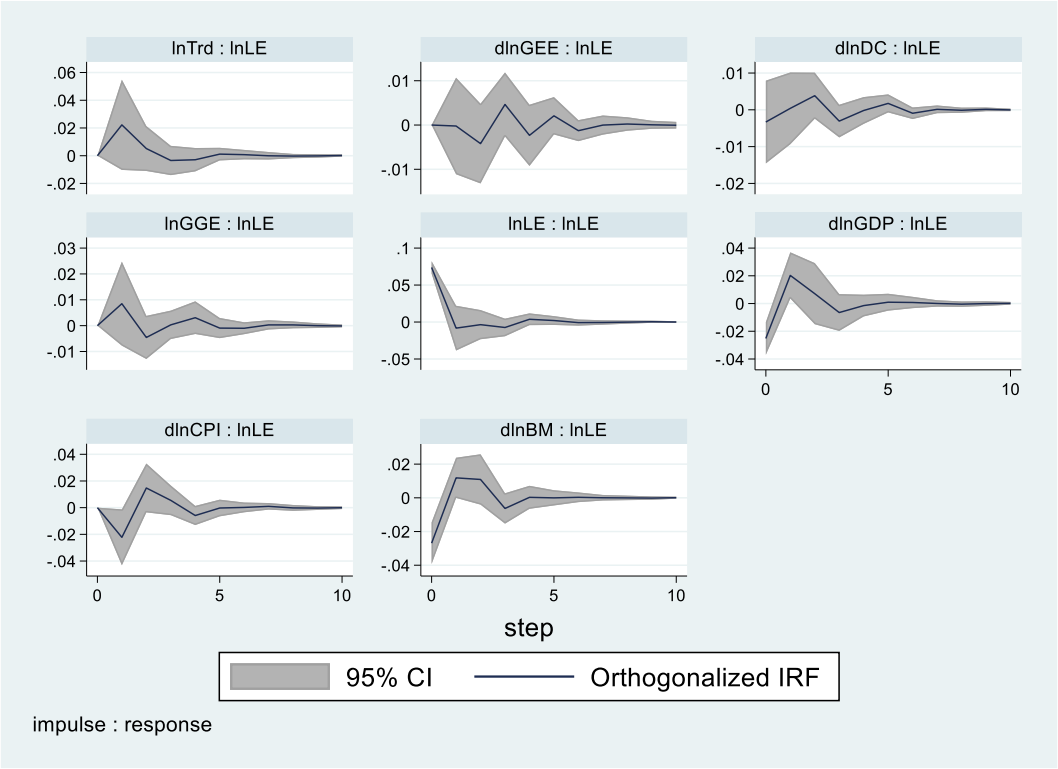


Figure 41: OIRF for LE

Source: Author's generation from Stata 17

Figure 42 illustrates that shocks to Trade, GGE and CPI decrease GEE in the initial period. GDP, DC, BM and LE effects on GEE are not different from zero, statistically.

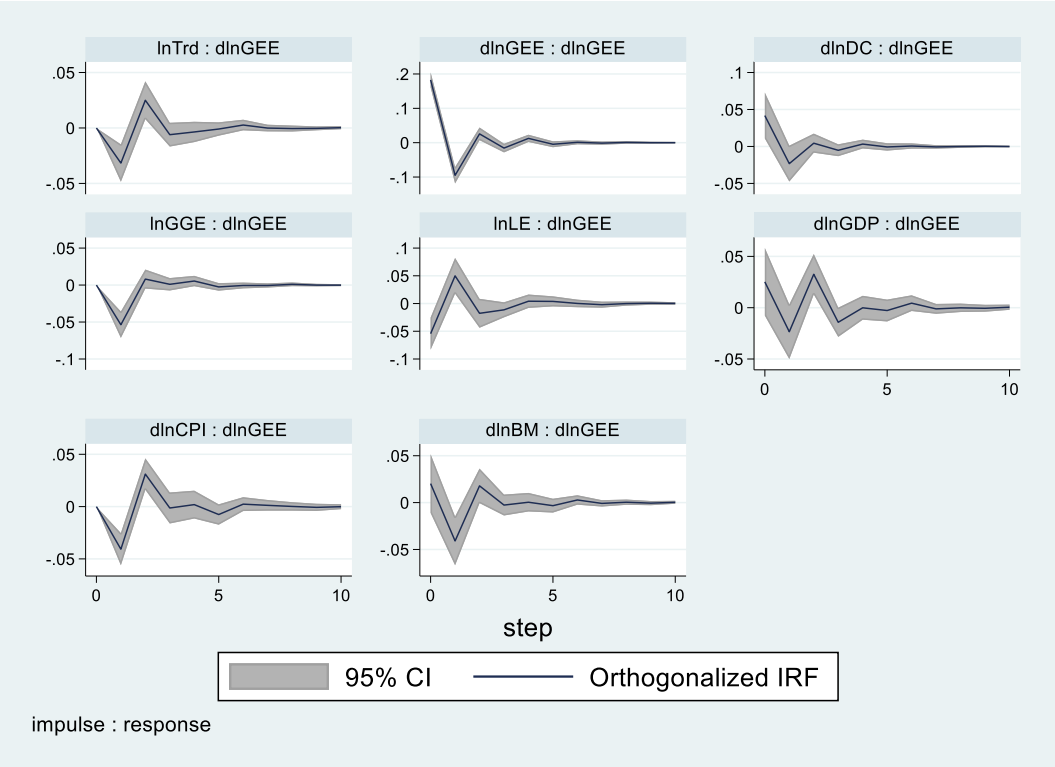


Figure 42: OIRF for GEE

Source: Author's generation from Stata 17

For more on OIRFs of the other variables please refer to Appendix 5.

6.7. Forecast Error Variance Decomposition (BEAC/CEMAC Model)

Based on Table 42 in Appendix 11, the FEVD of the main variables (Economic Growth proxy: real GDP; Financial Development proxies: DC and BM; Human Capital proxies: LE and GEE) are as follows:

In the first year, 100% of the forecast error in GDP is due to its own shocks. This percentage drops to around 75% in year 2, and 62% in year 10, indicating that GDP is influenced by other variables, meaning strong interdependence. From the short to the long run, shocks to GEE, CPI, LE, BM, Trd, GGE and DC predict, respectively, around 18%, 8%, 6%, 2,4%, 2%, 1,4%, and 0,3% of the forecast error variance of real GDP.

In year 1, up to 98% of FEV in domestic credit is explained by shocks to DC itself, while the remaining 2% is explained by real income. In the short run (in year 4), about 55% of error variance of domestic credit is explained by shocks to DC themselves, and in the long run (year 5 to 10), this share of forecast error of DC is about 53,5%, meaning

strong interdependence with other variables. In the long term (from year 5), shocks to BM, GEE, CPI, GDP, LE, Trade, and GGE, respectively account for about 17%, 8%, 5,3%, 5%, 4%, 4%, and 3,2% of domestic credit forecast error.

From year 1 through year 10, the change of Broad Money FEV from around 92% back to around only 59% is explained by shocks to BM itself. When moving forward into the future, shocks to education human capital, inflation, Domestic Credit, Government final consumption, GDP, Trade, and health human capital, respectively, contribute to about 13%, 9%, 6%, 5%, 4%, 3%, and 1% of FEV in Broad Money.

Life expectancy remains a strong influencer in predicting itself, with around 80% in the first year; but this decreases to about 60,3% in the long run, indicating strong influences of other variables dynamics. The main contributors to changes in FEV of LE, from short to long terms, have been GDP, BM, CPI, and Trade with, respectively, 12,3%, 11%, 8,4%, and 6% of forecast error of LE. The other variables (GGE, GEE and DC) joint-contribution to changes in health human capital has been around only 2%.

Finally, in year 1 GEE strongly predicts itself by almost 85%, and back to 68% in year 10. From short (from year 3) to long term, shocks to LE, GGE, CPI, GDP, BM, DC and LE explain, respectively and approximately, 9%, 4,7%, 4,2%, 3,8%, 3,7%, 3,6%, and 3% of error variance of education human capital, proving endogeneity of the variables within the VAR system.

CHAPTER 7: WAMZ MODEL (5 COUNTRIES, LIBERIA EXCLUDED)

7.1. Summary Statistics for WAMZ Model (n*T=5*54=270 Observations)

Table 43: Summary Statistics **(n*T=5*54=270 Observations)**

Variable	Obs	Mean	Std, dev,	Min	Max
GDP	270	1060,027	550,2875	454,0219	2585,734
DC	246	8,078727	5,095783	1,031624	25,118
BM	246	20,04132	8,795291	5,950832	57,02079
LE	270	51,18706	7,22191	38,619	65,86
GEE	203	2,70248	1,767683	,33494	9,442236
CPI	200	92,17376	115,356	,0017837	609,9726
GGE	234	9,445221	6,270451	,9112346	45,95932
Trd	252	52,43357	25,37625	6,320343	131,4854
OPr	270	43,60079	25,31134	5,212236	95,26411
lnGDP	270	6,852197	,4613126	6,118145	7,857765
lnDC	246	1,890167	,650374	,0311344	3,223585
lnBM	246	2,902635	,4451339	1,783531	4,043416
lnLE	270	3,925573	,1411513	3,653744	4,187531
lnGEE	203	,7708946	,7181046	-1,093804	2,245193
lnCPI	200	2,826893	2,911796	-6,329083	6,413414
lnGGE	234	2,049939	,6752743	-,0929549	3,827757
lnTrd	252	3,834959	,5262934	1,843773	4,878896
lnOPr	270	3,571389	,694303	1,651009	4,556653

Source: Author's compilation

7.2. WAMZ Zone Cross-Sectional Dependence Test and Unit Root Test Results

7.2.1 Cross-Sectional Dependence in WAMZ Zone

Based on Table 44, there is cross–sectional dependence across individual countries for all the variables. Therefore, 2nd generation unit root tests are more reliable than traditional unit root tests.

Table 44: Cross-sectional dependence CD-tests

Variable	CD (2004)	CD (2015, 2021)	CDw	CDw+
lnGDP	8,89***	8,46***	0,89	27,32***
lnDC	2,87***	-	-	-
lnBM	7,43***	-	-	-
lnLE	14,14***	21,85***	-4,49***	64,62***
lnGEE	-3,55 ***	-	-	-
lnCPI	14,86***	-	-	-
lnGGE	-1,67*	-	-	-
lnTrd	-1,33 (p=0,183)	-	-	-
lnOPr	23,24***	23,24***	4,65***	78,13***

*: significant at 10%, **: significant at 5%, ***: significant at 1%

Source: Author's compilation

7.2.2 Unit Root Tests for WAMZ Model

Table 45: Panel unit root test under cross-sectional dependence

		Pesaran's CADF test (Trend)	Pesaran's CADF test (Constan)	Im–Pesaran–Shin test (trend)	Fisher-type test (dfuller)	Fisher-type test (pperron)	
S/N	Variables	Z[t-bar] (P-value)	Z[t-bar] (P-value)	W-t-bar (P-value)	Inverse normal Z (P-value)	Inverse normal Z (P-value)	Decision
1	lnGDP, lags(1)	-1,831 (0,911)	-0,830 (0,990)	1,6833 (0,9538)	2,1595 (0,9846)	2,7186 (0,9967)	I(1)
	dlnGDP , lags(1)	-4,808 (0,000)***	-4,484 (0,000)***	-6,9763 (0,000)***	-7,3907 (0,0000)***	-12,0932 (0,0000)***	
2	lnDC , lags(1)	-1,727 (0,042)**	-0,682 (0,247)	-0,7153 (0,2372)	-0,1342 (0,4466)	-0,1988 (0,4212)	I(1)
	dlnDC , lags(1)	-6,438 (0,000)***	-7,472 (0,000)***	-8,3413 (0,0000)***	-9,7264 (0,0000)***	-13,2821 (0,0000)***	
3	lnBM , lags(1)	-0,780 (0,218)	-1,276 (0,101)	0,7082 (0,7606)	0,1595 (0,5634)	0,1277 (0,5508)	I(1)
	dlnBM , lags(1)	-7,126 (0,000)***	-8,087 (0,000)***	-8,4694 (0,000)***	-9,7802 (0,000)***	-13,8459 (0,0000)***	
4	lnLE , lags(1)	-0,225 (1,000)	-1,228 (0,910)	3,3732 (0,9996)	-0,8965 (0,1850)	-1,3535 (0,0879)*	I(1)
	dlnLE , lags(1)	-4,297 (0,000)**	-3,024 (0,001)**	-7,4402 (0,0000)***	-6,1253 (0,0000)***	-9,6588 (0,000)***	

	lnGEE , lags(1)	2,094 (0,982)	0,983 (0,837)	-0,3569 (0,3606)	-0,7346 (0,2313)	-1,0966 (0,1364)	I(1)
	dlnGEE , lags(1)	-4,059 (0,000)***	-4,598 (0,000)***	-5,2215 (0,0000)***	-6,7844 (0,000)***	-11,1179 (0,000)***	
6	lnCPI , lags(1)	-2,428 (0,399)	-2,510 (0,041)**	1,4575 (0,9275)	0,6055 (0,7276)	-2,6954 (0,0035)***	I(1)
	dlnCPI, lags(1)	-3,390 (0,000)***	-3,191 (0,000)***	-2,5621 (0,0052)***	-3,3198 (0,0000)***	-3,3634 (0,0004)***	
7	lnGGE , lags(1)	-2,302 (0,011)**	-1,050 (0,147)	-0,7554 (0,2250)	-0,3699 (0,3557)	-0,7957 (0,2131)	I(1)
	dlnGGE , lags(1)	-8,301 (0,000)***	-8,964 (0,000)***	-9,4181 (0,0000)***	-10,4890 (0,0000)***	-13,8117 (0,0000)***	
8	lnTrd , lags(1)	1,041 (0,851)	2,197 (0,986)	-0,8506 (0,1975)	-0,5293 (0,2983)	-0,9414 (0,1732)	I(1)
	dlnTrd , lags(1)	-7,234 (0,000)***	-8,103 (0,000)***	-9,1914 (0,000)***	-10,3139 (0,000)***	-14,0748 (0,000)***	
9	lnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-1,4892 (0,0682)*	-2,9945 (0,0014)***	-3,4865 (0,0002)***	I (0)
	dlnOPr , lags(1)	1,700 (1,000)	2,610 (1,000)	-9,3334 (0,000)***	-10,1759 (0,000)***	-14,0621 (0,000)***	

*: significant at 10%, **: significant at 5%, ***: significant at 1%

Source: Author's computations from STATA 17.

Decision: All the variables are stationary at 1st difference except OPr which is I (1).

7.3. WAMZ Model Estimation Results

Table 46: Consistent Moment and Model Selection Criteria (WAMZ Model)

Lags of endogenous variables	MBIC	MAIC	MQIC
1*	-322,2901	-93,96429	-186,7502
2	,	,	,
3	,	,	,

*: optimum lag with minimal criteria values

Source: Author's computations from STATA 17.

Based on Table 47 output, past realizations of GDP, BM, Life Expectancy at Birth, Government Expenditure on Education, and Trade openness are associated with an increase of about 49,02%; 4,94%; 348,16%; 3,91%; and 4,61% in GDP on average ceteris

paribus. But, past realizations of DC, CPI, GGE and CPI are statistically not significant in influencing real income.

Only GDP positively impact domestic credit, while GEE and CPI have negative effect on DC. The rest of the variables (DC itself, BM, LE, GGE, Trd and OPr) do not statistically significantly exert any influence on Domestic Credit.

A percentage increase in GDP, DC, and CPI is associated with a 28,37%; 10,37%; and 37,02% decrease in Broad Money, respectively, and on average, ceteris paribus. However, BM itself, LE, GEE, GGE, Trd and OPr do not significantly affect the money supply.

About 37,25% of increase in Life Expectancy (health human capital) is due to a percentage change in past realization of life expectancy. However, a percentage increase in CPI is found to exert a negative even though negligeable effect (of 0,53%) on life expectancy. All the remaining variables had no effect on LE.

Only a percentage change in DC and Trd has a statistically significant and positive impact of about 11,98% and 10,27% on the GEE. A percentage increase in GEE causes about a 15,10% decrease in GEE itself. Also, GDP, LE, and CPI have negative impact on GEE. BM, and GGE impacts on GEE are insignificant.

The Consumer Price Index is affected negatively by itself (a percentage increase in CPI causes about a 46,85% decrease in CPI a period ahead), GDP (45,04%), and by LE; However, it is impacted positively by DC and GGE. BM, GEE, Trd, and Opr effects on CPI are not statistically significant.

Only Trd affects General Government Expenditure positively and significantly, but GDP, BM, GEE, CPI, or Crude Oil Price negatively impact GGE. DC, LE, and GGE iteself influences are insignificant.

Lastly, all the statistically significant impacts on Trade are negative (from BM, LE, CPI, or OPr). Trade, itself, has no significant impact. Also, GDP, DC, and GGE influences on Trade are insignificant.

Table 47: WAMZ Model Estimation Results

	Equation							
	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	dlnCPI	dlnGGE	dlnTrd
L1. dlnGDP	0,4209 (6,19) ***	0,4152 (2,08) **	-0,2837 (-2,15) **	-0,0049 (-0,81)	-0,7200 (-3,71) ***	-0,4504 (-3,5) ***	-1,1715 (-4,27) ***	-0,1686 (-0,55)
L1. dlnDC	-0,0180 (-1,4)	-0,0161 (-0,19)	-0,1037 (-1,72) *	0,0003 (0,33)	0,1198 (2,08) **	0,0674 (1,93) *	0,0212 (0,26)	0,0825 (1,11)
L1. dlnBM	0,0494 (2,49) **	0,1126 (0,77)	-0,0071 (-0,08)	-0,0009 (-0,43)	-0,0746 (-0,55)	-0,0843 (-1,24)	-0,3875 (-2,33) **	-0,3446 -2,59) **
L1. dlnLE	3,4816 (3,93) ***	6,2543 (1,5)	1,5220 (0,55)	0,3725 (4,51) ***	-7,2756 (-2,08) **	-10,3459 (-3,87) ***	-7,4527 (-1,49)	-21,5165 (-4,04) ***
L1. dlnGEE	0,0391 (3,63) ***	-0,1261 (-2,49) **	-0,0069 (-0,22)	-0,0007 (-0,84)	-0,1510 (-2,13) **	0,0059 (0,27)	-0,0848 (-1,66) *	-0,0120 (-0,23)
L1. dlnCPI	-0,0022 (-0,07)	-0,3523 (-2,48) **	-0,3702 (-3,71) ***	-0,0053 (-2,28) **	-0,1782 (-1,73) *	-0,4685 (4,84) ***	-0,7815 (-4,85) ***	-0,5608 (-2,63) ***
L1. dlnGGE	-0,0064 (-0,54)	0,0503 (0,86)	0,0315 (0,43)	0,0011 (1,44)	0,0546 (1,3)	0,0661 (2,49) **	0,0587 (0,92)	0,0917 (1,47)
L1. dlnTrd	0,0461 (4,05) ***	-0,0464 (-0,75)	0,0351 (0,87)	-0,0003 (-0,31)	0,1027 (1,84) *	-0,0011 (-0,02)	0,1475 (2,13) **	-0,0037 (-0,05)
lnOPr	0,0192 (1,6)	-0,0718 (-0,89)	-0,0455 (-0,79)	-0,0011 (-0,98)	-0,0516 (-1,35)	-0,0467 (-1,13)	-0,1385 (-1,8) *	-0,1823 -2,02) **

Notes: *: significant at 10% level, **: significant at 5% level, ***: significant at 1% level
Z statistics in parentheses
Final GMM Criterion Q(b) = 0,436
Instruments: l (1/2). (dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd) lnOPr
Test of overidentifying restriction: Hansen's J chi2(64) = 66,718137 (p = 0,384)
Initial weight matrix: Identity
GMM weight matrix: Robust

Source: Author's compilation

7.4. Eigenvalue Stability Condition for WAMZ Model

Table 48: Stability Condition

Eigenvalue		
Real	Imaginary	Modulus
,6773418	0	,6773418
,4076749	0	,4076749
,085389	-,3756466	,3852293
,085389	,3756466	,3852293
-,1678054	0	,1678054
-,0324095	-,1340885	,1379496
-,0324095	,1340885	,1379496
,1195437	0	,1195437

Source: Author's compilation

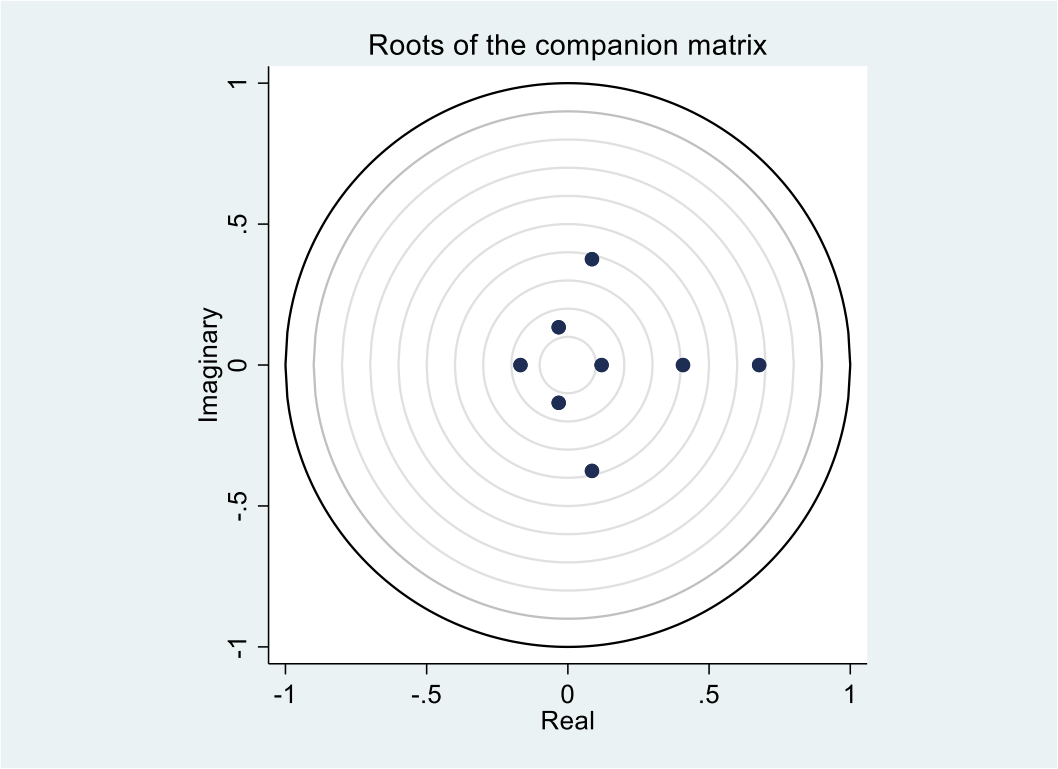


Figure 46: Unit Circle for Stability Condition

Source: Author's generation from Stata 17

All the moduli are less than 1, meaning the WAMZ Model is stable.

7.5. Granger Causality Tests for WAMZ Model

From the results of Table 49:

- GDP (per capita real income) is granger–caused by BM, LE, GEE and Trd.
- DC (domestic credit) is granger–caused by GDP, GEE and CPI.

- BM (Broad Money/Money supply) is granger–caused by GDP, DC, and CPI.
- LE (Life Expectancy at Birth/health human capital) is only granger–caused by CPI.
- GEE (government expenditures on education/education human capital) is granger–caused by GDP, DC, LE, CPI, and Trd.
- CPI (Consumer Price Index/ Inflation Proxy) is granger–caused by GDP, DC, LE and GGE.
- GGE (General Government Expenditure/ Final Government Consumption) is granger–caused by GDP, BM, GEE, CPI and Trd.
- Trd (Trade openness) is granger–caused by BM, LE, and CPI.
- Overall, all the variables Granger–cause all the equation variables, except "dlnLE" equation variable.

Consequently, there is evidence of bidirectional causality between:

- GEE and DC (DC↔GEE);
- GDP and BM (BM↔GDP);
- GDP and GEE (GDP↔GEE);
- CPI and DC (CPI ↔ DC);
- LE and CPI (CPI ↔ LE);
- GGE and CPI (GGE ↔ CPI).[11]

Furthermore, there is also evidence of unidirectional causality running from:

- GDP to DC (GDP→DC);
- CPI to BM (CPI→BM);
- BM to GGE (BM→GGE);
- BM to Trd (BM→Trd);
- CPI to Trd (CPI→Trd);
- LE to Trd (LE→Trd);
- LE to GDP (LE→GDP);
- DC to BM (DC→BM);
- GEE to GGE (GEE→GGE);
- GDP to CPI (GDP→CPI);

[11] ↔: bidirectional causality among the variables.

- GDP to GGE (GDP→GGE);
- LE to GEE (LE→GEE);
- Trd to GDP (Trd→GDP);
- CPI to GEE (CPI→GEE);
- Trd to GGE (Trd→GGE)
- Trd to GEE (Trd→GEE). [12]

Table 49: Causality Test

Equation Variable WAMZ ➡	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	dlnCPI	dlnGGE	dlnTrd
dlnGDP		4,328**	4,615**	0,650	13,767***	12,29***	18,275***	0,300
dlnDC	1,946		2,949*	0,107	4,332**	3,712*	0,065	1,229
dlnBM	6,200**	0,592		0,183	0,301	1,540	5,426**	6,720**
dlnLE	15,43***	2,242	0,307		4,325**	14,94***	2,234	16,345***
dlnGEE	13,21***	6,211**	0,047	0,701		0,074	2,768*	0,051
dlnCPI	0,005	6,142**	13,795***	5,203**	2,986*		23,537***	6,908***
dlnGGE	0,288	0,736	0,182	2,065	1,698	6,214**		2,167
dlnTrd	16,41***	0,555	0,750	0,097	3,374*	0,001	4,527**	
Overall	82,51***	26,227***	30,621***	6,571	27,999***	48,85***	55,037***	20,117***

Note: The values are for chi2, ***p < 0.01, **p < 0.05, *p < 0.1; p = Prob>chi2
Ho: The excluded variable does not Granger–cause equation variable
Ha: Excluded variable Granger–causes equation variable

Source: Author's compilation

7.6. Orthogonalised Impulse Response Functions

Based on Figure 47, the responses of GDP to an innovation to DC, CPI, and GGE are statistically not different from zero.

[12] →: unidirectional causality running from the left to the right variable.

The response of GDP to itself is contemporaneous and positive in the first period, then declines and converges to zero in the third period.

The GDP response to a shock to GEE, LE or Trd is positive during the initial two time periods.

The response to BM shock is only positive and significant in the second period.

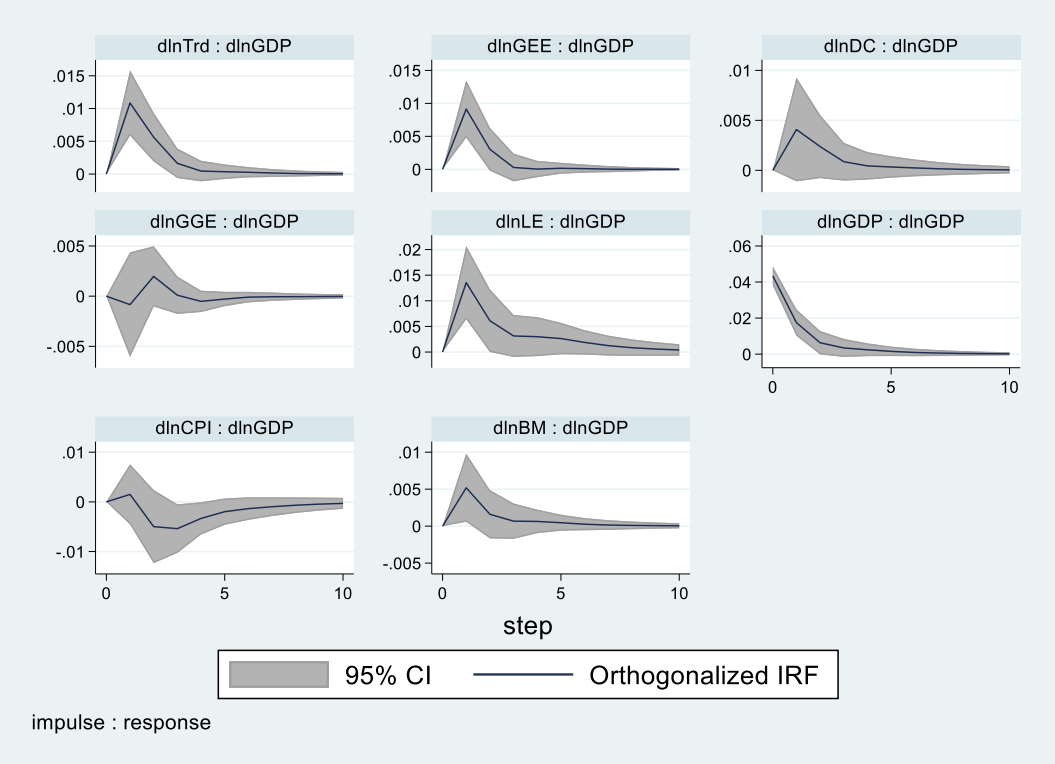


Figure 47: OIRF for GDP

Source: Author's generation from Stata 17

Figure 48 shows that the responses to BM, GGE, and Trd shocks are statistically insignificant.

Moreover, 1 standard deviation shock to CPI or GEE has a brief negative effect on DC, but the LE and GDP effects are negative and die out quickly.

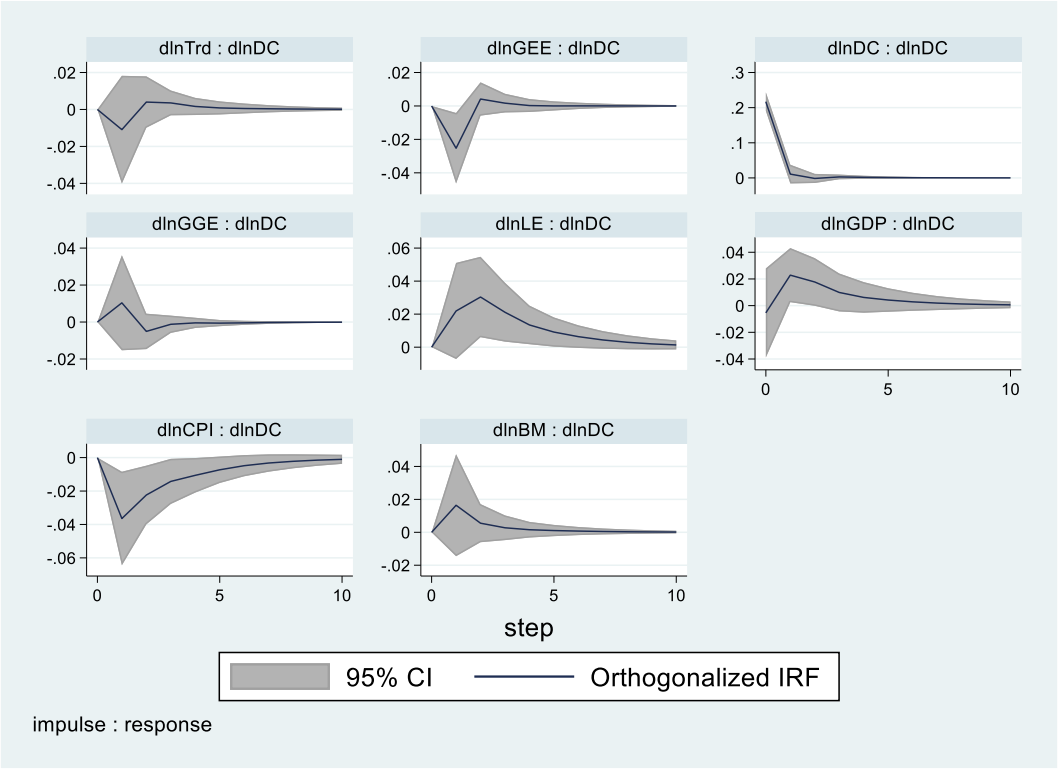


Figure 48: OIRF for DC

Source: Author's generation from Stata 17

As illustrated in Figure 49, the BM responses to Trd, GGE, GEE, LE and DC shocks are statistically equal to zero.

Nevertheless, GDP and CPI have a brief negative impact on money supply.

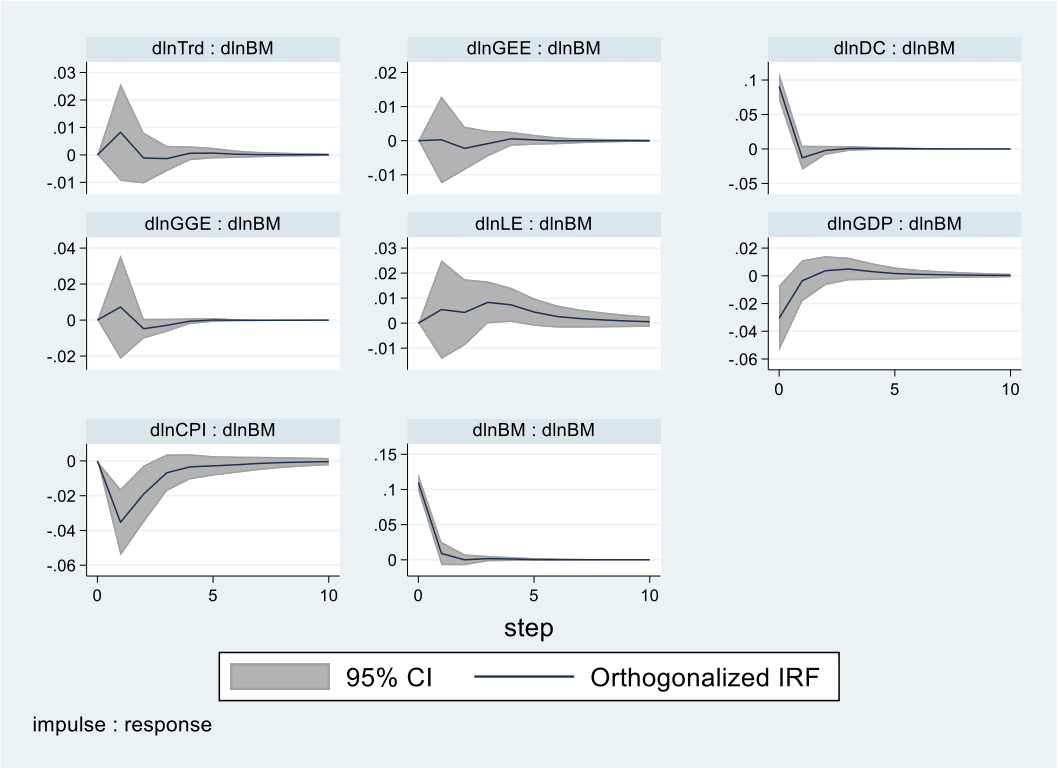


Figure 49: OIRF for BM

Source: Author's generation from Stata 17

Figure 50 demonstrates that standard deviation shock to, only, CPI or LE itself yields a statistically significant reaction from LE. While CPI affects LE negatively, LE impacts itself positively.

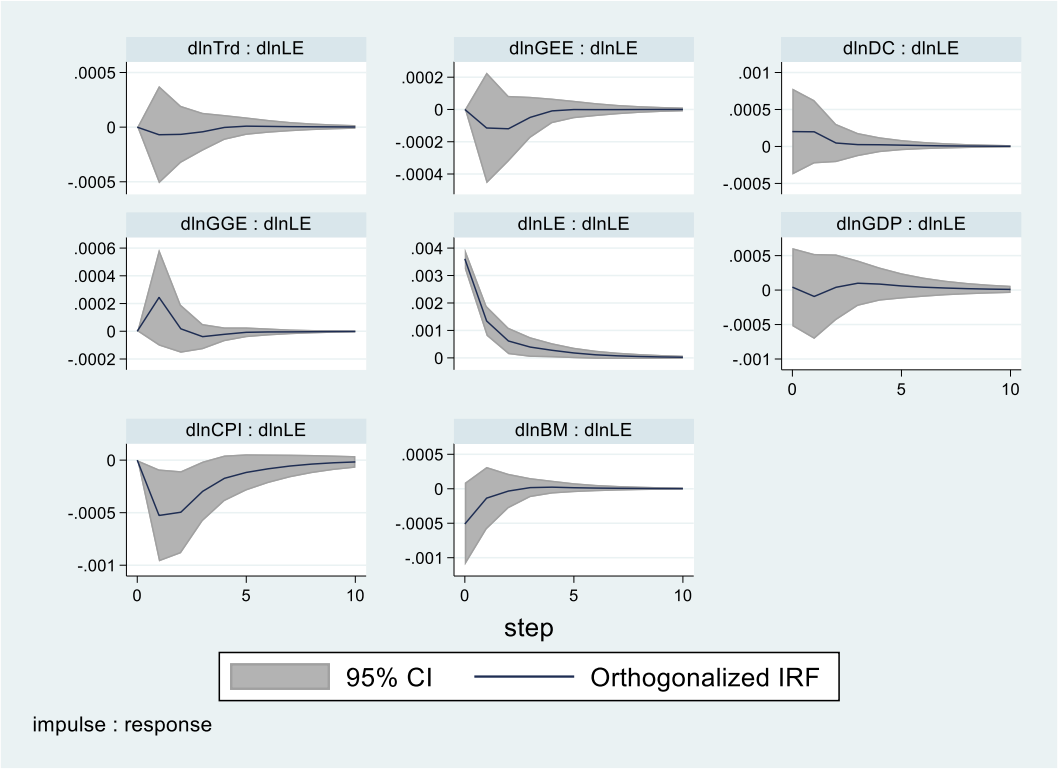


Figure 50: OIRF for LE

Source: Author's generation from Stata 17

Figure 51 indicates that BM, GGE, Trade, or CPI does not significantly impact expenditure on education. Nonetheless, LE and GDP have a very small and brief negative effect on education human capital while DC effect on GEE is a brief positive one.

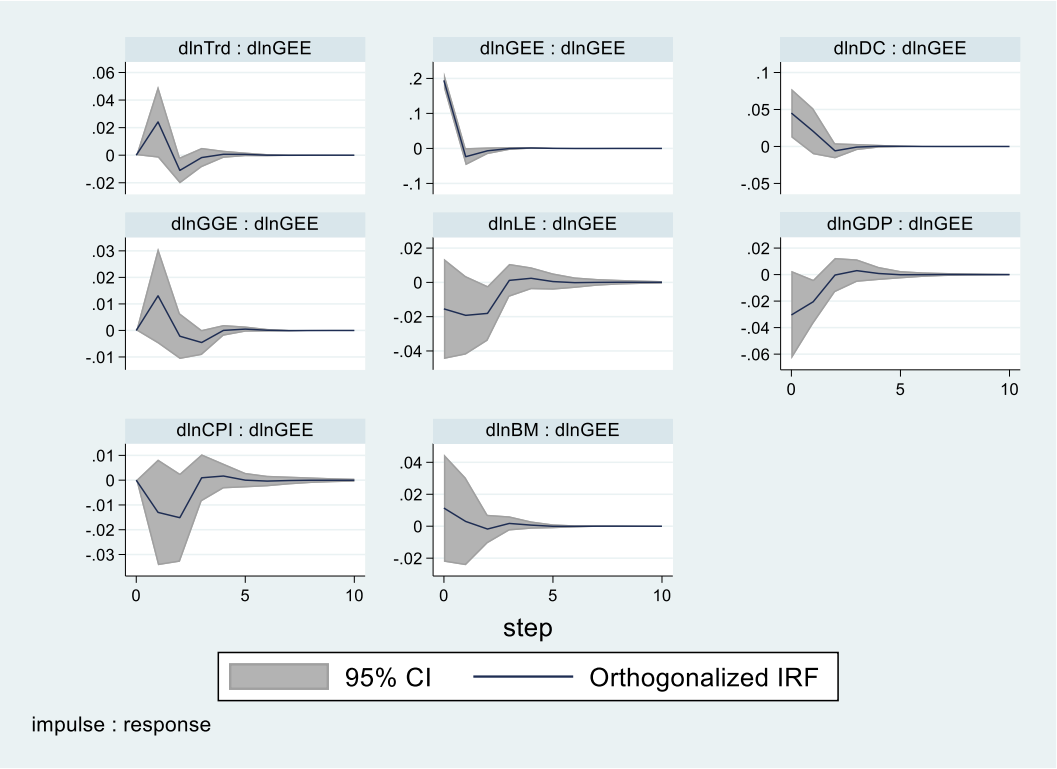


Figure 51: OIRF for GEE

Source: Author's generation from Stata 17

For detailed information on the remaining OIRFs figures for CPI, GGE & Trd, check Appendix 6.

7.7. Forecast Error Variance Decomposition

Based on Table 50 in Appendix 12, it can be concluded about the forecast error variance of the Economic Growth, Financial Development, and Human Capital variables that:

In year 1, 100% of the forecast error in GDP is due to shocks to GDP itself. This percentage decreases to around 78% in year 10, indicating that GDP is influenced by other variables, too. From the short to the long run (from year 3 or 4 through 10), shocks to LE, Trd, GEE, CPI, BM, DC, and GGE explain, respectively, around 8,7%, 5,3%, 3,2%, 2,5%, 1,07%, 0,82%, and 0,17% of the forecast error variance of real GDP.

In year 1, almost 100% of FEV in domestic credit is explained by shocks to DC itself. In the long run, about 88% of error variance of domestic credit is explained by shocks to DC themselves, indicating some interdependence with others. In the long term (from year 3 or 4 to 10), shocks to LE, CPI, GDP, and GEE, respectively account for about 4%, 4%, 2%, and 1% of domestic credit forecast error. Shocks to BM, GGE and Trade, jointly, account for around 1% FEV in DC.

In the first year, 57% of the forecast error in Broad Money is due to its own shocks; 39% is due to DC shocks; and 4% is due to real income shocks. In year 10, 51,5%; 36%; 7%; and 4% of the forecast error variance in Broad Money are due, respectively to shocks to Broad Money itself, Domestic Credit, Consumer Price Index, and GDP. Government final consumption, Trade, Education and health human capital, jointly, contribute to about 1,5% of FEV in Broad Money.

Life expectancy remains a very strong influencer in predicting itself, with around 98% in the first year, and 93% even in the tenth year, indicating weak influences of other variables. The main influencers to changes in LE have been CPI and BM, whose shocks explain about, respectively, 4% and 1,7% of forecast error of LE in year 10. The other variables joint-contribution to changes in health human capital has been around only 1,3%, in the same year.

Finally, in year 1 GEE strongly predicts itself by almost 92%, and up to 86% in year 10. From short (from year 2 or 3) to long term (to year 10), approximately, 6%, 3%, 2%, and 1,5% of error variance of education human capital are due to, respectively, shocks to DC, GDP, LE, and Trade. The other variables jointly explain only about 1,5% of education human capital error variance.

CHAPTER 8: DISCUSSIONS AND SYNTHESIS

8.1. Discussions

Considering Table 51 below which resumes the Global model estimation results as well as the granger causality test results, and as for the nexus between financial development (FD), human capital (HC) and Economic Growth (GDP/ Income):

- Real income is positively impacted by both FD (proxied by BM), and HC (proxied by LE). Also, Trade and Oil Prices impacts are positive.
- FD (proxied by DC) is positively impacted by GDP, and negatively by HC (proxied by LE).
- Human Capital has a mixed impact on FD (proxied by BM): The impact is negative when proxied by Health, and positive when proxied by Education.
- Human Capital (proxied by Health) is impacted positively by Income, FD (DC) and Education.
- Human Capital (proxied by Education) is impacted positively by FD (DC) and Health.

Table 51: Global Model Coefficients Signs and Significance

Global	GDP	DC	BM	LE	GEE	CPI	GGE	Trd
GDP	+	+		+		+	-	
DC		+		+	+		+	
BM	+		-			+	-	+
LE	+	-	-	-	+	-	+	+
GEE			+	+	-			
CPI			-	-		+		+
GGE		-		+	-		+	-
Trd	+	-	+	-		-		+
OPr	+	-	+				-	

Source: Author's compilation

Based on Table 52 synthesis on ECOWAS Model:

- Income is positively impacted by HC (irrespective of the proxy used). Also, Trade and Oil Prices impacts are positive.
- FD (proxied by DC) is positively impacted by GDP and HC (proxied by LE).
- FD (proxied by BM) is positively impacted by GDP.

- Human Capital (proxied by Health) is impacted positively by Income. FD has a mixed effect on Health: The effect is positive when proxied by DC, and negative when proxied by Money Supply.
- Human Capital (proxied by Education) is impacted positively by FD (DC) and Health.

Table 52: ECOWAS Model Coefficients Signs and Significance

ECOWAS	GDP	DC	BM	LE	GEE	CPI	GGE	Trd
GDP	+	+	+	+		+	-	+
DC				+	+		+	+
BM			-	-				+
LE	+	+		+	+	-	+	+
GEE	+				-		-	
CPI		+	-	-		+	+	+
GGE			+					-
Trd	+	-	+	+		-	-	+
OPr	+	-	+	+			-	

Source: Author's compilation

Based on Table 53 synthesis on FCFA Model:

- Income is positively impacted by FD (proxied by BM), and negatively by HC (irrespective of the proxy used). Also, while Trade impact is positive, GGE effect is negative.
- FD (proxied by either DC or BM) is positively impacted by GDP. Human Capital has a mixed impact on FD: The impact is negative when proxied by Health, and positive when proxied by Education.
- Human Capital (proxied by Health) is impacted positively by Income, and FD (proxied by Money Supply) and Education.
- Human Capital (proxied by Education) is impacted positively by GDP, FD (DC) , and negatively by Health.

Table 53: FCFA Model Coefficients Signs and Significance

F CFA	GDP	DC	BM	LE	GEE	CPI	GGE	Trd
GDP	+	+	+	+	+	+	-	
DC					+	-	+	
BM	+		-	+				
LE	-	-	-	-	-	-	+	-
GEE	-	+	+	+	-	-		
CPI		-	-	-		+	+	-
GGE	-		+			+	+	+
Trd	+			-		+	+	+
OPr		+	+	+	+	+	-	+

Source: Author's compilation

Concluding from Table 54 synthesis on WAEMU Model:

- Income is positively impacted by HC (Education as proxy). Also, General Price Level, Trade and GGE impacts are positive.
- FD (proxied by either DC or BM) is positively impacted by GDP, and negatively by Health Human Capital. Also, BM impact on FD (DC) is negative.
- Human Capital (proxied by either Health or Education) is impacted positively by Income. FD has a mixed effect on HC: The effect is positive when proxied by DC, and negative when proxied by Money Supply. Moreover, the effect of health on education is positive.

Table 54: BCEAO Model Coefficients Signs and Significance

BCEAO	GDP	DC	BM	LE	GEE	CPI	GGE	Trd
GDP	+	+	+	+	+		-	+
DC		-		+	+	-	+	+
BM		-	-	-	-	+	+	+
LE		-	-	+	+	-	+	-
GEE	+				-	-	-	
CPI	+	-	-	-		+	+	-
GGE	+	+	+	+			-	
Trd	+	-		-		+	+	+
OPr		+	+	+		+	-	+

Source: Author's compilation

According to Table 55 summary on CEMAC Model:

- Income is negatively impacted by HC (irrespective of the proxy used). Also, Trade impact is positive.
- FD (proxied by DC) is positively impacted by Education Human Capital. Also, BM impact on FD (DC) is positive.
- FD (BM as proxy) is positively impacted by Human Capital (irrespective of the proxy used). Also, DC impact on FD (BM) is positive.
- Human Capital (proxied by Health) is impacted positively by Income.
- Human Capital (proxied by Education) is impacted positively by FD (BM).

Table 55: BEAC Model Coefficients Signs and Significance

BEAC	GDP	DC	BM	LE	GEE	CPI	GGE	Trd
GDP	-		-	+		-	-	-
DC		-	+			-	+	
BM		+	-		+	-	+	-
LE	-		+			-	+	-
GEE	-	+	+		-		+	
CPI		+	+	-	-		-	+
GGE		-	-		-			+
Trd	+	+	-		-	-	-	
OPr				+	-		-	

Source: Author's compilation

Finally, as shown in Table 56 recap on WAMZ Model:
- Income is positively impacted by FD (BM), and HC (irrespective of the proxy used). Also, Trade impact is positive.
- FD (proxied by DC) is impacted positively by Income, and negatively by Education Human Capital.
- FD (BM as proxy) is negatively impacted by Income, and FD (DC).
- Human Capital (proxied by Education) is impacted negatively by Income, and positively by FD (DC). Health Human Capital impact on Education Human Capital is negative.

Table 56: WAMZ Model Coefficients Signs and Significance

WAMZ	GDP	DC	BM	LE	GEE	CPI	GGE	Trd
GDP	+	+	-		-	-	-	
DC			-		+	+		
BM	+						-	-
LE	+			+	-	-		-
GEE	+	-			-		-	
CPI		-	-	-	-	-	-	-
GGE						+		
Trd	+				+		+	
OPr							-	-

Source: Author's compilation

8.2. Synthesis

8.2.1. Impact on Income

In all the models, Trade impact on income is positive.

In both the Global and ECOWAS models Income is positively impacted by HC (proxied by LE), and Oil Prices.

In the Global, FCFA and WAMZ models Income is positively impacted by FD (proxied by BM).

In both the FCFA and BEAC models Income is negatively impacted by HC (irrespective of the proxy used).

In both the ECOWAS and WAMZ models Income is positively impacted by HC (irrespective of the proxy used).

The GGE effect on income is negative in FCFA model, while its impact is positive in WAEMU model where Income is positively impacted by Education human capital and General Price Level.

8.2.2. Impact on Financial Development

In both FCFA and WAEMU zones models, FD (irrespective of the proxy used) is positively impacted by GDP, and negatively by Health Human Capital.

In Global, ECOWAS, FCFA, WAEMU, and WAMZ models, Income positively impacts FD (proxied by DC).

When proxied by DC, FD is negatively impacted by Education Human Capital in WAMZ model, while this impact is positive in CEMAC and FCFA models.

While FD (proxied by DC) is positively impacted by Health Human Capital in ECOWAS model, contrariwise, this impact is negative in Global model.

Also, while BM impact on FD (DC) is negative in WAEMU zone, this impact is positive in CEMAC zone.

In both Global and FCFA zones, FD (proxied by BM) is impacted negatively by Health Human Capital, and positively by Education Human Capital.

Like in ECOWAS zone, FD (proxied by BM) is positively impacted by GDP in FCFA, and WAEMU zones too. On the opposite, this income effect on FD (money supply as proxy) is negative in WAMZ zone.

While DC impact on FD (BM as proxy) is positive in CEMAC zone, it is negative in WAMZ zone.

Irrespective of the proxy used, FD is negatively impacted by Health Human Capital in WAEMU zone.

And irrespective of the proxy used for Human Capital, this latter impact on FD (proxied by money supply) is positive in BEAC zone.

8.2.3. Impact on Human Capital

In all the economic zones (except WAMZ) Income has positive effect on Health Human Capital. Moreover, Income effect on Education Human Capital is positive in FCFA and WAEMU zones.

FD (DC as proxy) has positive effect on health human capital in Global, ECOWAS, and WAEMU models.

Thus, in both ECOWAS and WAEMU models, Income and FD (DC) impacts on health human capital are positive, while that of FD (BM) on health is negative. Contrariwise, FD (proxied by Money Supply) impact on Health Human Capital is positive in FCFA zone.

Education Human Capital impacts positively Health Human Capital in the Global and FCFA models.

In Global, ECOWAS and WAEMU models, FD (DC) and Health HC impacts on Education HC are positive. FD (DC) impact is also positive in FCFA and WAMZ zones.

Irrespective of HC measures, FD when proxied by Money Supply has a negative effect on HC in WAEMU zone, while the FD (BM) effect on Education Human Capital is positive in CEMAC zone.

Both in WAEMU AND FCFA zones, Income impact on Education Human Capital is positive, while in WAMZ zone Income effect is negative.

Nonetheless, Health Human Capital has negative impact on Education Human Capital in both FCFA and WAMZ models.

CONCLUSION

The general aim of this study was to analyze the interactions between financial development, human capital, and economic growth in the Global, ECOWAS, FCFA, CEMAC, WAEMU and WAMZ zones during the period 1970-2023 using the panel VARX econometric technique. Economic growth was proxied by real GDP (GDP). Besides, financial development was proxied by broad money or money supply (BM) and domestic credit to the private sector (DC), both as a ratio of GDP. Human capital was proxied by Life Expectancy at birth (LE) as a measure of health human capital and government expenditure on education (GEE) as a measure of education human capital. Moreover, some control variables were used (Trade openness (TRD), government expenditure (GGE), consumer price index (CPI), and Crude Oil prices (OPr)).

The study found, among others, that: In all the models, Trade impact on income is positive; and in all the economic zones (except WAMZ) Income has positive effect on Health Human Capital; which is in line with established macroeconomic theory.

In the Global and ECOWAS models, Income, positively, impacts FD (proxied by DC) which has positive effect on both Education and Health human capital, and Income is positively impacted by the latter (Health) and Oil Prices. Also, Health HC impacts Education HC positively. While Health Human Capital positively impacts FD (proxied by DC) in ECOWAS model, contrariwise, this Health HC impact is negative in Global model. This may imply a lack of adequate healthcare system in both central and west Africa and a need to invest more in it in order to produce not only healthy but also educated HC which will benefit and boost the financial sector.

In Global and FCFA models, Health HC impact on FD (BM) is negative, while that of Education HC is positive. Education HC impacts positively Health HC.

In ECOWAS and WAMZ areas, HC (both health and education) positively impacts Income which, in turn, has a positive impact on FD (proxied by DC). In WAMZ model, Income effect on Education HC is negative, and Education, in turn, has a negative effect on FD (DC). This result may suggest that the education sector, when underfinanced, produces uneducated HC, which is unproductive or even hinders the development of the financial industry.

In both ECOWAS and WAEMU models, Income and FD (DC) impacts on health human capital are positive, while that of FD (BM) on health is negative. Also, FD (DC) and Health HC have positive impacts on Education HC.

In the Global, FCFA and WAMZ models, Income positively impacts FD (proxied by DC), and is positively impacted by FD (proxied by BM). FD (DC) impact on Education HC is positive. This indicates GDP, FD and HC are positively interconnected and complementary (as in Sekmen et al., 2025), in line with the standard economic theory.

In both FCFA and WAMZ zones, Health HC impact on Education HC is negative, indicating an underfinanced and neglected health sector.

In the FCFA and BEAC models, Income is negatively impacted by HC (irrespective of the proxy used), but Education Human Capital impact on FD (DC) is positive. Moreover, FD (BM) has positive impact on Health HC in FCFA zone. The negative effect of HC on GDP can be a direct result of very poor public investments in education and health care.

In the FCFA and BCEAO models, Income affects positively Education Human Capital and FD (irrespective of the proxy used). This latter is impacted negatively by Health Human Capital. The GGE effect on income is negative in FCFA (probably as a result of insufficient public spending in infrastructure, education, health, agriculture, security, …) model, while its impact is positive in WAEMU zone where Education human capital and General Price Level impacts on Income are positive. This is an evidence of the case where moderate inflation can boost economy (when economy operates below its full potential).

In CEMAC and BCEAO zones, FD (BM) has a negative effect on FD (DC), and on both health and education HC in WAEMU zone, whereas in CEMAC zone the FD (BM) effect on Education HC is positive and the effect on FD (DC) is positive. This can suggest that the health and education sectors have no access to sufficient investments through access to various financial credits for example.

Moreover, computed FEVDs and IRFs support the study's findings, overall.

As for policy implications, the West and Central African monetary authorities, governments and policymakers in general, should stimulate economic growth by producing more goods and services to be exported, by facilitating access to domestic credit, by encouraging health and education investments by public as well as private sectors, and avoiding expansionary monetary policies. Nonetheless, specifically for WAEMU case, a little bit of inflation may boost economic growth.

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APPENDICES

Appendix 1: Global Model OIRFs (CPI, GGE & Trd)

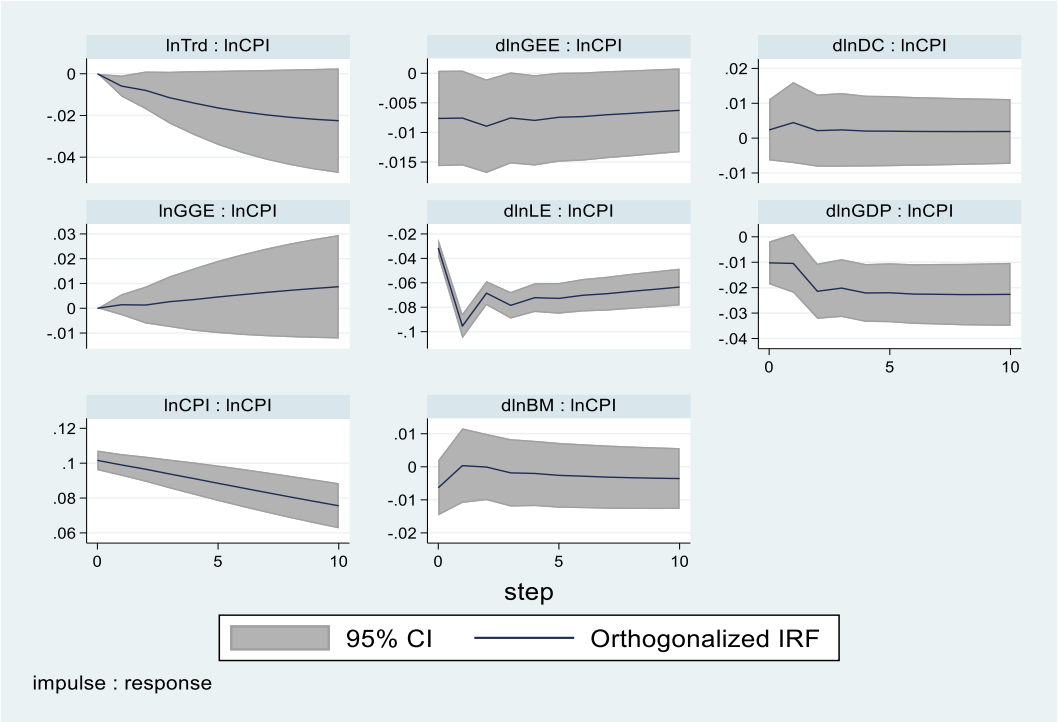

Figure 7: OIRF for CPI

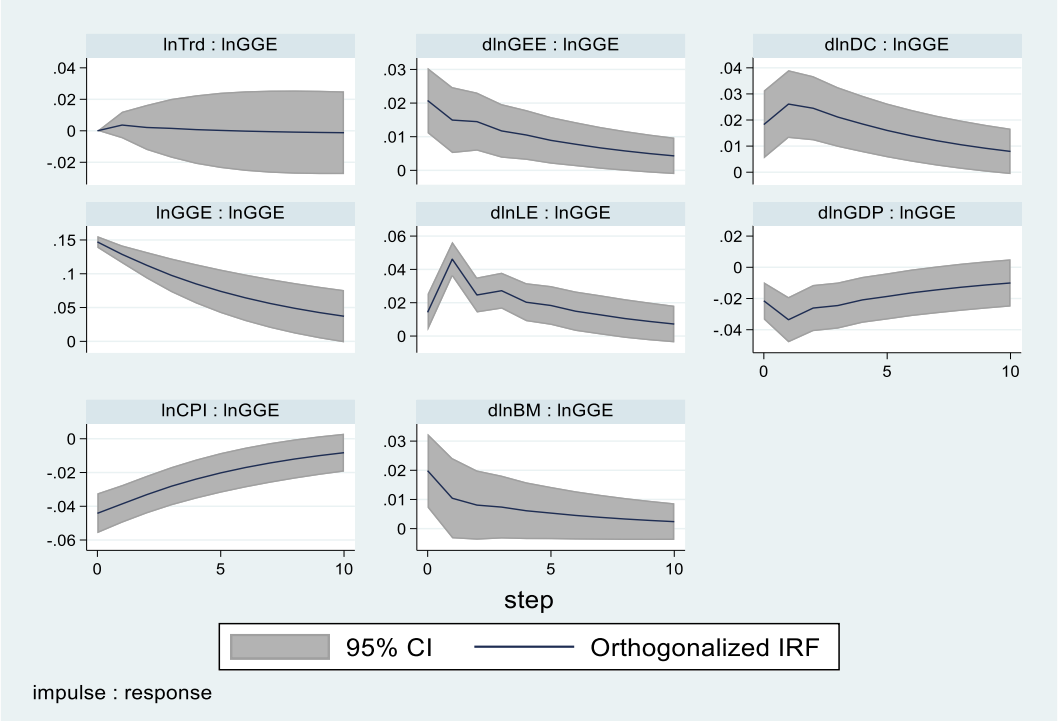

Figure 8: OIRF for GGE

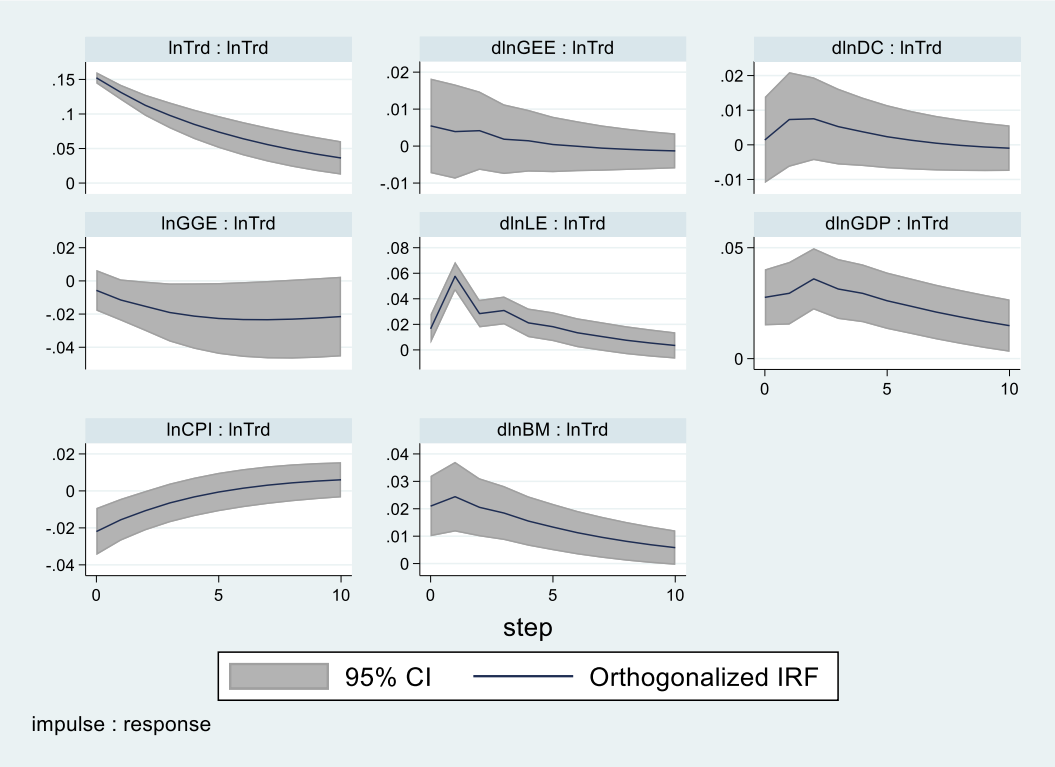

Figure 9: OIRF for Trd

Source: Author's generation from Stata 17

Appendix 2: ECOWAS Model OIRFs (CPI, GGE & Trd)

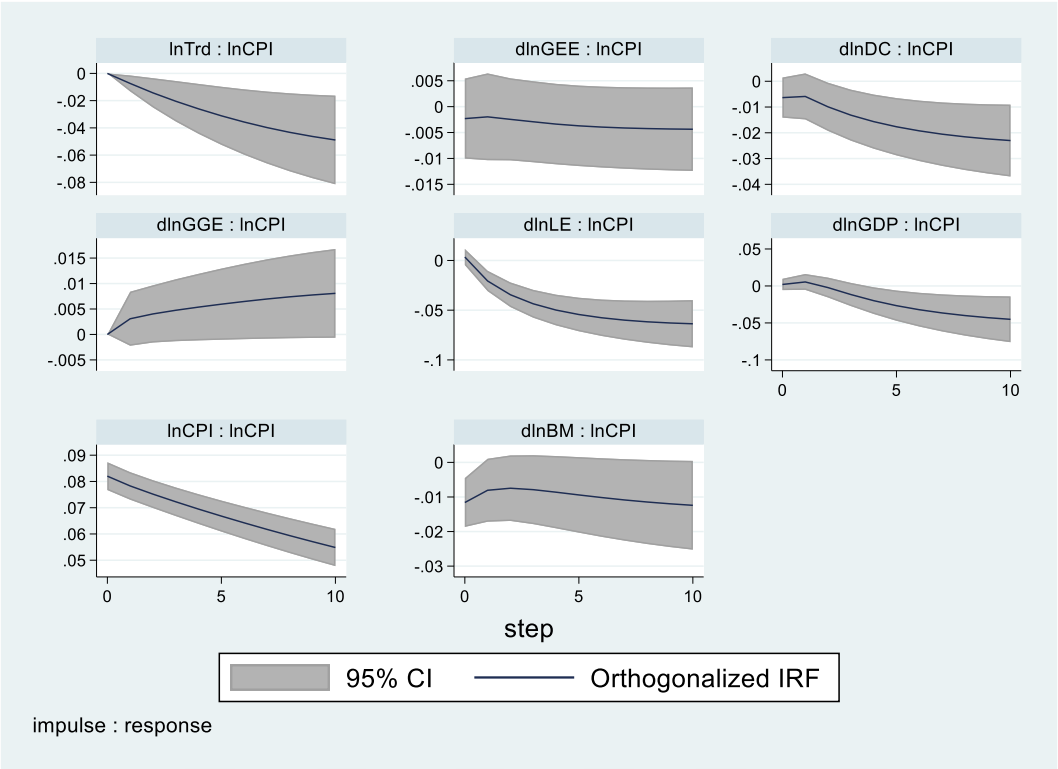

Figure 16: OIRF for CPI

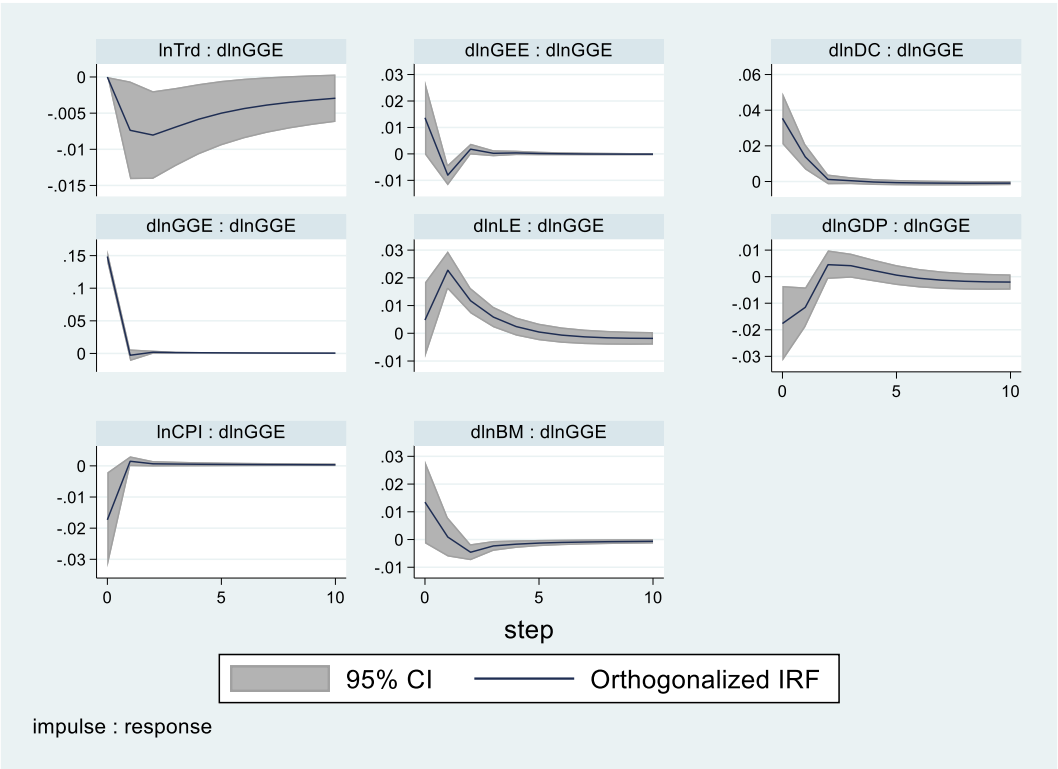

Figure 17: OIRF for GGE

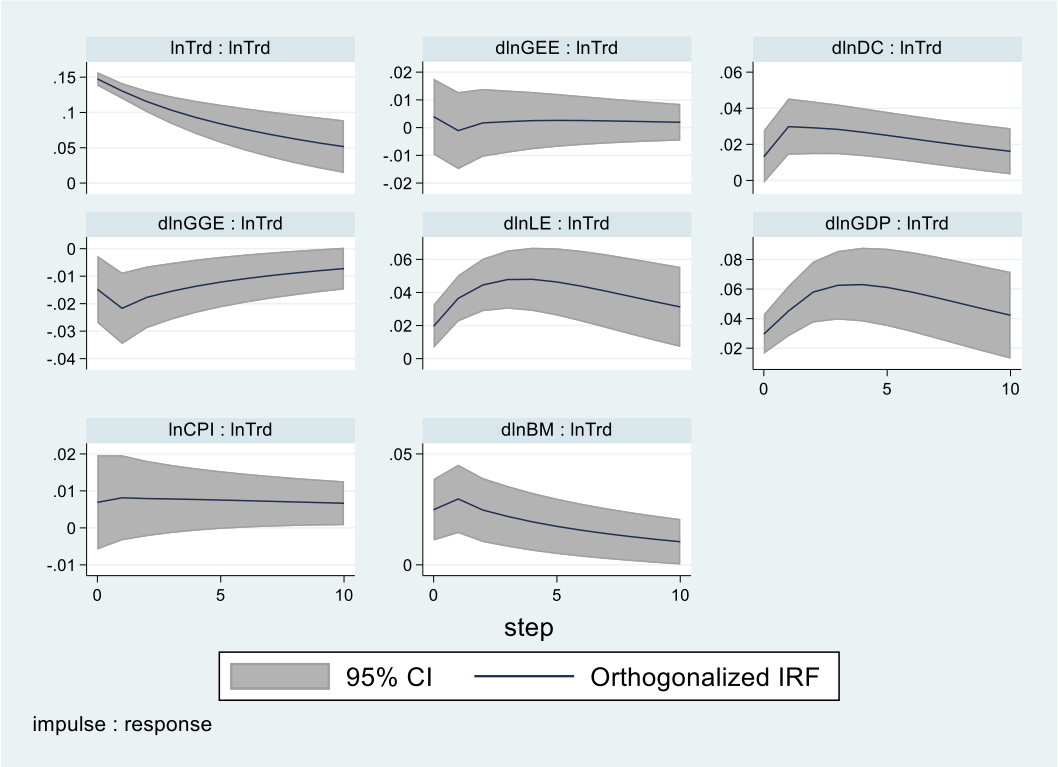

Figure 18: OIRF for Trd

Source: Author's generation from Stata 17

Appendix 3: FCFA Zone Model OIRFs (CPI, GGE & Trd)

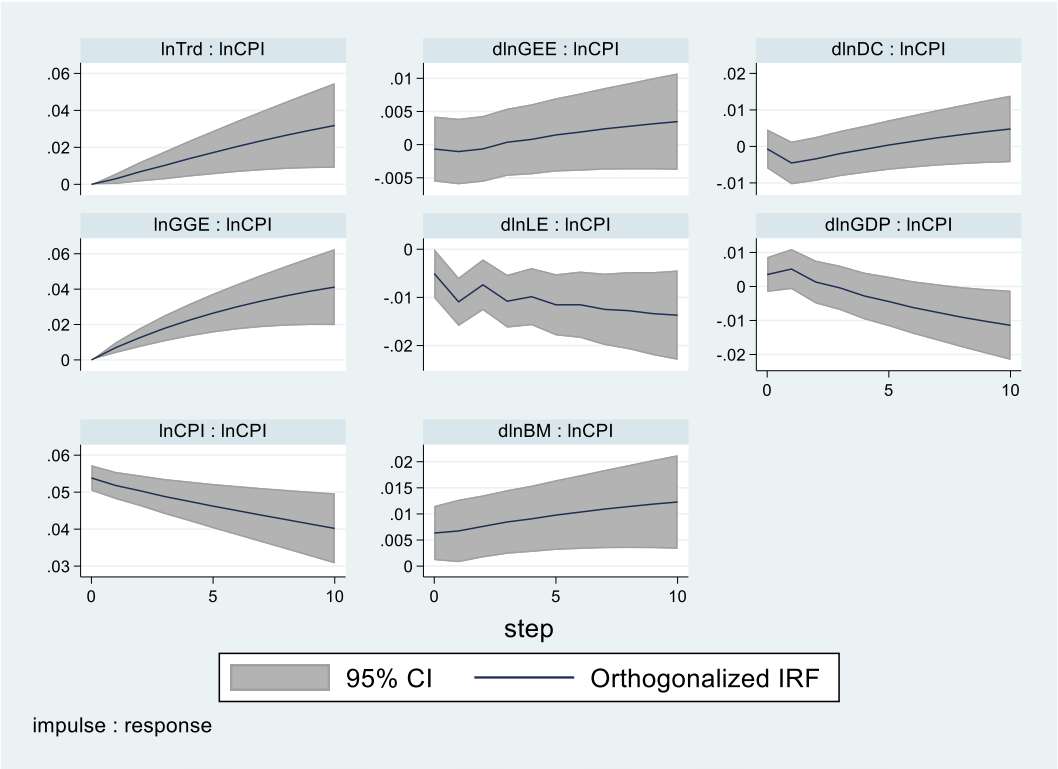

Figure 25: OIRF for CPI

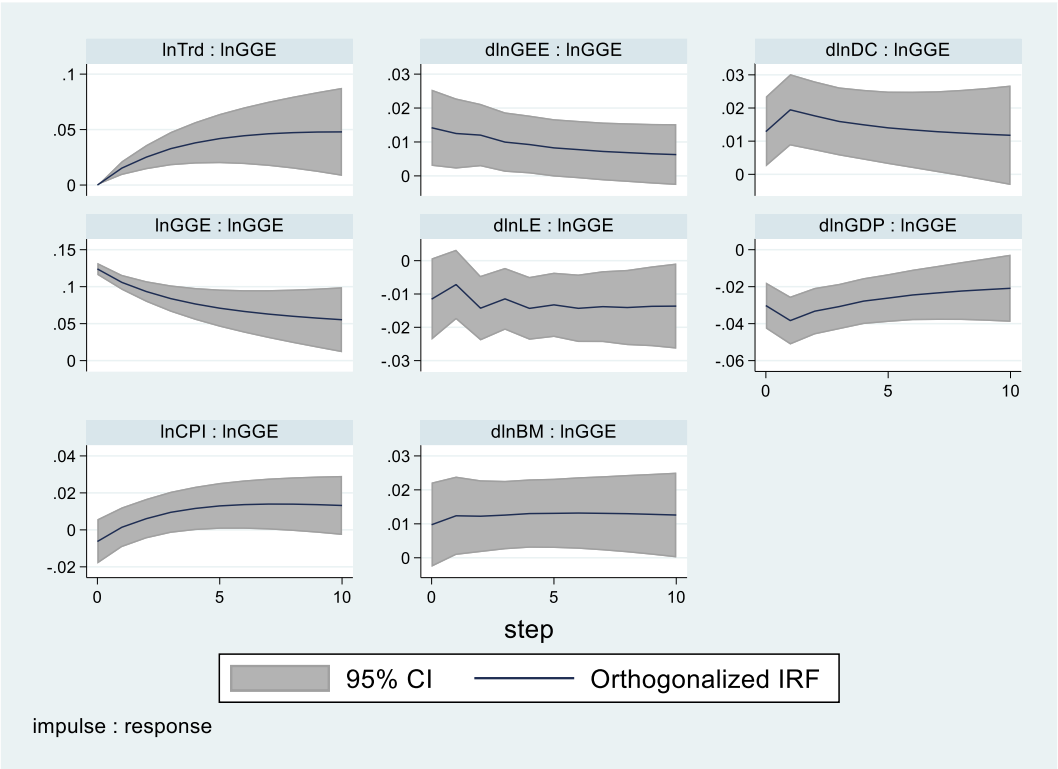

Figure 26: OIRF for GGE

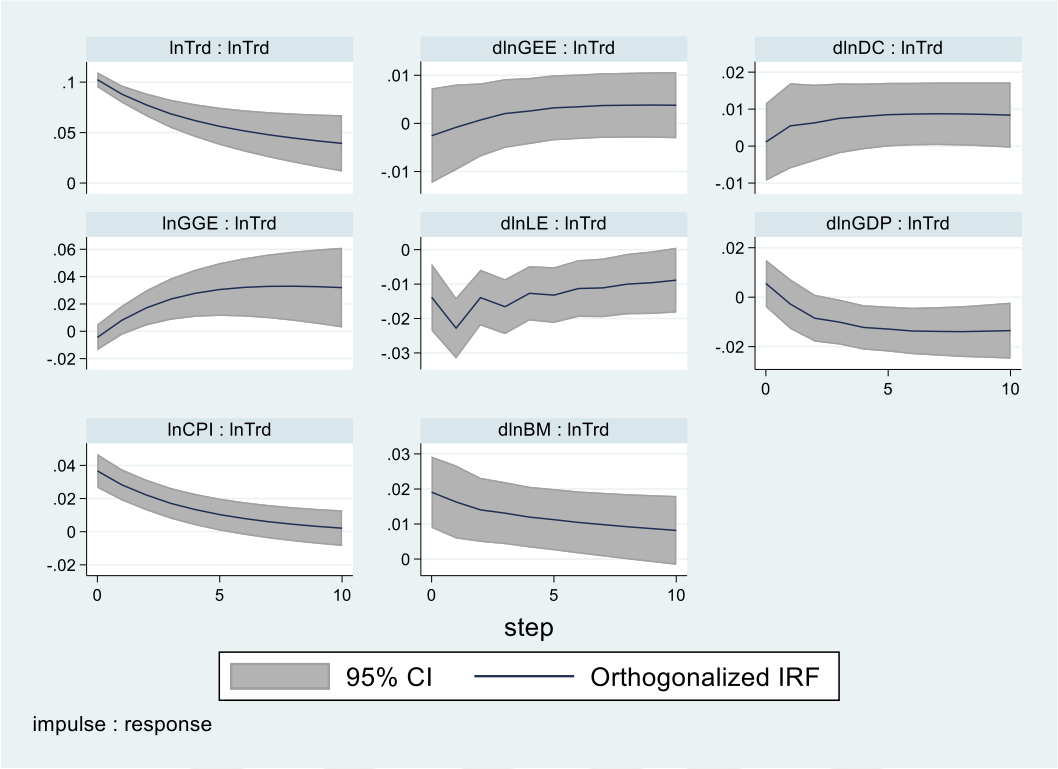

Figure 27: OIRF for Trd

Source: Author's generation from Stata 17

Appendix 4: BCEAO/WAEMU Zone Model OIRFs (CPI, GGE & Trd)

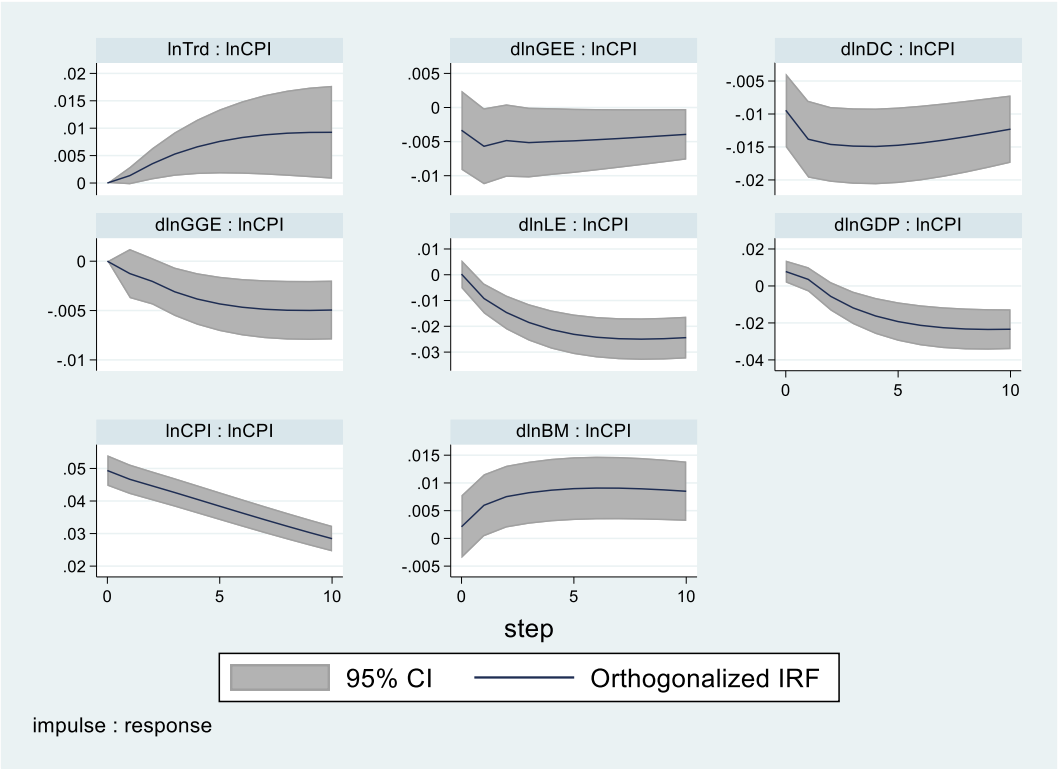

Figure 34: OIRF for CPI

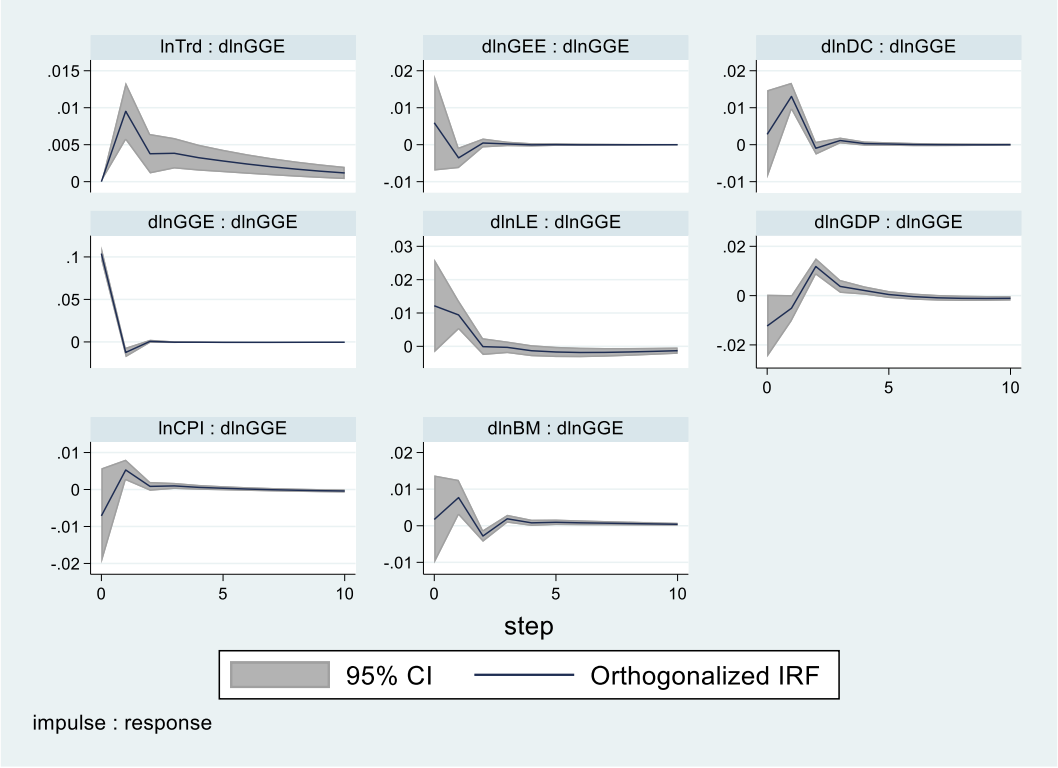

Figure 35: OIRF for GGE

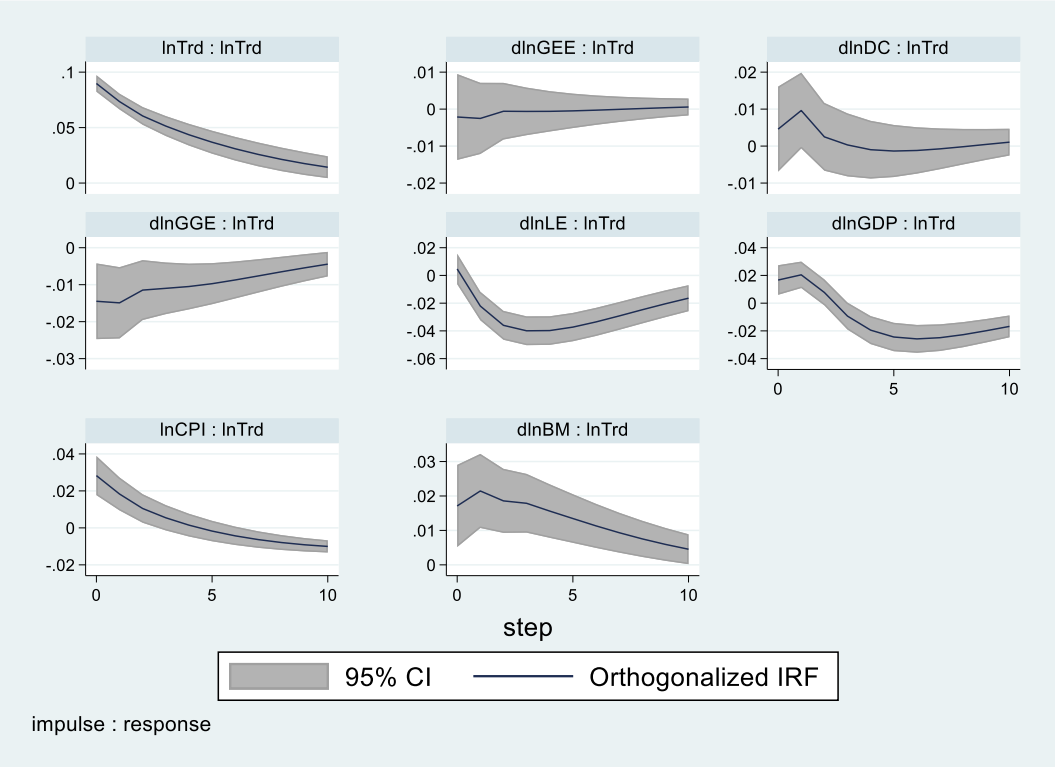

Figure 36: OIRF for Trd

Source: Author's generation from Stata 17

Appendix 5: BEAC/CEMAC Zone Model OIRFs (CPI, GGE & Trd)

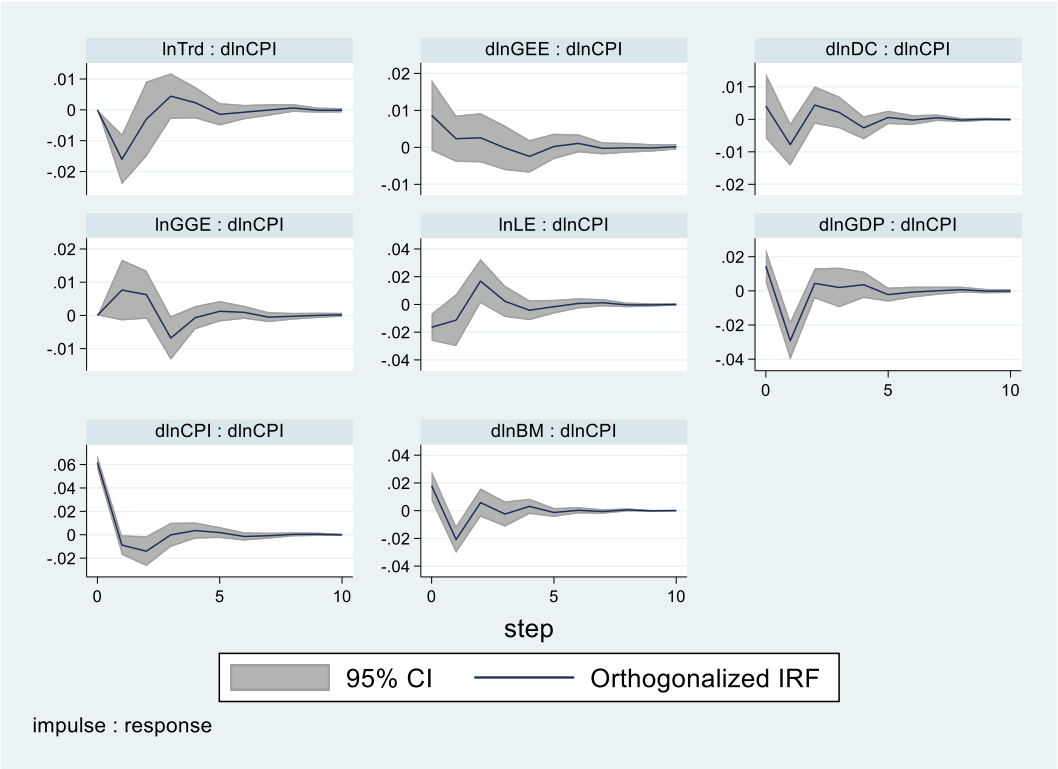

Figure 43: OIRF for CPI

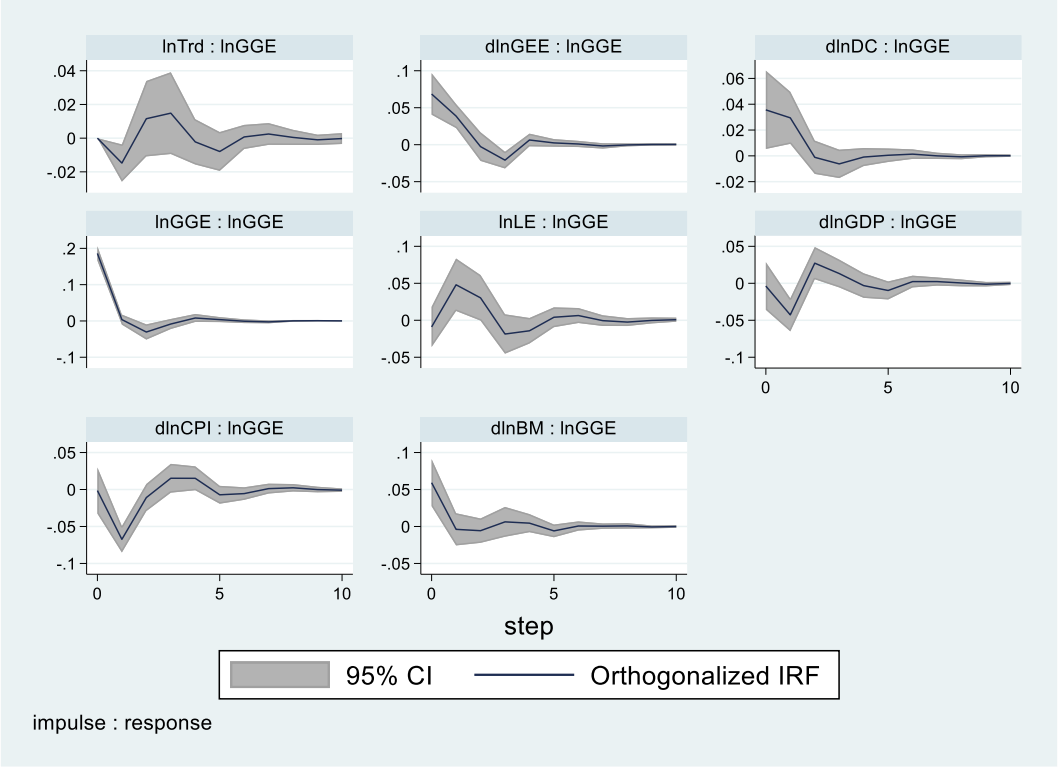

Figure 44: OIRF for GGE

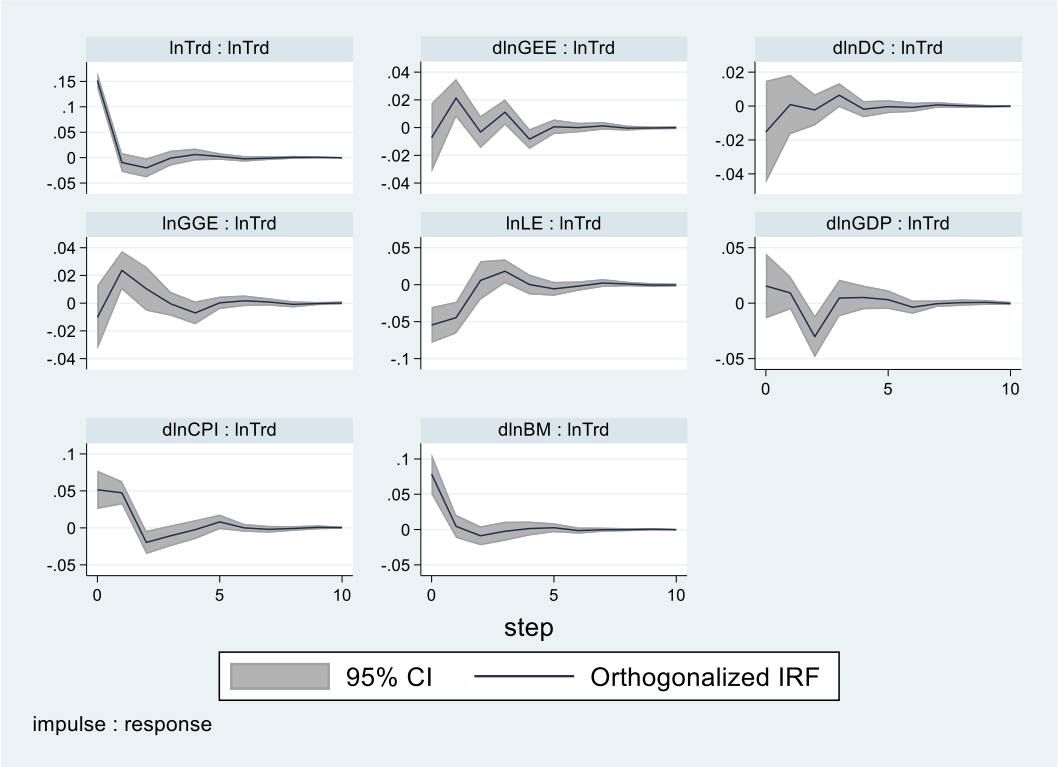

Figure 45: OIRF for Trd

Source: Author's generation from Stata 17

Appendix 6: WAMZ Zone Model OIRFs (CPI, GGE & Trd)

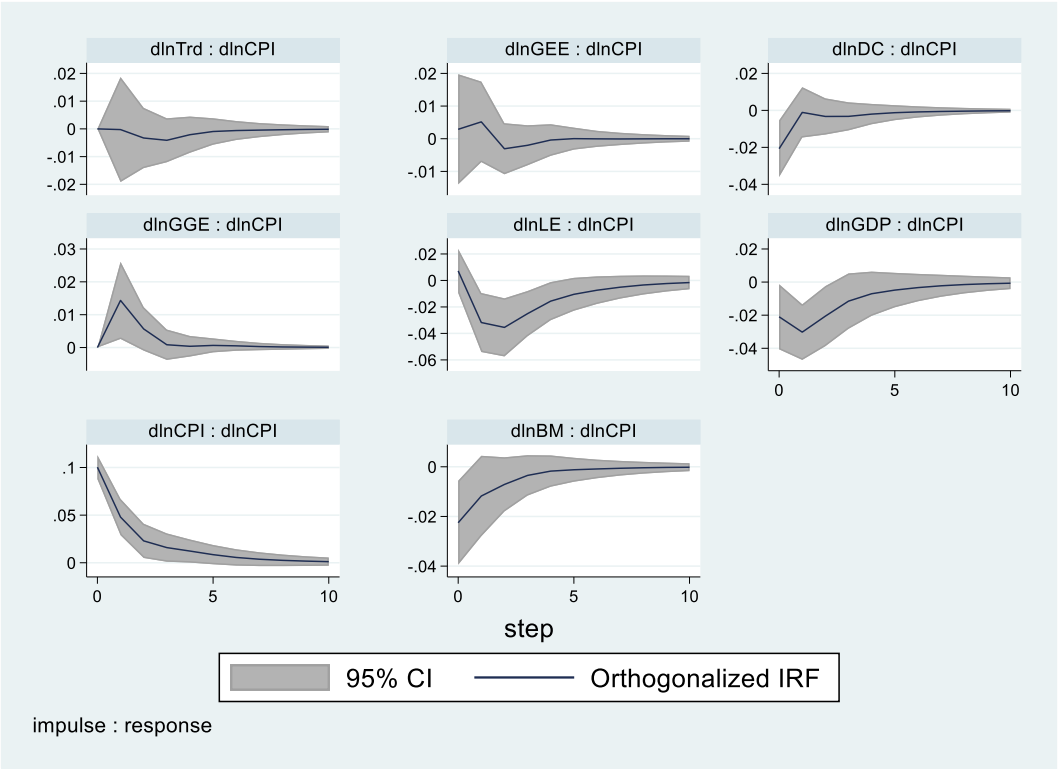

Figure 52: OIRF for CPI

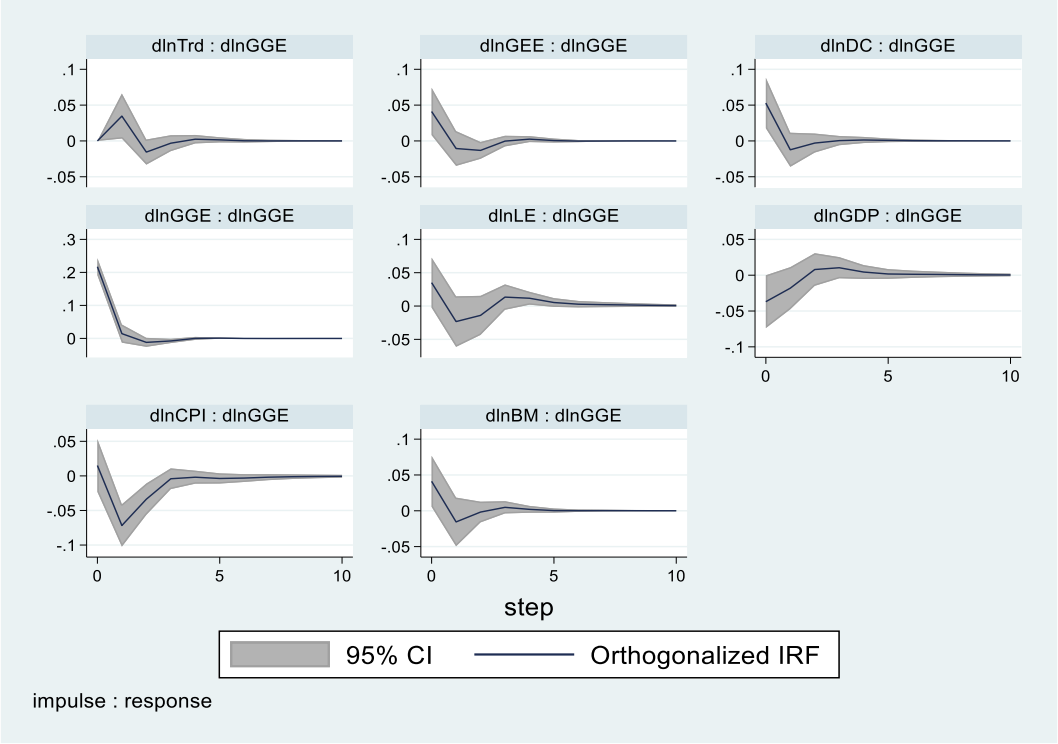

Figure 53: OIRF for GGE

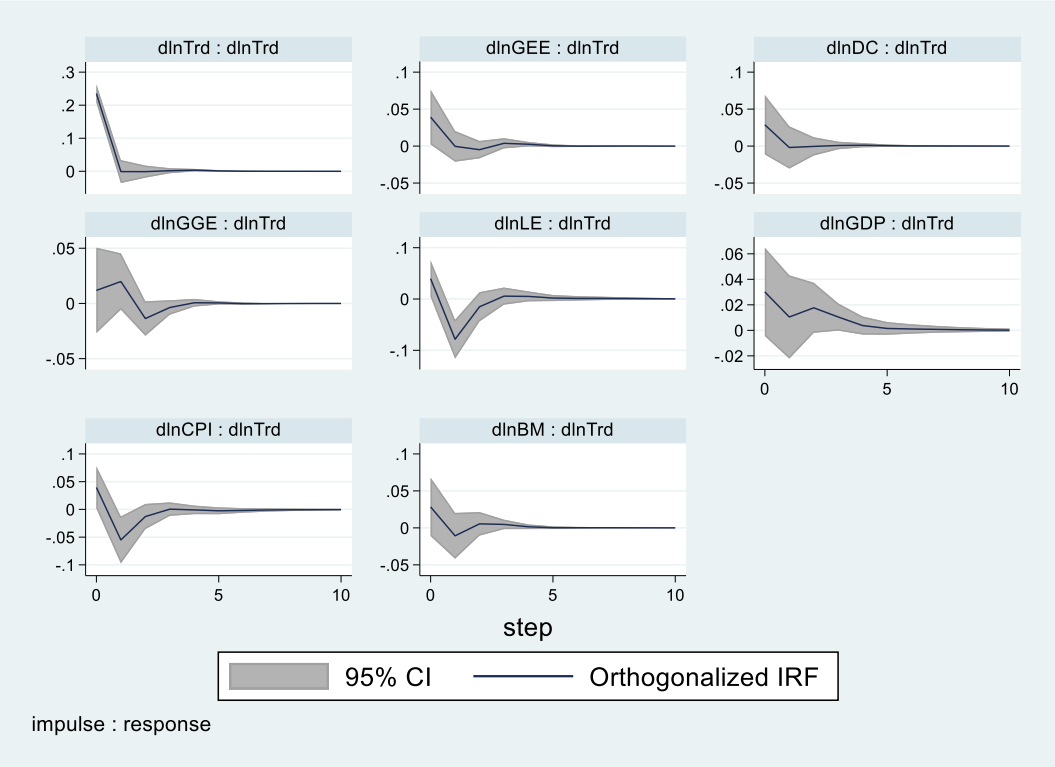

Figure 54: OIRF for Trd

Source: Author's generation from Stata 17

Appendix 7: FEVD for Global Model

Table 10: FEVD for Global Model

Response variable and Forecast horizon	Impulse variable							
	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	lnGGE	lnTrd
dlnGDP								
0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0
2	0,9642	0,0003	0,0115	0,0121	0,0002	0,000001	0,0015	0,0103
3	0,9489	0,0003	0,0123	0,0118	0,0002	0,00001	0,0033	0,0231
4	0,9345	0,0003	0,0126	0,0130	0,0002	0,00001	0,0052	0,0341
5	0,9244	0,0003	0,0127	0,0130	0,0002	0,00001	0,0071	0,0423
6	0,9162	0,0003	0,0127	0,0132	0,0002	0,00004	0,0088	0,0484
7	0,9100	0,0003	0,0128	0,0132	0,0002	0,0001	0,0104	0,0530
8	0,9051	0,0003	0,0128	0,0132	0,0002	0,0001	0,0119	0,0564
9	0,9013	0,0003	0,0128	0,0131	0,0002	0,0002	0,0132	0,0589
10	0,8982	0,0004	0,0128	0,0131	0,0002	0,0003	0,0143	0,0607
dlnDC								
0	0	0	0	0	0	0	0	0
1	0,0058	0,9942	0	0	0	0	0	0
2	0,0141	0,9559	0,00003	0,0111	0,0001	0,0021	0,0126	0,0040
3	0,0149	0,9384	0,0001	0,0116	0,0005	0,0039	0,0245	0,0062
4	0,0151	0,9246	0,0003	0,0137	0,0006	0,0051	0,0330	0,0077
5	0,0150	0,9158	0,0004	0,0144	0,0008	0,0059	0,0391	0,0086
6	0,0150	0,9092	0,0005	0,0152	0,0008	0,0065	0,0434	0,0093
7	0,0150	0,9047	0,0006	0,0156	0,0009	0,0069	0,0465	0,0098
8	0,0150	0,9014	0,0006	0,0160	0,0009	0,0072	0,0488	0,0102
9	0,0149	0,8991	0,0007	0,0162	0,0010	0,0073	0,0504	0,0105
10	0,0149	0,8974	0,0007	0,0163	0,0010	0,0075	0,0515	0,0107
dlnBM								
0	0	0	0	0	0	0	0	0
1	0,0339	0,1456	0,8204	0	0	0	0	0
2	0,0336	0,1450	0,8120	0,0019	0,0022	0,0003	0,000002	0,0050
3	0,0334	0,1441	0,8070	0,0047	0,0023	0,0004	0,0001	0,0079
4	0,0337	0,1438	0,8049	0,0047	0,0023	0,0005	0,0002	0,0098
5	0,0338	0,1434	0,8030	0,0051	0,0023	0,0005	0,0004	0,0114
6	0,0340	0,1432	0,8016	0,0052	0,0023	0,0006	0,0006	0,0126
7	0,0341	0,1430	0,8005	0,0053	0,0023	0,0006	0,0007	0,0135
8	0,0342	0,1428	0,7996	0,0054	0,0023	0,0006	0,0009	0,0142
9	0,0343	0,1427	0,7989	0,0055	0,0023	0,0006	0,0010	0,0147
10	0,0343	0,1426	0,7984	0,0055	0,0023	0,0006	0,0012	0,0151

dlnLE								
0	0	0	0	0	0	0	0	0
1	0,0075	0,0003	0,0007	0,9916	0	0	0	0
2	0,0333	0,0013	0,0006	0,9632	0,0007	0,0001	0,0004	0,0005
3	0,0328	0,0013	0,0009	0,9631	0,0009	0,0001	0,0004	0,0005
4	0,0331	0,0013	0,0009	0,9626	0,0010	0,0001	0,0004	0,0006
5	0,0331	0,0013	0,0009	0,9625	0,0010	0,0001	0,0004	0,0006
6	0,0331	0,0013	0,0009	0,9625	0,0010	0,0001	0,0004	0,0006
7	0,0331	0,0013	0,0009	0,9624	0,0010	0,0001	0,0004	0,0007
8	0,0331	0,0013	0,0009	0,9624	0,0010	0,0001	0,0004	0,0007
9	0,0331	0,0013	0,0009	0,9624	0,0010	0,0001	0,0004	0,0007
10	0,0331	0,0013	0,0009	0,9623	0,0010	0,0001	0,0004	0,0007
dlnGEE								
0	0	0	0	0	0	0	0	0
1	0,0108	0,0102	0,0063	0,0022	0,9705	0	0	0
2	0,0105	0,0161	0,0086	0,0026	0,9604	0,0001	0,0016	0,0001
3	0,0109	0,0162	0,0086	0,0040	0,9567	0,0002	0,0032	0,0001
4	0,0109	0,0162	0,0086	0,0040	0,9552	0,0003	0,0045	0,0002
5	0,0110	0,0162	0,0086	0,0042	0,9539	0,0004	0,0055	0,0002
6	0,0110	0,0162	0,0086	0,0042	0,9531	0,0004	0,0062	0,0002
7	0,0111	0,0163	0,0086	0,0043	0,9524	0,0005	0,0068	0,0002
8	0,0111	0,0163	0,0086	0,0043	0,9520	0,0005	0,0072	0,0002
9	0,0111	0,0163	0,0086	0,0043	0,9516	0,0005	0,0075	0,0002
10	0,0111	0,0163	0,0086	0,0043	0,9513	0,0005	0,0077	0,0002
lnCPI								
0	0	0	0	0	0	0	0	0
1	0,0091	0,0005	0,0035	0,0862	0,0051	0,8957	0	0
2	0,0070	0,0008	0,0013	0,3295	0,0038	0,6564	0,0001	0,0011
3	0,0149	0,0007	0,0009	0,3266	0,0043	0,6504	0,0001	0,0022
4	0,0177	0,0006	0,0007	0,3442	0,0042	0,6286	0,0002	0,0038
5	0,0209	0,0005	0,0006	0,3480	0,0042	0,6197	0,0003	0,0057
6	0,0230	0,0005	0,0006	0,3529	0,0042	0,6105	0,0005	0,0078
7	0,0250	0,0005	0,0006	0,3554	0,0042	0,6036	0,0007	0,0100
8	0,0267	0,0004	0,0006	0,3575	0,0041	0,5973	0,0010	0,0123
9	0,0282	0,0004	0,0007	0,3589	0,0041	0,5918	0,0013	0,0146
10	0,0296	0,0004	0,0007	0,3600	0,0041	0,5868	0,0017	0,0168
lnGGE								
0	0	0	0	0	0	0	0	0
1	0,0181	0,0131	0,0155	0,0080	0,0170	0,0768	0,8515	0
2	0,0333	0,0212	0,0105	0,0488	0,0137	0,0721	0,8001	0,0003
3	0,0356	0,0254	0,0089	0,0461	0,0136	0,0713	0,7988	0,0003
4	0,0378	0,0271	0,0082	0,0484	0,0132	0,0701	0,7949	0,0003
5	0,0388	0,0282	0,0078	0,0481	0,0131	0,0693	0,7945	0,0002
6	0,0397	0,0289	0,0075	0,0481	0,0129	0,0685	0,7942	0,0002

7	0,0403	0,0293	0,0073	0,0478	0,0129	0,0678	0,7943	0,0002
8	0,0408	0,0296	0,0072	0,0476	0,0128	0,0672	0,7946	0,0002
9	0,0412	0,0299	0,0071	0,0473	0,0128	0,0667	0,7949	0,0002
10	0,0416	0,0300	0,0070	0,0470	0,0127	0,0662	0,7953	0,0002
lnTrd								
0	0	0	0	0	0	0	0	0
1	0,0302	0,0001	0,0174	0,0108	0,0012	0,0191	0,0013	0,9199
2	0,0342	0,0012	0,0217	0,0754	0,0010	0,0152	0,0035	0,8479
3	0,0462	0,0018	0,0230	0,0695	0,0010	0,0133	0,0063	0,8389
4	0,0517	0,0019	0,0238	0,0708	0,0009	0,0117	0,0101	0,8293
5	0,0563	0,0018	0,0240	0,0684	0,0008	0,0105	0,0143	0,8239
6	0,0593	0,0017	0,0241	0,0667	0,0007	0,0097	0,0188	0,8191
7	0,0616	0,0017	0,0240	0,0647	0,0007	0,0092	0,0233	0,8149
8	0,0633	0,0016	0,0239	0,0631	0,0007	0,0089	0,0276	0,8109
9	0,0647	0,0015	0,0237	0,0616	0,0007	0,0088	0,0318	0,8072
10	0,0657	0,0015	0,0236	0,0604	0,0007	0,0088	0,0357	0,8037

Source: Author's compilation

Appendix 8: FEVD for ECOWAS Model

Table 18: FEVD for ECOWAS Model

Response variable and Forecast horizon	Impulse Variable							
	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	dlnGGE	lnTrd
dlnGDP								
0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0
2	0,9900	0,0007	0,0026	0,0022	0,0019	0,000005	0,000005	0,0027
3	0,9806	0,0015	0,0031	0,0053	0,0019	0,00002	0,00001	0,0075
4	0,9719	0,0022	0,0034	0,0082	0,0019	0,0000	0,0001	0,0124
5	0,9645	0,0027	0,0036	0,0105	0,0019	0,0001	0,0001	0,0167
6	0,9583	0,0031	0,0037	0,0123	0,0019	0,0001	0,0002	0,0203
7	0,9533	0,0035	0,0038	0,0138	0,0019	0,0001	0,0003	0,0234
8	0,9492	0,0037	0,0039	0,0149	0,0019	0,0001	0,0003	0,0260
9	0,9458	0,0039	0,0040	0,0158	0,0019	0,0001	0,0004	0,0281
10	0,9430	0,0041	0,0040	0,0165	0,0019	0,0001	0,0004	0,0298
dlnDC								
0	0	0	0	0	0	0	0	0
1	0,0041	0,9959	0	0	0	0	0	0
2	0,0282	0,9275	0,0030	0,0066	0,0003	0,00002	0,0008	0,0336
3	0,0306	0,8994	0,0042	0,0071	0,0005	0,00003	0,0016	0,0566
4	0,0300	0,8829	0,0050	0,0070	0,0005	0,00004	0,0021	0,0724
5	0,0304	0,8696	0,0056	0,0076	0,0005	0,00005	0,0024	0,0839
6	0,0319	0,8576	0,0060	0,0090	0,0005	0,0001	0,0026	0,0925
7	0,0340	0,8468	0,0063	0,0107	0,0005	0,0001	0,0028	0,0991
8	0,0363	0,8371	0,0065	0,0125	0,0005	0,0001	0,0029	0,1043
9	0,0386	0,8286	0,0066	0,0142	0,0005	0,0001	0,0030	0,1084
10	0,0408	0,8213	0,0068	0,0158	0,0005	0,0001	0,0030	0,1118
dlnBM								
0	0	0	0	0	0	0	0	0
1	0,0111	0,1377	0,8512	0	0	0	0	0
2	0,0160	0,1359	0,8375	0,0008	0,0005	0,0001	0,0038	0,0054
3	0,0179	0,1354	0,8307	0,0027	0,0006	0,0001	0,0040	0,0087
4	0,0199	0,1348	0,8251	0,0041	0,0006	0,0001	0,0040	0,0115
5	0,0215	0,1343	0,8205	0,0052	0,0006	0,0001	0,0041	0,0138
6	0,0229	0,1338	0,8166	0,0062	0,0006	0,0001	0,0041	0,0157
7	0,0241	0,1335	0,8134	0,0070	0,0006	0,0001	0,0041	0,0174
8	0,0250	0,1332	0,8107	0,0076	0,0006	0,0001	0,0041	0,0187
9	0,0259	0,1329	0,8084	0,0082	0,0006	0,0001	0,0041	0,0199
10	0,0265	0,1327	0,8065	0,0086	0,0006	0,0001	0,0041	0,0209

dlnLE								
0	0	0	0	0	0	0	0	0
1	0,0793	0,0125	0,0006	0,9077	0	0	0	0
2	0,1700	0,0214	0,0022	0,8032	0,0013	0,0001	0,0001	0,0018
3	0,2190	0,0242	0,0019	0,7490	0,0015	0,0001	0,0001	0,0042
4	0,2439	0,0255	0,0017	0,7195	0,0016	0,0002	0,0001	0,0075
5	0,2565	0,0262	0,0017	0,7023	0,0017	0,0002	0,0001	0,0113
6	0,2631	0,0268	0,0018	0,6911	0,0017	0,0003	0,0002	0,0152
7	0,2666	0,0272	0,0019	0,6831	0,0017	0,0003	0,0002	0,0191
8	0,2686	0,0275	0,0020	0,6770	0,0017	0,0003	0,0003	0,0226
9	0,2698	0,0277	0,0021	0,6721	0,0017	0,0004	0,0003	0,0259
10	0,2705	0,0279	0,0023	0,6681	0,0017	0,0004	0,0004	0,0288
dlnGEE								
0	0	0	0	0	0	0	0	0
1	0,0024	0,0163	0,0053	0,0002	0,9758	0	0	0
2	0,0024	0,0191	0,0055	0,0027	0,9697	0,000001	0,0006	0,0001
3	0,0031	0,0190	0,0055	0,0036	0,9678	0,00000	0,0006	0,0004
4	0,0034	0,0190	0,0055	0,0038	0,9671	0,00001	0,0006	0,0006
5	0,0035	0,0190	0,0055	0,0039	0,9668	0,00001	0,0006	0,0007
6	0,0035	0,0190	0,0055	0,0039	0,9667	0,00001	0,0006	0,0008
7	0,0035	0,0190	0,0055	0,0039	0,9666	0,00001	0,0006	0,0009
8	0,0035	0,0190	0,0055	0,0039	0,9666	0,00001	0,0006	0,0009
9	0,0035	0,0190	0,0055	0,0039	0,9665	0,00001	0,0006	0,0010
10	0,0035	0,0190	0,0055	0,0039	0,9665	0,00001	0,0006	0,0010
lnCPI								
0	0	0	0	0	0	0	0	0
1	0,0006	0,0058	0,0194	0,0017	0,0008	0,9717	0	0
2	0,0024	0,0055	0,0146	0,0320	0,0007	0,9402	0,0007	0,0040
3	0,0018	0,0083	0,0122	0,0778	0,0007	0,8856	0,0012	0,0124
4	0,0060	0,0120	0,0110	0,1222	0,0008	0,8229	0,0017	0,0234
5	0,0151	0,0157	0,0104	0,1599	0,0009	0,7598	0,0021	0,0360
6	0,0271	0,0192	0,0102	0,1902	0,0010	0,7006	0,0024	0,0493
7	0,0402	0,0222	0,0102	0,2140	0,0011	0,6470	0,0027	0,0627
8	0,0532	0,0248	0,0103	0,2324	0,0012	0,5994	0,0030	0,0757
9	0,0656	0,0270	0,0104	0,2467	0,0012	0,5574	0,0032	0,0883
10	0,0771	0,0290	0,0106	0,2577	0,0013	0,5205	0,0035	0,1002
dlnGGE								
0	0	0	0	0	0	0	0	0
1	0,0128	0,0516	0,0075	0,0009	0,0077	0,0123	0,9072	0
2	0,0176	0,0571	0,0072	0,0214	0,0099	0,0119	0,8727	0,0021
3	0,0182	0,0566	0,0080	0,0265	0,0100	0,0118	0,8642	0,0046
4	0,0188	0,0564	0,0082	0,0278	0,0099	0,0118	0,8607	0,0065
5	0,0189	0,0563	0,0082	0,0279	0,0099	0,0118	0,8591	0,0078
6	0,0189	0,0562	0,0083	0,0279	0,0099	0,0118	0,8582	0,0088

7	0,0189	0,0562	0,0083	0,0279	0,0099	0,0118	0,8574	0,0095
8	0,0190	0,0562	0,0084	0,0280	0,0099	0,0118	0,8568	0,0101
9	0,0191	0,0562	0,0084	0,0280	0,0099	0,0118	0,8561	0,0105
10	0,0192	0,0562	0,0084	0,0281	0,0099	0,0118	0,8555	0,0109
lnTrd								
0	0	0	0	0	0	0	0	0
1	0,0362	0,0072	0,0257	0,0159	0,0007	0,0020	0,0091	0,9034
2	0,0622	0,0227	0,0321	0,0366	0,0004	0,0024	0,0147	0,8290
3	0,0931	0,0284	0,0313	0,0549	0,0003	0,0026	0,0149	0,7744
4	0,1187	0,0316	0,0302	0,0697	0,0003	0,0028	0,0145	0,7322
5	0,1387	0,0336	0,0291	0,0812	0,0003	0,0029	0,0140	0,7002
6	0,1541	0,0349	0,0281	0,0898	0,0003	0,0030	0,0136	0,6761
7	0,1659	0,0358	0,0274	0,0964	0,0003	0,0032	0,0132	0,6578
8	0,1749	0,0365	0,0268	0,1013	0,0004	0,0033	0,0130	0,6438
9	0,1819	0,0369	0,0264	0,1051	0,0004	0,0035	0,0127	0,6331
10	0,1874	0,0373	0,0260	0,1079	0,0004	0,0036	0,0126	0,6249

Source: Author's compilation

Appendix 9: FEVD for FCFA Model

Table 26: FEVD for FCFA Model

Response variable and Forecast horizon		Impulse variable							
		dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	lnGGE	lnTrd
dlnGDP									
	0	0	0	0	0	0	0	0	0
	1	1	0	0	0	0	0	0	0
	2	0,9701	0,0010	0,0085	0,0009	0,0053	0,0009	0,0087	0,0045
	3	0,9594	0,0010	0,0086	0,0010	0,0053	0,0015	0,0150	0,0083
	4	0,9529	0,0010	0,0085	0,0011	0,0054	0,0018	0,0189	0,0103
	5	0,9493	0,0011	0,0085	0,0011	0,0054	0,0019	0,0213	0,0114
	6	0,9473	0,0011	0,0085	0,0011	0,0055	0,0019	0,0229	0,0119
	7	0,9461	0,0011	0,0084	0,0011	0,0055	0,0019	0,0239	0,0121
	8	0,9453	0,0011	0,0084	0,0011	0,0055	0,0019	0,0246	0,0121
	9	0,9447	0,0011	0,0084	0,0011	0,0055	0,0019	0,0251	0,0121
	10	0,9443	0,0011	0,0084	0,0011	0,0055	0,0020	0,0255	0,0121
dlnDC									
	0	0	0	0	0	0	0	0	0
	1	0,0009	0,9991	0	0	0	0	0	0
	2	0,0292	0,9295	0,0001	0,0381	0,0028	0,0000	0,0001	0,0001
	3	0,0289	0,9164	0,0001	0,0486	0,0038	0,0001	0,0008	0,0013
	4	0,0293	0,9102	0,0002	0,0535	0,0039	0,0001	0,0011	0,0017
	5	0,0292	0,9081	0,0002	0,0550	0,0039	0,0001	0,0013	0,0021
	6	0,0293	0,9071	0,0002	0,0557	0,0039	0,0001	0,0014	0,0023
	7	0,0293	0,9067	0,0002	0,0559	0,0039	0,0001	0,0015	0,0024
	8	0,0293	0,9064	0,0002	0,0560	0,0039	0,0001	0,0015	0,0024
	9	0,0293	0,9063	0,0002	0,0561	0,0039	0,0002	0,0016	0,0025
	10	0,0293	0,9063	0,0002	0,0561	0,0039	0,0002	0,0016	0,0025
dlnBM									
	0	0	0	0	0	0	0	0	0
	1	0,0291	0,1397	0,8313	0	0	0	0	0
	2	0,0294	0,1363	0,7997	0,0219	0,0073	0,0001	0,0052	0,0001
	3	0,0297	0,1349	0,7912	0,0274	0,0078	0,0001	0,0077	0,0011
	4	0,0295	0,1341	0,7854	0,0310	0,0081	0,0001	0,0099	0,0018
	5	0,0299	0,1336	0,7822	0,0315	0,0081	0,0001	0,0117	0,0029
	6	0,0299	0,1332	0,7794	0,0322	0,0081	0,0001	0,0133	0,0038
	7	0,0301	0,1328	0,7771	0,0321	0,0081	0,0001	0,0147	0,0049
	8	0,0302	0,1325	0,7750	0,0323	0,0081	0,0001	0,0160	0,0058
	9	0,0303	0,1323	0,7732	0,0322	0,0081	0,0002	0,0171	0,0067
	10	0,0304	0,1320	0,7714	0,0322	0,0081	0,0002	0,0181	0,0076
dlnLE									

	0	0	0	0	0	0	0	0
	1	0,0004	0,0022	0,0020	0,9953	0	0	0	0
	2	0,0245	0,0029	0,0032	0,9641	0,0004	0,0013	0,0001	0,0036
	3	0,0249	0,0029	0,0034	0,9627	0,0011	0,0011	0,0006	0,0033
	4	0,0263	0,0028	0,0033	0,9597	0,0013	0,0015	0,0009	0,0042
	5	0,0261	0,0029	0,0035	0,9589	0,0015	0,0015	0,0014	0,0043
	6	0,0265	0,0028	0,0034	0,9575	0,0015	0,0017	0,0017	0,0049
	7	0,0264	0,0029	0,0035	0,9566	0,0016	0,0017	0,0022	0,0052
	8	0,0265	0,0029	0,0035	0,9554	0,0016	0,0019	0,0026	0,0056
	9	0,0265	0,0029	0,0035	0,9545	0,0016	0,0019	0,0031	0,0060
	10	0,0266	0,0029	0,0036	0,9535	0,0016	0,0020	0,0035	0,0064
dlnGEE									
	0	0	0	0	0	0	0	0	0
	1	0,0184	0,0083	0,0040	0,0000002	0,9692	0	0	0
	2	0,0263	0,0092	0,0038	0,0013	0,9594	0,00001	0,00002	0,00001
	3	0,0263	0,0092	0,0038	0,0016	0,9590	0,00002	0,00004	0,0001
	4	0,0263	0,0092	0,0038	0,0018	0,9588	0,00002	0,00004	0,0001
	5	0,0263	0,0092	0,0038	0,0018	0,9587	0,00002	0,00005	0,0001
	6	0,0263	0,0092	0,0038	0,0018	0,9587	0,00002	0,00005	0,0001
	7	0,0263	0,0092	0,0038	0,0018	0,9587	0,00002	0,0001	0,0001
	8	0,0263	0,0092	0,0038	0,0018	0,9587	0,00002	0,0001	0,0001
	9	0,0263	0,0092	0,0038	0,0018	0,9587	0,00002	0,0001	0,0001
	10	0,0263	0,0092	0,0038	0,0018	0,9587	0,00002	0,0001	0,0001
lnCPI									
	0	0	0	0	0	0	0	0	0
	1	0,0041	0,0001	0,0135	0,0085	0,0001	0,9736	0	0
	2	0,0065	0,0035	0,0144	0,0244	0,0003	0,9412	0,0082	0,0015
	3	0,0046	0,0037	0,0163	0,0226	0,0002	0,9226	0,0237	0,0063
	4	0,0034	0,0031	0,0182	0,0268	0,0002	0,8902	0,0446	0,0136
	5	0,0032	0,0025	0,0199	0,0276	0,0002	0,8544	0,0687	0,0235
	6	0,0037	0,0020	0,0215	0,0298	0,0003	0,8133	0,0942	0,0353
	7	0,0048	0,0018	0,0228	0,0309	0,0004	0,7710	0,1198	0,0486
	8	0,0063	0,0017	0,0239	0,0322	0,0005	0,7280	0,1445	0,0627
	9	0,0082	0,0018	0,0249	0,0331	0,0007	0,6861	0,1678	0,0773
	10	0,0101	0,0021	0,0257	0,0340	0,0009	0,6458	0,1895	0,0919
lnGGE									
	0	0	0	0	0	0	0	0	0
	1	0,0539	0,0098	0,0056	0,0079	0,0119	0,0023	0,9086	0
	2	0,0779	0,0178	0,0081	0,0060	0,0117	0,0014	0,8694	0,0076
	3	0,0833	0,0204	0,0095	0,0093	0,0120	0,0019	0,8429	0,0207
	4	0,0858	0,0215	0,0108	0,0101	0,0116	0,0033	0,8193	0,0377
	5	0,0860	0,0220	0,0120	0,0120	0,0113	0,0050	0,7957	0,0561
	6	0,0856	0,0222	0,0130	0,0131	0,0110	0,0069	0,7734	0,0749
	7	0,0847	0,0223	0,0140	0,0144	0,0106	0,0086	0,7523	0,0931

	8	0,0838	0,0223	0,0148	0,0154	0,0103	0,0102	0,7330	0,1103
	9	0,0827	0,0223	0,0155	0,0164	0,0100	0,0115	0,7154	0,1262
	10	0,0818	0,0222	0,0161	0,0172	0,0098	0,0126	0,6996	0,1408
lnTrd									
	0	0	0	0	0	0	0	0	0
	1	0,0025	0,0001	0,0293	0,0153	0,0005	0,1080	0,0016	0,8427
	2	0,0018	0,0014	0,0288	0,0325	0,0003	0,0979	0,0039	0,8335
	3	0,0038	0,0024	0,0283	0,0310	0,0003	0,0903	0,0130	0,8309
	4	0,0060	0,0036	0,0283	0,0334	0,0003	0,0828	0,0264	0,8192
	5	0,0089	0,0047	0,0281	0,0330	0,0005	0,0764	0,0420	0,8064
	6	0,0117	0,0058	0,0279	0,0334	0,0006	0,0708	0,0582	0,7916
	7	0,0144	0,0068	0,0277	0,0331	0,0008	0,0659	0,0740	0,7772
	8	0,0169	0,0077	0,0275	0,0329	0,0010	0,0618	0,0888	0,7632
	9	0,0193	0,0086	0,0273	0,0326	0,0012	0,0583	0,1023	0,7504
	10	0,0214	0,0093	0,0271	0,0324	0,0014	0,0553	0,1144	0,7388

Source: Author's compilation

Appendix 10: FEVD for WAEMU Model

Table 34: FEVD for WAEMU/BCEAO Model

Response variable and Forecast horizon	Impulse variable							
	dlnGDP	dlnDC	dlnBM	dlnLE	dlnGEE	lnCPI	dlnGGE	lnTrd
dlnGDP								
0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0
2	0,9894	0,0004	0,0008	0,0015	0,0014	0,0004	0,0039	0,0022
3	0,9843	0,0008	0,0011	0,0019	0,0014	0,0012	0,0039	0,0055
4	0,9811	0,0009	0,0013	0,0019	0,0014	0,0016	0,0038	0,0081
5	0,9783	0,0009	0,0015	0,0021	0,0013	0,0020	0,0038	0,0100
6	0,9758	0,0009	0,0016	0,0027	0,0013	0,0021	0,0039	0,0115
7	0,9737	0,0009	0,0018	0,0035	0,0013	0,0022	0,0039	0,0127
8	0,9718	0,0009	0,0019	0,0043	0,0013	0,0023	0,0040	0,0135
9	0,9704	0,0009	0,0020	0,0050	0,0013	0,0023	0,0040	0,0141
10	0,9692	0,0009	0,0021	0,0056	0,0013	0,0023	0,0040	0,0145
dlnDC								
0	0	0	0	0	0	0	0	0
1	0,0132	0,9868	0	0	0	0	0	0
2	0,2159	0,6915	0,0218	0,0355	0,0005	0,0090	0,0034	0,0224
3	0,2142	0,6834	0,0225	0,0362	0,0011	0,0108	0,0044	0,0275
4	0,2145	0,6795	0,0227	0,0360	0,0011	0,0116	0,0045	0,0302
5	0,2143	0,6771	0,0228	0,0363	0,0011	0,0120	0,0045	0,0320
6	0,2136	0,6751	0,0229	0,0369	0,0011	0,0123	0,0046	0,0334
7	0,2132	0,6734	0,0230	0,0377	0,0011	0,0125	0,0046	0,0345
8	0,2130	0,6717	0,0231	0,0386	0,0011	0,0126	0,0047	0,0352
9	0,2129	0,6703	0,0232	0,0394	0,0011	0,0127	0,0047	0,0357
10	0,2130	0,6690	0,0232	0,0401	0,0011	0,0127	0,0048	0,0361
dlnBM								
0	0	0	0	0	0	0	0	0
1	0,000005	0,0968	0,9032	0	0	0	0	0
2	0,0228	0,0977	0,8682	0,0050	0,0000	0,0007	0,0056	0,00005
3	0,0242	0,0975	0,8660	0,0052	0,0001	0,0007	0,0058	0,0005
4	0,0243	0,0974	0,8653	0,0057	0,0001	0,0007	0,0058	0,0006
5	0,0245	0,0974	0,8648	0,0059	0,0001	0,0008	0,0058	0,0008
6	0,0247	0,0973	0,8644	0,0060	0,0001	0,0008	0,0058	0,0009
7	0,0248	0,0973	0,8641	0,0061	0,0001	0,0008	0,0058	0,0010
8	0,0248	0,0973	0,8639	0,0062	0,0001	0,0009	0,0058	0,0010
9	0,0249	0,0973	0,8638	0,0062	0,0001	0,0009	0,0058	0,0010
10	0,0249	0,0973	0,8637	0,0062	0,0001	0,0010	0,0058	0,0010
dlnLE								
0	0	0	0	0	0	0	0	0
1	0,0867	0,0681	0,0020	0,8432	0	0	0	0
2	0,3140	0,0502	0,0130	0,6160	0,00005	0,0014	0,0025	0,0028
3	0,3915	0,0448	0,0128	0,5390	0,0004	0,0023	0,0044	0,0047
4	0,4232	0,0425	0,0129	0,5065	0,0005	0,0029	0,0055	0,0059
5	0,4375	0,0414	0,0129	0,4913	0,0006	0,0034	0,0061	0,0067

6	0,4446	0,0409	0,0130	0,4835	0,0006	0,0037	0,0065	0,0073
7	0,4482	0,0405	0,0131	0,4792	0,0007	0,0040	0,0067	0,0077
8	0,4501	0,0403	0,0132	0,4767	0,0007	0,0041	0,0068	0,0081
9	0,4511	0,0402	0,0132	0,4752	0,0007	0,0043	0,0069	0,0084
10	0,4517	0,0402	0,0132	0,4743	0,0007	0,0044	0,0069	0,0086
dlnGEE								
0	0	0	0	0	0	0	0	0
1	0,0006	0,0115	0,0004	0,0053	0,9823	0	0	0
2	0,0504	0,0123	0,0026	0,0088	0,9251	0,0000004	0,0007	0,0001
3	0,0585	0,0121	0,0026	0,0095	0,9164	0,00002	0,0008	0,0001
4	0,0618	0,0122	0,0026	0,0102	0,9122	0,00002	0,0008	0,0001
5	0,0631	0,0123	0,0026	0,0105	0,9105	0,00003	0,0009	0,0002
6	0,0637	0,0123	0,0026	0,0106	0,9098	0,00003	0,0009	0,0002
7	0,0640	0,0123	0,0026	0,0106	0,9094	0,00004	0,0009	0,0002
8	0,0641	0,0123	0,0026	0,0106	0,9093	0,00004	0,0009	0,0002
9	0,0642	0,0123	0,0026	0,0107	0,9092	0,0001	0,0009	0,0002
10	0,0642	0,0123	0,0026	0,0107	0,9091	0,0001	0,0009	0,0002
lnCPI								
0	0	0	0	0	0	0	0	0
1	0,0233	0,0342	0,0017	0,00003	0,0043	0,9365	0	0
2	0,0143	0,0545	0,0078	0,0165	0,0085	0,8978	0,0003	0,0004
3	0,0136	0,0642	0,0126	0,0389	0,0087	0,8594	0,0007	0,0018
4	0,0238	0,0691	0,0159	0,0620	0,0090	0,8146	0,0015	0,0041
5	0,0390	0,0717	0,0184	0,0836	0,0091	0,7695	0,0023	0,0065
6	0,0556	0,0728	0,0202	0,1026	0,0090	0,7277	0,0031	0,0090
7	0,0717	0,0732	0,0217	0,1189	0,0088	0,6906	0,0038	0,0114
8	0,0866	0,0731	0,0228	0,1327	0,0087	0,6582	0,0044	0,0136
9	0,0998	0,0727	0,0236	0,1444	0,0085	0,6304	0,0050	0,0156
10	0,1115	0,0722	0,0243	0,1543	0,0084	0,6065	0,0055	0,0173
dlnGGE								
0	0	0	0	0	0	0	0	0
1	0,0135	0,0007	0,0003	0,0132	0,0031	0,0045	0,9646	0
2	0,0150	0,0151	0,0053	0,0200	0,0040	0,0067	0,9262	0,0077
3	0,0265	0,0150	0,0059	0,0198	0,0040	0,0066	0,9136	0,0088
4	0,0276	0,0150	0,0061	0,0197	0,0040	0,0067	0,9109	0,0100
5	0,0279	0,0150	0,0062	0,0198	0,0040	0,0067	0,9096	0,0108
6	0,0279	0,0150	0,0062	0,0200	0,0040	0,0067	0,9087	0,0115
7	0,0279	0,0150	0,0063	0,0203	0,0040	0,0067	0,9079	0,0119
8	0,0279	0,0150	0,0063	0,0206	0,0040	0,0067	0,9073	0,0122
9	0,0280	0,0150	0,0064	0,0208	0,0040	0,0067	0,9067	0,0125
10	0,0281	0,0150	0,0064	0,0210	0,0040	0,0067	0,9063	0,0126
lnTrd								
0	0	0	0	0	0	0	0	0
1	0,0287	0,0022	0,0302	0,0023	0,0005	0,0826	0,0217	0,8320
2	0,0407	0,0066	0,0440	0,0297	0,0006	0,0664	0,0253	0,7866
3	0,0333	0,0053	0,0483	0,0794	0,0005	0,0549	0,0248	0,7535
4	0,0307	0,0044	0,0515	0,1234	0,0004	0,0464	0,0249	0,7183
5	0,0385	0,0038	0,0524	0,1569	0,0004	0,0403	0,0250	0,6827
6	0,0514	0,0035	0,0521	0,1801	0,0003	0,0363	0,0251	0,6511
7	0,0647	0,0032	0,0515	0,1955	0,0003	0,0339	0,0252	0,6257
8	0,0763	0,0031	0,0507	0,2053	0,0003	0,0330	0,0252	0,6063
9	0,0853	0,0029	0,0499	0,2113	0,0003	0,0331	0,0251	0,5920

10	0,0919	0,0029	0,0493	0,2147	0,0003	0,0341	0,0251	0,5819

Source: Author's compilation

Appendix 11: FEVD for CEMAC Model

Table 42: FEVD for BEAC Model

Response variable and Forecast horizon	Impulse variable							
	dlnGDP	dlnDC	dlnBM	lnLE	dlnGEE	dlnCPI	lnGGE	lnTrd
dlnGDP								
0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0
2	0,7517	0,0015	0,0211	0,0580	0,1243	0,0258	0,0062	0,0114
3	0,6609	0,0014	0,0200	0,0573	0,1797	0,0500	0,0148	0,0160
4	0,6240	0,0016	0,0225	0,0610	0,1775	0,0797	0,0139	0,0199
5	0,6197	0,0027	0,0239	0,0619	0,1777	0,0787	0,0138	0,0216
6	0,6172	0,0030	0,0239	0,0627	0,1785	0,0785	0,0145	0,0217
7	0,6165	0,0030	0,0240	0,0628	0,1784	0,0789	0,0147	0,0216
8	0,6164	0,0030	0,0241	0,0628	0,1783	0,0789	0,0147	0,0217
9	0,6164	0,0030	0,0241	0,0628	0,1783	0,0790	0,0147	0,0217
10	0,6163	0,0030	0,0241	0,0628	0,1783	0,0790	0,0147	0,0217
dlnDC								
0	0	0	0	0	0	0	0	0
1	0,0193	0,9807	0	0	0	0	0	0
2	0,0159	0,7236	0,0510	0,0477	0,0554	0,0659	0,0332	0,0073
3	0,0374	0,5857	0,1326	0,0446	0,0807	0,0579	0,0268	0,0344
4	0,0448	0,5473	0,1599	0,0420	0,0823	0,0546	0,0303	0,0389
5	0,0469	0,5383	0,1665	0,0419	0,0812	0,0538	0,0320	0,0394
6	0,0479	0,5360	0,1681	0,0421	0,0808	0,0535	0,0320	0,0397
7	0,0482	0,5353	0,1686	0,0420	0,0807	0,0535	0,0320	0,0397
8	0,0482	0,5350	0,1688	0,0421	0,0808	0,0534	0,0320	0,0398
9	0,0482	0,5349	0,1689	0,0421	0,0808	0,0534	0,0320	0,0398
10	0,0482	0,5348	0,1689	0,0421	0,0808	0,0534	0,0320	0,0398
dlnBM								
0	0	0	0	0	0	0	0	0
1	0,0004	0,0836	0,9161	0	0	0	0	0
2	0,0442	0,0418	0,7119	0,0070	0,0802	0,0273	0,0533	0,0342
3	0,0451	0,0491	0,6169	0,0067	0,1312	0,0732	0,0474	0,0304
4	0,0445	0,0566	0,5925	0,0065	0,1347	0,0890	0,0456	0,0306
5	0,0452	0,0595	0,5881	0,0087	0,1341	0,0888	0,0452	0,0305
6	0,0450	0,0600	0,5869	0,0097	0,1337	0,0886	0,0452	0,0308
7	0,0450	0,0600	0,5868	0,0097	0,1337	0,0887	0,0452	0,0309
8	0,0450	0,0600	0,5867	0,0097	0,1337	0,0887	0,0452	0,0309
9	0,0450	0,0600	0,5867	0,0098	0,1337	0,0887	0,0453	0,0309
10	0,0450	0,0600	0,5867	0,0098	0,1337	0,0887	0,0452	0,0309
lnLE								
0	0	0	0	0	0	0	0	0
1	0,0931	0,0016	0,1061	0,7992	0	0	0	0
2	0,1231	0,0013	0,1017	0,6491	0,0000	0,0581	0,0085	0,0582
3	0,1222	0,0029	0,1095	0,6158	0,0020	0,0793	0,0103	0,0581
4	0,1240	0,0038	0,1113	0,6077	0,0043	0,0808	0,0101	0,0581
5	0,1232	0,0038	0,1104	0,6043	0,0048	0,0839	0,0111	0,0585
6	0,1231	0,0041	0,1102	0,6038	0,0053	0,0837	0,0111	0,0586

7	0,1231	0,0042	0,1102	0,6035	0,0055	0,0837	0,0112	0,0586
8	0,1231	0,0042	0,1102	0,6035	0,0055	0,0838	0,0112	0,0586
9	0,1231	0,0042	0,1102	0,6034	0,0055	0,0838	0,0113	0,0586
10	0,1231	0,0042	0,1102	0,6034	0,0055	0,0838	0,0113	0,0586
dlnGEE								
0	0	0	0	0	0	0	0	0
1	0,0162	0,0446	0,0105	0,0754	0,8534	0	0	0
2	0,0201	0,0387	0,0353	0,0924	0,7196	0,0281	0,0488	0,0170
3	0,0357	0,0366	0,0381	0,0914	0,6840	0,0417	0,0467	0,0258
4	0,0385	0,0366	0,0378	0,0925	0,6809	0,0413	0,0462	0,0261
5	0,0383	0,0366	0,0377	0,0925	0,6809	0,0412	0,0465	0,0262
6	0,0384	0,0366	0,0378	0,0925	0,6800	0,0420	0,0465	0,0262
7	0,0387	0,0366	0,0379	0,0925	0,6795	0,0421	0,0465	0,0263
8	0,0387	0,0366	0,0379	0,0925	0,6795	0,0421	0,0465	0,0263
9	0,0387	0,0366	0,0379	0,0925	0,6795	0,0421	0,0465	0,0263
10	0,0387	0,0366	0,0379	0,0925	0,6794	0,0421	0,0465	0,0263
dlnCPI								
0	0	0	0	0	0	0	0	0
1	0,0448	0,0036	0,0682	0,0575	0,0160	0,8099	0	0
2	0,1615	0,0118	0,1147	0,0606	0,0123	0,5912	0,0089	0,0390
3	0,1505	0,0134	0,1097	0,0950	0,0122	0,5686	0,0136	0,0369
4	0,1493	0,0139	0,1092	0,0946	0,0120	0,5619	0,0198	0,0392
5	0,1496	0,0147	0,1095	0,0960	0,0127	0,5582	0,0197	0,0396
6	0,1499	0,0147	0,1094	0,0962	0,0127	0,5574	0,0198	0,0398
7	0,1499	0,0147	0,1094	0,0962	0,0129	0,5573	0,0199	0,0398
8	0,1498	0,0147	0,1094	0,0963	0,0129	0,5571	0,0200	0,0398
9	0,1498	0,0147	0,1094	0,0963	0,0129	0,5570	0,0200	0,0398
10	0,1498	0,0147	0,1094	0,0963	0,0129	0,5570	0,0200	0,0398
lnGGE								
0	0	0	0	0	0	0	0	0
1	0,0003	0,0288	0,0794	0,0018	0,1065	0,00005	0,7832	0
2	0,0331	0,0386	0,0635	0,0430	0,1118	0,0818	0,6242	0,0039
3	0,0442	0,0367	0,0609	0,0566	0,1064	0,0798	0,6093	0,0060
4	0,0460	0,0364	0,0600	0,0609	0,1109	0,0816	0,5946	0,0096
5	0,0457	0,0360	0,0598	0,0637	0,1105	0,0846	0,5901	0,0095
6	0,0470	0,0359	0,0601	0,0636	0,1101	0,0851	0,5876	0,0105
7	0,0471	0,0359	0,0600	0,0642	0,1100	0,0855	0,5868	0,0105
8	0,0471	0,0359	0,0600	0,0642	0,1100	0,0854	0,5867	0,0106
9	0,0471	0,0359	0,0600	0,0643	0,1100	0,0855	0,5866	0,0106
10	0,0472	0,0359	0,0600	0,0643	0,1100	0,0855	0,5866	0,0106
lnTrd								
0	0	0	0	0	0	0	0	0
1	0,0068	0,0066	0,1739	0,0840	0,0015	0,0749	0,0029	0,6495
2	0,0080	0,0057	0,1512	0,1214	0,0124	0,1200	0,0163	0,5651
3	0,0289	0,0056	0,1461	0,1167	0,0121	0,1235	0,0181	0,5490
4	0,0289	0,0065	0,1441	0,1226	0,0148	0,1243	0,0178	0,5410
5	0,0294	0,0065	0,1435	0,1220	0,0163	0,1239	0,0189	0,5395
6	0,0296	0,0065	0,1433	0,1224	0,0163	0,1251	0,0188	0,5381
7	0,0298	0,0065	0,1433	0,1224	0,0162	0,1250	0,0189	0,5379
8	0,0298	0,0065	0,1432	0,1225	0,0163	0,1250	0,0189	0,5378
9	0,0298	0,0065	0,1432	0,1225	0,0163	0,1250	0,0189	0,5377
10	0,0298	0,0065	0,1432	0,1225	0,0163	0,1251	0,0189	0,5377

Source: Author's compilation

Appendix 12: FEVD for WAMZ Zone Model

Table 50: FEVD for WAMZ Model

Response variable and Forecast horizon	Impulse variable							
	dlnGDP	dlnDC	dlnBM	lnLE	dlnGEE	dlnCPI	lnGGE	lnTrd
dlnGDP								
0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0
2	0,8350	0,0064	0,0103	0,0702	0,0320	0,0009	0,0003	0,0451
3	0,8027	0,0081	0,0107	0,0797	0,0335	0,0098	0,0017	0,0539
4	0,7914	0,0082	0,0106	0,0817	0,0329	0,0198	0,0016	0,0538
5	0,7859	0,0082	0,0107	0,0840	0,0326	0,0235	0,0017	0,0534
6	0,7830	0,0082	0,0107	0,0861	0,0324	0,0248	0,0017	0,0532
7	0,7815	0,0082	0,0107	0,0871	0,0323	0,0254	0,0017	0,0531
8	0,7809	0,0082	0,0107	0,0876	0,0323	0,0257	0,0017	0,0530
9	0,7805	0,0082	0,0107	0,0878	0,0323	0,0258	0,0017	0,0530
10	0,7804	0,0082	0,0107	0,0879	0,0323	0,0259	0,0017	0,0530
dlnDC								
0	0	0	0	0	0	0	0	0
1	0,0006	0,9994	0	0	0	0	0	0
2	0,0109	0,9311	0,0053	0,0095	0,0126	0,0262	0,0021	0,0023
3	0,0165	0,8987	0,0057	0,0267	0,0125	0,0348	0,0025	0,0026
4	0,0181	0,8857	0,0058	0,0347	0,0124	0,0381	0,0025	0,0028
5	0,0187	0,8801	0,0058	0,0378	0,0123	0,0399	0,0025	0,0028
6	0,0190	0,8776	0,0058	0,0393	0,0123	0,0408	0,0025	0,0028
7	0,0191	0,8764	0,0058	0,0400	0,0122	0,0412	0,0025	0,0028
8	0,0192	0,8758	0,0058	0,0403	0,0122	0,0413	0,0025	0,0028
9	0,0192	0,8756	0,0058	0,0405	0,0122	0,0414	0,0025	0,0028
10	0,0192	0,8755	0,0058	0,0405	0,0122	0,0415	0,0025	0,0028
dlnBM								
0	0	0	0	0	0	0	0	0
1	0,0440	0,3873	0,5687	0	0	0	0	0
2	0,0414	0,3665	0,5312	0,0013	0,0000	0,0544	0,0023	0,0030
3	0,0412	0,3599	0,5214	0,0021	0,0002	0,0690	0,0032	0,0030
4	0,0419	0,3576	0,5181	0,0050	0,0002	0,0705	0,0036	0,0030
5	0,0422	0,3564	0,5165	0,0073	0,0003	0,0708	0,0036	0,0030
6	0,0423	0,3560	0,5158	0,0081	0,0003	0,0710	0,0036	0,0031
7	0,0423	0,3558	0,5155	0,0084	0,0003	0,0712	0,0036	0,0031
8	0,0423	0,3557	0,5154	0,0085	0,0003	0,0713	0,0036	0,0031
9	0,0423	0,3556	0,5153	0,0086	0,0003	0,0713	0,0036	0,0031
10	0,0423	0,3556	0,5153	0,0086	0,0003	0,0713	0,0036	0,0031

dlnLE								
0	0	0	0	0	0	0	0	0
1	0,0001	0,0030	0,0196	0,9772	0	0	0	0
2	0,0007	0,0051	0,0180	0,9534	0,0008	0,0178	0,0038	0,0003
3	0,0007	0,0051	0,0173	0,9387	0,0017	0,0323	0,0037	0,0006
4	0,0013	0,0050	0,0171	0,9333	0,0018	0,0371	0,0037	0,0007
5	0,0018	0,0050	0,0170	0,9314	0,0018	0,0386	0,0037	0,0007
6	0,0020	0,0050	0,0170	0,9305	0,0018	0,0393	0,0037	0,0007
7	0,0021	0,0050	0,0169	0,9301	0,0018	0,0397	0,0037	0,0007
8	0,0021	0,0050	0,0169	0,9298	0,0018	0,0399	0,0037	0,0007
9	0,0022	0,0050	0,0169	0,9298	0,0018	0,0399	0,0037	0,0007
10	0,0022	0,0050	0,0169	0,9297	0,0018	0,0400	0,0037	0,0007
dlnGEE								
0	0	0	0	0	0	0	0	0
1	0,0225	0,0496	0,0031	0,0058	0,9189	0	0	0
2	0,0307	0,0561	0,0032	0,0139	0,8751	0,0039	0,0039	0,0133
3	0,0302	0,0559	0,0032	0,0210	0,8611	0,0089	0,0039	0,0158
4	0,0304	0,0559	0,0032	0,0210	0,8604	0,0089	0,0044	0,0159
5	0,0304	0,0559	0,0032	0,0211	0,8602	0,0090	0,0044	0,0159
6	0,0304	0,0559	0,0032	0,0211	0,8602	0,0090	0,0044	0,0159
7	0,0304	0,0559	0,0032	0,0211	0,8602	0,0090	0,0044	0,0159
8	0,0304	0,0559	0,0032	0,0211	0,8602	0,0090	0,0044	0,0159
9	0,0304	0,0559	0,0032	0,0211	0,8602	0,0090	0,0044	0,0159
10	0,0304	0,0559	0,0032	0,0211	0,8602	0,0090	0,0044	0,0159
dlnCPI								
0	0	0	0	0	0	0	0	0
1	0,0382	0,0373	0,0441	0,0045	0,0007	0,8752	0	0
2	0,0841	0,0267	0,0401	0,0659	0,0022	0,7683	0,0128	0,0000
3	0,0964	0,0239	0,0378	0,1258	0,0024	0,7001	0,0129	0,0006
4	0,0980	0,0232	0,0364	0,1512	0,0025	0,6751	0,0123	0,0014
5	0,0982	0,0228	0,0357	0,1600	0,0024	0,6673	0,0120	0,0016
6	0,0983	0,0227	0,0354	0,1637	0,0024	0,6639	0,0119	0,0016
7	0,0984	0,0226	0,0352	0,1656	0,0024	0,6623	0,0118	0,0017
8	0,0984	0,0226	0,0352	0,1665	0,0024	0,6615	0,0118	0,0017
9	0,0984	0,0225	0,0352	0,1669	0,0024	0,6611	0,0118	0,0017
10	0,0984	0,0225	0,0351	0,1671	0,0024	0,6609	0,0118	0,0017
dlnGGE								
0	0	0	0	0	0	0	0	0
1	0,0244	0,0498	0,0302	0,0219	0,0301	0,0040	0,8396	0
2	0,0265	0,0460	0,0302	0,0277	0,0281	0,0838	0,7389	0,0188
3	0,0266	0,0448	0,0293	0,0299	0,0299	0,0984	0,7191	0,0219
4	0,0281	0,0445	0,0295	0,0324	0,0298	0,0981	0,7157	0,0219
5	0,0283	0,0444	0,0295	0,0344	0,0298	0,0979	0,7137	0,0220
6	0,0284	0,0444	0,0295	0,0348	0,0298	0,0980	0,7132	0,0220

7	0,0284	0,0444	0,0295	0,0349	0,0298	0,0981	0,7130	0,0220
8	0,0284	0,0444	0,0295	0,0349	0,0298	0,0982	0,7129	0,0220
9	0,0284	0,0444	0,0295	0,0350	0,0298	0,0982	0,7129	0,0220
10	0,0284	0,0444	0,0295	0,0350	0,0298	0,0982	0,7128	0,0220
dlnTrd								
0	0	0	0	0	0	0	0	0
1	0,0145	0,0133	0,0129	0,0250	0,0245	0,0250	0,0022	0,8827
2	0,0140	0,0115	0,0127	0,1064	0,0212	0,0634	0,0074	0,7634
3	0,0181	0,0114	0,0129	0,1082	0,0212	0,0648	0,0098	0,7536
4	0,0195	0,0114	0,0132	0,1083	0,0213	0,0647	0,0100	0,7516
5	0,0197	0,0114	0,0132	0,1086	0,0214	0,0646	0,0100	0,7511
6	0,0197	0,0114	0,0132	0,1086	0,0214	0,0647	0,0100	0,7510
7	0,0198	0,0114	0,0132	0,1086	0,0214	0,0647	0,0100	0,7509
8	0,0198	0,0114	0,0132	0,1086	0,0214	0,0647	0,0100	0,7509
9	0,0198	0,0114	0,0132	0,1086	0,0214	0,0647	0,0100	0,7509
10	0,0198	0,0114	0,0132	0,1086	0,0214	0,0647	0,0100	0,7509

Source: Author's compilation

Appendix 13: Stata Do-File

Table 57: Stata Do-File

```
encode CountryName, gen(Country_id)
rename Time Year
rename GDPpercapitaconstant2015US GDPpc
rename Domesticcredittoprivatesecto DCps
rename BroadmoneyofGDP BM
rename Lifeexpectancyatbirthtotal LE
rename Pupilteacherratioprimary PTR
rename Governmentexpenditureoneducat GEE
rename Consumerpriceindex2010100 CPI2010
rename Generalgovernmentfinalconsump GGE
rename TradeofGDP TRD
rename Crudeoilaveragebbl OPr
xtset Country_id Year
bysort Country_id : ipolate GDPpc Year, generate(GDP)
(25 missing values generated)
bysort Country_id : ipolate DCps Year, generate(DC)
(86 missing values generated)
rename BM BMi
bysort Country_id : ipolate BMi Year, generate(BM)
(89 missing values generated)
rename LE LEi
bysort Country_id : ipolate LEi Year, generate(LE)
(5 missing values generated)
bysort Country_id : ipolate PTR Year, generate(PTr)
(201 missing values generated)
rename GEE GEEi
bysort Country_id : ipolate GEEi Year, generate(GEE)
(344 missing values generated)
rename CPI2010 CPI2010i
bysort Country_id : ipolate CPI2010i Year, generate(CPI2010)
(231 missing values generated)

rename GGE GGEi
bysort Country_id : ipolate GGEi Year, generate(GGE)
(169 missing values generated)
bysort Country_id : ipolate TRD Year, generate(Trd)
(122 missing values generated)
xtsum GDP DC BM LE PTr GEE CPI2010 GGE Trd
summarize GDP DC BM LE PTr GEE CPI2010 GGE Trd
gen lnGDP=ln(GDP)
(25 missing values generated)
gen lnDC =ln(DC)
(87 missing values generated)
replace GGE = . in 823
(1 real change made, 1 to missing)
replace GGE = . in 824
(1 real change made, 1 to missing)
replace GGE = . in 825
```

```
(1 real change made, 1 to missing)
replace GGE = . in 826
(1 real change made, 1 to missing)
replace GGE = . in 827
(1 real change made, 1 to missing)
bysort Country_id : ipolate CPI2010 Year, generate(CPI)
(231 missing values generated)
rename GGE GGe
bysort Country_id : ipolate GGe Year, generate(GGE)
(169 missing values generated)
xtsum GDP DC BM LE PTr GEE CPI2010 GGE Trd
xtsum GDP DC BM LE PTr GEE CPI GGE Trd
summarize GDP DC BM LE PTr GEE CPI GGE Trd
replace DCps = . in 736
(1 real change made, 1 to missing)

rename DC Dc
bysort Country_id : ipolate Dc Year, generate(DC)
(86 missing values generated)
drop lnDC
summarize GDP DC BM LE PTr GEE CPI GGE Trd
drop DC
bysort Country_id : ipolate DCps Year, generate(DC)
(86 missing values generated)
summarize GDP DC BM LE PTr GEE CPI GGE Trd
gen lnDC =ln(DC)
(86 missing values generated)
drop Dc
gen lnGGE =ln(GGE)
(169 missing values generated)
gen lnCPI =ln(CPI)
(231 missing values generated)
gen lnGEE =ln(GEE)
(344 missing values generated)
gen lnBM =ln(BM)
(89 missing values generated)
gen lnLE =ln(LE)
(5 missing values generated)
gen lnTrd =ln(Trd)
(122 missing values generated)
summarize GDP DC BM LE GEE CPI GGE Trd
summarize lnGDP lnDC lnBM lnLE lnGEE lnCPI lnGGE lnTrd
xtline GDP DC BM LE GEE CPI GGE Trd
xtline lnGDP lnDC lnBM lnLE lnGEE lnCPI lnGGE lnTrd
xtline lnDC lnBM lnGEE lnCPI lnGGE
xtline lnDC lnBM
xtline lnDC
xtline DC
xtline lnDC
xtline lnTrd. drop in 433/433
(1 observation deleted)
drop in 757/757
(1 observation deleted)
```

```
drop in 757/810
(54 observations deleted)
summarize GDP DC BM LE GEE CPI GGE Trd
summarize lnGDP lnDC lnBM lnLE lnGEE lnCPI lnGGE lnTrd
drop BM
drop lnBM
bysort Country_id : ipolate BMi Year, generate(BM)
(80 missing values generated)
gen lnBM =ln(BM)
(80 missing values generated)
summarize GDP DC BM LE GEE CPI GGE Trd
summarize lnGDP lnDC lnBM lnLE lnGEE lnCPI lnGGE lnTrd
replace LEi = 46.651 in 256
(1 real change made)
summarize GDP DC BM LE GEE CPI GGE Trd
drop LE
drop lnLE
bysort Country_id : ipolate LEi Year, generate(LE)
(3 missing values generated)
gen lnLE =ln(LE)
(3 missing values generated)
summarize GDP DC BM LE GEE CPI GGE Trd
replace LEi = . in 269
(1 real change made, 1 to missing)
drop LE
drop lnLE
bysort Country_id : ipolate LEi Year, generate(LE)
(3 missing values generated)
gen lnLE =ln(LE)
(3 missing values generated)
summarize GDP DC BM LE GEE CPI GGE Trd
summarize lnGDP lnDC lnBM lnLE lnGEE lnCPI lnGGE lnTrd
xtline GDP DC BM LE GEE CPI GGE Trd OPr
xtline lnGDP lnDC lnBM lnLE lnGEE lnCPI lnGGE lnTrd lnOPr
xtline DC
xtline lnDC
xtline BM
xtline GDP
xtline lnGDP
twoway (line lnGDP Countryid)
xtline LE
xtline lnLE
xtline GEE
xtline lnGEE
xtline CPI
xtline lnCPI
xtline GGE
xtline lnGGE
xtline Trd
xtline lnTrd
gen lnOPr =ln(OPr)
(3 missing values generated)
xtline OPr
```

```
xtline lnOPr
xtdescribe
xttab lnGDP
summarize GDP DC BM LE GEE CPI GGE Trd OPr
summarize lnGDP lnDC lnBM lnLE lnGEE lnCPI lnGGE lnTrd lnOPr

search pedscaf
ssc install pescadf
ssc install xtfisher
xtset Country_id Year
xtcd lnGDP
xtcd lnGDP lnDC lnBM lnLE
xtcd lnGEE lnCPI lnGGE lnTrd
xtcd lnOPr
drop in 1081/1083
(3 observations deleted)
xtcd lnOPr
xtcd2 lnGDP lnDC lnBM lnLE
xtcd2 lnGEE lnCPI lnGGE lnTrd
xtcd2 lnOPr
. gen dlnGDP = d.lnGDP
(40 missing values generated)
. gen dlnDC = d.lnDC
(96 missing values generated)
. gen dlnBM = d.lnBM
(97 missing values generated)
. gen dlnLE = d.lnLE
(20 missing values generated)
. gen dlnGEE = d.lnGEE
(350 missing values generated)
. gen dlnCPI = d.lnCPI
(215 missing values generated)
. gen dlnGGE = d.lnGGE
(130 missing values generated)
. gen dlnTrd = d.lnTrd
(83 missing values generated)
. gen dlnOPr = d.lnOPr
(20 missing values generated)

GLOBAL MODEL
pescadf lnGDP , lags(1) trend
pescadf dlnGDP , lags(1) trend
pescadf lnDC , lags(1) trend
pescadf dlnDC , lags(1) trend
pescadf lnBM , lags(1) trend
pescadf dlnBM , lags(1) trend
pescadf lnLE , lags(1) trend
pescadf dlnLE , lags(1) trend
pescadf lnGEE , lags(1) trend
pescadf dlnGEE , lags(1) trend
pescadf lnCPI , lags(1) trend
pescadf dlnCPI , lags(1) trend
pescadf lnGGE , lags(1) trend
```

```
pescadf dlnGGE , lags(1) trend
pescadf lnTrd , lags(1) trend
pescadf dlnTrd , lags(1) trend
pescadf lnOPr , lags(1) trend
pescadf dlnOPr , lags(1) trend
xtunitroot ips lnOPr , lags(1) trend
pescadf lnOPr , lags(1)
pescadf lnGDP , lags(1) trend
pescadf lnGDP , lags(1)
pescadf lnDC , lags(1) trend
pescadf lnDC , lags(1)
pescadf lnBM , lags(1)
pescadf lnBM , lags(1) trend
pescadf lnLE , lags(1) trend
pescadf lnLE , lags(1)
pescadf lnCPI , lags(1) trend
pescadf dlnCPI , lags(1)
pescadf lnCPI , lags(1)
pescadf lnGGE , lags(1) trend
pescadf lnGGE , lags(1)
pescadf lnTrd , lags(1) trend
pescadf lnTrd , lags(1)
pescadf dlnTrd , lags(1)
pescadf lnGGE , lags(1)
pescadf dlnGGE , lags(1)
pescadf lnOPr , lags(1)
pescadf dlnOPr , lags(1)
pescadf lnCPI , lags(1)
pescadf dlnCPI , lags(1)
pescadf lnGGE , lags(1)
pescadf lnGEE , lags(1)
pescadf lnGGE , lags(1) trunoff
pescadf lnGEE , lags(1) trunoff
pescadf lnGEE , lags(1) trunoff nodemean
pescadf lnGEE , lags(1) nodemean
pescadf lnGEE , lags(0) nodemean
pescadf lnGEE , lags(0) trunoff nodemean
pescadf lnLE , lags(1)
pescadf dlnLE , lags(1)
pescadf lnBM , lags(1)
pescadf dlnBM , lags(1)
pescadf lnDC , lags(1)
pescadf dlnDC , lags(1)
pescadf lnGDP , lags(1)
pescadf dlnGDP , lags(1)
xtunitroot ips lnOPr , lags(1) trend
xtunitroot ips dlnOPr , lags(1) trend
xtunitroot ips lnOPr , lags(1)
xtunitroot ips dlnOPr , lags(1) trend
xtunitroot ips lnTrd , lags(1)
xtunitroot ips dlnTrd , lags(1)
xtunitroot ips lnGGE , lags(1)
xtunitroot ips lnGEE , lags(1)
```

```
xtunitroot ips lnLE , lags(1)
xtunitroot ips lnGGE , lags(1)
xtunitroot ips dlnGGE , lags(1)
xtunitroot ips lnCPI , lags(1)
xtunitroot ips lnLE , lags(1) trend
xtunitroot ips lnOPr , lags(1) trend
xtunitroot ips dlnOPr , lags(1) trend
xtunitroot ips lnTrd , lags(1) trend
xtunitroot ips dlnTrd , lags(1) trend
xtunitroot ips lnGGE , lags(1) trend
xtunitroot ips dlnGGE , lags(1) trend
xtunitroot ips lnCPI , lags(1) trend
xtunitroot ips dlnCPI , lags(1) trend
xtunitroot ips lnLE , lags(1) trend
xtunitroot ips dlnLE , lags(1) trend
xtunitroot ips lnBM , lags(1) trend
xtunitroot ips dlnBM , lags(1) trend
xtunitroot ips lnDC , lags(1) trend
xtunitroot ips dlnDC , lags(1) trend
xtunitroot ips lnGDP , lags(1) trend
xtunitroot ips dlnGDP , lags(1) trend
xtunitroot ips lnGEE , lags(1) trend
xtunitroot ips lnGEE , trend
xtunitroot ips lnGEE
xtunitroot breitung lnGEE
xtunitroot ht lnGEE
xtunitroot llc lnGEE
xtunitroot ips lnGEE
xtunitroot fisher lnGEE, dfuller lags(1)   is ok with few observations
xtunitroot hadri lnGEE
xtunitroot fisher lnGEE, dfuller lags(1)
xtunitroot fisher dlnGEE, dfuller lags(1)
xtunitroot fisher lnGDP, dfuller lags(1)
xtunitroot fisher dlnGDP, dfuller lags(1)
xtunitroot fisher lnDC, dfuller lags(1)
xtunitroot fisher dlnDC, dfuller lags(1)
xtunitroot fisher lnBM, dfuller lags(1)
xtunitroot fisher dlnBM, dfuller lags(1)
xtunitroot fisher lnLE, dfuller lags(1)
xtunitroot fisher dlnLE, dfuller lags(1)
xtunitroot fisher lnCPI, dfuller lags(1)
xtunitroot fisher dlnCPI, dfuller lags(1)
xtunitroot fisher lnGGE, dfuller lags(1)
xtunitroot fisher dlnGGE, dfuller lags(1)
xtunitroot fisher lnTrd, dfuller lags(1)
xtunitroot fisher dlnTrd, dfuller lags(1)
xtunitroot fisher lnOPr, dfuller lags(1)
xtunitroot fisher dlnOPr, dfuller lags(1)
xtunitroot fisher lnGEE, pperron lags(1)
xtunitroot fisher dlnGEE, pperron lags(1)
xtunitroot fisher lnGDP, pperron lags(1)
xtunitroot fisher dlnGDP, pperron lags(1)
xtunitroot fisher lnDC, pperron lags(1)
```

```
xtunitroot fisher dlnDC, pperron lags(1)
xtunitroot fisher lnBM, pperron lags(1)
xtunitroot fisher dlnBM, pperron lags(1)
xtunitroot fisher lnLE, pperron lags(1)
xtunitroot fisher dlnLE, pperron lags(1)
xtunitroot fisher lnCPI, pperron lags(1)
xtunitroot fisher dlnCPI, pperron lags(1)
xtunitroot fisher lnGGE, pperron lags(1)
xtunitroot fisher dlnGGE, pperron lags(1)
xtunitroot fisher lnTrd, pperron lags(1)
xtunitroot fisher dlnTrd, pperron lags(1)
xtunitroot fisher lnOPr, pperron lags(1)
xtunitroot fisher dlnOPr, pperron lags(1)
help pvar
pvarsoc dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd lnOPr , maxlag(3) pvaropts(instl(1/4))
pvar dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd, exog(lnOPr) instl(1/4) fod gmmstyle overid
pvarstable, graph
pvargranger
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd) response(dlnGDP) save(GLOBAL)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd) response(dlnDC)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(dlnBM)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(dlnLE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(dlnGEE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(lnCPI)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(lnGGE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(lnTrd)
pvarfevd

ECOWAS ZONE
pvarsoc dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd lnOPr , maxlag(4) pvaropts(instl(1/4))
pvar dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd, exog(lnOPr) instl(1/4) fod gmmstyle overid
pvarstable, graph
pvargranger
pvarirf, mc(200) oirf byopt(yrescale)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd) response(dlnGDP) save(ECOWAS)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd) response(dlnDC)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(dlnBM)
```

```
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(dlnLE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(dlnGEE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(lnCPI)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(dlnGGE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(lnTrd)
pvarfevd
pvarfevd, step(15)
pvarfevd, mc(200)
pvarfevd, mc(200)  save(FEVDGlobal)
pvargranger

FCFA ZONE
drop in 109/162
drop in 487/648
drop in 649/702
drop in 703/756
xtdescribe
summarize GDP DC BM LE GEE CPI GGE Trd OPr
summarize lnGDP lnDC lnBM lnLE lnGEE lnCPI lnGGE lnTrd lnOPr
xtcd lnGDP lnDC lnBM lnLE
xtcd lnGEE lnCPI lnGGE lnTrd
xtcd lnOPr
xtcd2 lnGDP lnDC lnBM lnLE
xtcd2 lnGEE lnCPI lnGGE lnTrd
xtcd2 lnOPr
pescadf lnGDP , lags(1) trend
pescadf dlnGDP , lags(1) trend
pescadf lnDC , lags(1) trend
pescadf dlnDC , lags(1) trend
pescadf lnBM , lags(1) trend
pescadf dlnBM , lags(1) trend
pescadf lnLE , lags(1) trend
pescadf dlnLE , lags(1) trend
pescadf lnGEE , lags(1) trend
pescadf dlnGEE , lags(1) trend
pescadf lnCPI , lags(1) trend
pescadf dlnCPI , lags(1) trend
pescadf lnGGE , lags(1) trend
pescadf dlnGGE , lags(1) trend
pescadf lnTrd , lags(1) trend
pescadf dlnTrd , lags(1) trend
pescadf lnOPr , lags(1) trend
pescadf dlnOPr , lags(1) trend
pescadf lnGDP , lags(1)
pescadf dlnGDP , lags(1)
pescadf lnDC , lags(1)
pescadf dlnDC , lags(1)
pescadf lnBM , lags(1)
```

```
pescadf dlnBM , lags(1)
pescadf lnLE , lags(1)
pescadf dlnLE , lags(1)
pescadf lnGEE , lags(1)
pescadf dlnGEE , lags(1)
pescadf lnCPI , lags(1)
pescadf dlnCPI , lags(1)
pescadf lnGGE , lags(1)
pescadf dlnGGE , lags(1)
pescadf lnTrd , lags(1)
pescadf dlnTrd , lags(1)
pescadf lnOPr , lags(1)
pescadf dlnOPr , lags(1)
xtunitroot ips lnGDP , lags(1) trend
xtunitroot ips dlnGDP , lags(1) trend
xtunitroot ips lnDC , lags(1) trend
xtunitroot ips dlnDC , lags(1) trend
xtunitroot ips lnBM , lags(1) trend
xtunitroot ips dlnBM , lags(1) trend
xtunitroot ips lnLE , lags(1) trend
xtunitroot ips dlnLE , lags(1) trend
xtunitroot ips lnGEE , lags(1) trend
xtunitroot ips dlnGEE , lags(1) trend
xtunitroot ips lnCPI , lags(1) trend
xtunitroot ips dlnCPI , lags(1) trend
xtunitroot ips lnGGE , lags(1) trend
xtunitroot ips dlnGGE , lags(1) trend
xtunitroot ips lnTrd , lags(1) trend
xtunitroot ips dlnTrd , lags(1) trend
xtunitroot ips lnOPr , lags(1) trend
xtunitroot ips dlnOPr , lags(1) trend
xtunitroot fisher lnGDP, dfuller lags(1)
xtunitroot fisher dlnGDP, dfuller lags(1)
xtunitroot fisher lnDC, dfuller lags(1)
xtunitroot fisher dlnDC, dfuller lags(1)
xtunitroot fisher lnBM, dfuller lags(1)
xtunitroot fisher dlnBM, dfuller lags(1)
xtunitroot fisher lnLE, dfuller lags(1)
xtunitroot fisher dlnLE, dfuller lags(1)
xtunitroot fisher lnGEE, dfuller lags(1)
xtunitroot fisher dlnGEE, dfuller lags(1)
xtunitroot fisher lnCPI, dfuller lags(1)
xtunitroot fisher dlnCPI, dfuller lags(1)
xtunitroot fisher lnGGE, dfuller lags(1)
xtunitroot fisher dlnGGE, dfuller lags(1)
xtunitroot fisher lnTrd, dfuller lags(1)
xtunitroot fisher dlnTrd, dfuller lags(1)
xtunitroot fisher lnOPr, dfuller lags(1)
xtunitroot fisher dlnOPr, dfuller lags(1)
xtunitroot fisher lnGDP, pperron lags(1)
xtunitroot fisher dlnGDP, pperron lags(1)
xtunitroot fisher lnDC, pperron lags(1)
xtunitroot fisher dlnDC, pperron lags(1)
```

```
xtunitroot fisher lnBM, pperron lags(1)
xtunitroot fisher dlnBM, pperron lags(1)
xtunitroot fisher lnLE, pperron lags(1)
xtunitroot fisher dlnLE, pperron lags(1)
xtunitroot fisher lnGEE, pperron lags(1)
xtunitroot fisher dlnGEE, pperron lags(1)
xtunitroot fisher lnCPI, pperron lags(1)
xtunitroot fisher dlnCPI, pperron lags(1)
xtunitroot fisher lnGGE, pperron lags(1)
xtunitroot fisher dlnGGE, pperron lags(1)
xtunitroot fisher lnTrd, pperron lags(1)
xtunitroot fisher dlnTrd, pperron lags(1)
xtunitroot fisher lnOPr, pperron lags(1)
xtunitroot fisher dlnOPr, pperron lags(1)
pvarsoc dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd lnOPr , maxlag(3) pvaropts(instl(1/4))
pvar dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd, exog(lnOPr) instl(1/4) fod gmmstyle overid
pvarstable, graph
pvargranger
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd) response(dlnGDP)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTr) response(dlnDC)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(dlnBM)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(dlnLE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(dlnGEE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(lnCPI)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(lnGGE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI lnGGE lnTrd)  response(lnTrd)
pvarfevd, mc(200)

BCEAO ZONE
drop in 109/324
drop in 163/270
xtcd2 lnGDP
xtcd2 lnDC
xtcd2 lnBM
xtcd2 lnLE
xtcd2 lnGEE
xtcd2 lnCPI
xtcd2 lnGGE
xtcd2 lnTrd
xtcd2 lnOPr
pvarsoc dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd lnOPr , maxlag(3) pvaropts(instl(1/4))
```

```
pvar dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd, exog(lnOPr) instl(1/4) fod gmmstyle overid
pvarstable, graph
pvargranger
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd) response(dlnGDP)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTr) response(dlnDC)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(dlnBM)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(dlnLE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(dlnGEE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(lnCPI)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(dlnGGE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE lnCPI dlnGGE lnTrd)  response(lnTrd)
pvarfevd, mc(200)

BEAC ZONE
drop in 1/108
drop in 217/270
drop in 325/594
xtcd2 lnGDP
xtcd2 lnDC
xtcd2 lnBM
xtcd2 lnLE
xtcd2 lnGEE
xtcd2 lnCPI
xtcd2 lnGGE
xtcd2 lnTrd
xtcd2 lnOPr
xtcd lnTrd lnGEE
xtcd lnTrd
xtcd lnGDP
pvarsoc dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd lnOPr , maxlag(2) pvaropts(instl(2/3))
pvar dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd, exog(lnOPr) instl(1/3) fd gmmstyle overid
pvarstable, graph
pvargranger
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd) response(dlnGDP)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd) response(dlnDC)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd)  response(dlnBM)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd)  response(lnLE)
```

```
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd)  response(dlnGEE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd)  response(dlnCPI)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd)  response(lnGGE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM lnLE dlnGEE dlnCPI lnGGE lnTrd)  response(lnTrd)
pvarfevd

ZMAO ZONE
drop in 1/270
drop in 2/324
drop in 217/270
pvarsoc dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd lnOPr , maxlag(1) pvaropts(instl(1/4))
pvar dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd, exog(lnOPr) instl(1/2) fod gmmstyle overid
pvarstable, graph
pvargranger
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd) response(dlnGDP)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd) response(dlnDC)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd)  response(dlnBM)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd)  response(dlnLE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd)  response(dlnGEE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd)  response(dlnCPI)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd)  response(dlnGGE)
pvarirf, mc(200) oirf byopt(yrescale) impulse(dlnGDP dlnDC dlnBM dlnLE dlnGEE dlnCPI dlnGGE dlnTrd)  response(dlnTrd)
pvarfevd, mc(200)
```

Source: Author's compilation

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Articles and Papers	

1. Kahyaoglu Bozkus, S., Kahyaoglu, H., & Mahamane Lawali, A. M. (2020). **Multifractal analysis of atmospheric carbon emissions and OECD industrial production index**. *International Journal of Climate Change Strategies and Management, 12*(4), 511–531. https://doi.org/10.1108/IJCCSM-08-2019-0050

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4. Atahirou Mahamane, M. L. (in press). **Impact analysis of islamic finance on the economic growth of Nigeria: an ARDL approach**. *Journal of Islamic Research*. https://doi.org/10.62862/isar.2025-112184