Cilt: 12 Sayı: 1, 2025, ss. 190-215
PAMUKKALE ÜNİVERSİTESİ
İŞLETME ARAŞTIRMALARI DERGİSİ (PIAR)
Pamukkale University Journal of Business Research
https://dergipark.org.tr/tr/pub/piar

Economic Integration and Financial Development Effect on Selected SSA Countries' Economic Growth

Ekonomik Entegrasyon ve Finansal Gelişmenin Seçilmiş SSA Ülkelerinin Ekonomik Büyümesi Üzerindeki Etkisi

Fuat SEKMEN [1*] **Mahamane Lawali ATAHIROU MAHAMANE** [2] **Haşmet GÖKIRMAK** [3]

[1] Sakarya University, sekmen@sakarya.edu.tr, ORCID: 0000-0002-8854-8737
[2] Sakarya University, atahirou.lawali@ogr.sakarya.edu.tr, ORCID: 0000-0003-1036-947X
[3] Istanbul Sabahattin Zaim University, hasmet.gokirmak@izu.edu.tr, ORCID: 0000-0003-2294-5382
[*] Yazışılan Yazar/Corresponding author

Makale Geliş/Received: 17.04.2025 Makale Kabul/Accepted: 12.06.2025

Araştırma Makalesi / Research Paper DOI: 10.47097/piar.1678012

Abstract

This study investigates the relationship between financial development (FD) and economic growth within the context of economic integration in five African countries over the period 1970–2018. Employing a VECMX(p,s) model, the analysis provides evidence of both long-term equilibrium relationships and short-term dynamics among the variables. The empirical findings reveal that in Cameroon, financial development has a positive cumulative impact on economic growth. In contrast, no significant effect of FD—whether through broad money or domestic credit—is observed in Benin and Niger. In Chad, FD (as proxied by broad money) exerts a negative influence, while domestic credit remains statistically insignificant. Nigeria shows a positive linkage between broad money and growth, yet no statistically significant effect from domestic credit is detected. Moreover, inter-country spillover effects are observed, suggesting a regional dimension to financial interactions. Overall, the estimated VECMX (3,0) model demonstrates satisfactory predictive performance. Policy implications emphasize the need for country-specific adjustments in fiscal and monetary frameworks to improve credit access, particularly for SMEs and cooperative entities. Regionally, the African Union should design integration strategies that are responsive to the heterogeneous financial structures and institutional realities across member states.

Keywords: *VECMX, Financial Development, Economic Integration, African Union.*

Jel Kodları: *B22, B23, F62, F63.*

Öz

Bu çalışma, 1970–2018 dönemi için beş Afrika ülkesinde finansal gelişme (FD) ile ekonomik büyüme arasındaki ilişkiyi ekonomik entegrasyon bağlamında incelemektedir. VECMX(p,s) modeli kullanılarak yapılan analiz, değişkenler arasında hem uzun dönemli denge ilişkileri hem de kısa dönemli dinamikler olduğunu ortaya koymaktadır. Ampirik bulgulara göre Kamerun'da finansal gelişme, ekonomik büyüme üzerinde kümülatif ve pozitif bir etki meydana getirmektedir. Buna karşılık, Benin ve Nijer'de FD'nin, ne geniş para arzı (broad money) ne de yurtiçi kredi (domestic credit) kanalıyla anlamlı bir etkisi bulunmamaktadır. Çad'da ise geniş para arzı göstergesi olarak FD'nin büyüme üzerinde olumsuz etkisi gözlemlenirken, yurtiçi kredinin etkisi istatistiksel olarak anlamlı değildir. Nijerya'da geniş para arzı büyümeyi pozitif yönde etkilerken, yurtiçi kredi etkisiz kalmaktadır. Ayrıca ülkeler arasında finansal etkileşimlere dair dışsal etkiler (spillover) de tespit edilmiştir. Modelin tahmin gücü tatmin edici düzeydedir. Politika önerileri, her ülkenin mali ve parasal politikalarını özellikle KOBİ'ler ve kooperatifler için krediye erişimi artıracak şekilde uyarlaması gerektiğine işaret etmektedir. Bölgesel düzeyde ise Afrika Birliği'nin entegrasyon stratejilerini, üye ülkelerin farklılaşan finansal yapıları ve kurumsal özelliklerini dikkate alarak tasarlaması önem arz etmektedir.

Anahtar Kelimeler: *VECMX, Finansal Kalkınma, Ekonomik Entegrasyon, Afrika Birliği.*

Jel Codes: *B22, B23, F62, F63.*

Atıf için (Cite as): Sekmen, F., Atahirou Mahamane, M. L., & Gökırmak, H. (2025). Economic integration and financial development effect on selected SSA countries' economic growth. *Pamukkale Üniversitesi İşletme Araştırmaları Dergisi, 12*(1), 190-215. https://doi.org/10.47097/piar.1678012

1. INTRODUCTION

As stated by (Landreth & Colander, 2002: 120), considered by most economists as "the father of political economy" or of "classical" economics," Adam Smith, in his work *The Wealth of Nations* (Adam S., 1776), characterizes the State (and by extension the community) as the guardian of the general interest through the so-called sovereign duties (police, defense, justice). The State must not only protect citizens against injustices and internal and external violence. Still, it must also take charge of certain economic activities that are not profitable for any company yet largely benefit society (certain large infrastructures, public services). To ensure security and economic development, Adam Smith stipulates that the State must also regulate the financial sector because the logic of a free and competitive market should not extend to the financial sphere. Indeed, according to the World Bank (Banque Mondiale, 2022), the creation of solid financial systems (and therefore financial development) is the basis of development and economic growth: Financial stability generates jobs and improves productivity; a banking system and a solid financial market ensure the efficient allocation of resources for their optimal use; Financial inclusion, or access to financial services, allows economic agents to meet their needs, broaden their perspectives, improve their standard of living and reduce inequalities. (Nubukpo, 2021: 56) explained financial development as a multidimensional process by which a financial system gains in depth, accessibility, profitability, stability, efficiency, international openness, and diversity. Among these dimensions or pillars of financial development, we distinguish the depth of the financial system, referring to the importance of the financial sector within an economy and its capacity to mobilize savings to finance investment opportunities. Thus, the author highlighted several indicators of the depth of the financial system, as follows: total financial assets as a percentage of GDP; credit to the private sector as a percentage of GDP; savings rate as a percentage of GDP; deposits in the financial system as a percentage of GDP; and stock market capitalization as a percentage of GDP. This study will focus particularly on two of these indicators to investigate economic and financial integration among the selected countries. Economic and financial integration in Africa, in general, and in Sub-Saharan Africa, in particular, faces several hurdles. Institutional inefficiencies (corruption, bad governance, conflicting regulatory systems) complicate sustainable financial transactions and hurdle investments. Moreover, structural asymmetries, such as economic differences between resource-dependent (e.g., Nigeria, Chad) and agriculture or manufacturing-driven economies (e.g., Cameroon), uneven financial development, infrastructure deficiencies (inadequate energy supply, poor transport networks, and digital connectivity) make policy alignment difficult, limit trade efficiency, and hinder industrialization. Additionally, political uncertainty or security issues (border conflicts, terrorism, smuggling networks, ...) prevent long-term investments and hinder economic stability. Also, divergences in trade policies and agreements, as well as the use of different currencies, create inefficiencies in intra-Africa commerce. Fortunately, efforts such as the African Continental Free Trade Area (ACFTA) seek to promote regional integration by overcoming these challenges through stronger institutions, good governance, adequate infrastructure and strengthened financial systems (ECA, 2023). Accordingly, the African Union, for its part, is deploying considerable efforts to achieve several strategic development objectives, including the Connection and integration of the African a) financial markets and b) markets of goods and services between the many regional economic communities (RECs) on

the one hand, and between the countries comprising these RECs on the other hand. The African Union report on African integration (Union Africaine, 2023: 07) recalls that on January 1, 2021, African countries launched the creation of the African Continental Free Trade Area (ZLECAF) to boost commerce between African countries and use it as an engine of growth and sustainable development while promoting industrialization and private sector development. To connect African financial markets, efforts are also being made to create specific financial institutions (the African Central Bank (BCA), the African Investment Bank (AIB), the African Monetary Fund (AMF), and the Pan-African Stock Exchange (PASE). The role of these institutions would be to (a) facilitate economic integration, (b) ensure financial stability, and thus (c) promote economic transformation and growth. That being said, let's note that Nigeria is the most populous country in Africa, with approximately 224 million inhabitants as of 2023 (Saifaddin, 2024), and the second-largest economy in Africa (World Economic Outlook, 2024), with a nominal GDP of int-$ 1,49 trillion (Purchasing power parity; international dollars). It shares land borders with Benin to the west, Chad and Cameroon to the east, and Niger to the north. Nigeria, Benin, and Niger are members of ECOWAS (the Economic Community of West African States), while Chad and Cameroon belong to the CEMAC (the Central African Economic and Monetary Community). In addition: Niger borders Benin and Chad, and Chad borders Cameroon. Moreover, they belong to the categories of low-income (Chad and Niger) with a GNI per capita of $1145 or less in 2023 and lower-middle-income (Benin, Cameroon, and Nigeria) countries with a GNI per capita between $1146 and $4515, according to the World Bank (The World Bank, 2025). This interconnected geographical configuration and economic characteristics motivated the selection of the five countries as the study's sample to analyze economic integration and the effect of financial systems across these countries. Therefore, the main objective of our present study is, on the one hand, to analyze the contribution of financial development to the economic growth of these neighboring countries belonging to different regional economic communities (RECs)[1] within the African Union and, on the other hand, to analyze the nature of the economic integration between them through the interdependence of their economies. Our paper is structured as follows: Chapter 2 presents a review of the relative empirical literature, while Chapter 3 discusses the data and methodology. Chapter 4 presents and discusses the results of the analysis, followed by the conclusion and policy recommendations.

2. LITERATURE REVIEW

Studies, albeit limited, have been conducted on cross-border trade (economic integration) between Nigeria and its neighbors or between countries south of the Sahara in general. This study will revisit some of the points below. According to (Moussa, 2018: 87), Benin's economy (BNGDP) is highly vulnerable to Nigeria's economic fluctuations. Economic slowdowns in Nigeria reduce demand for Beninese informal re-exports and agricultural products, affecting GDP. Additionally, a dynamic general equilibrium model predicts severe economic consequences for Benin if official and informal trade with Nigeria ceases (Sêgnon & Baudoin, 2024: 1). Furthermore, Niger's economic and social development is shaped by Nigeria's

1 Among the regional economic communities involved are the Community of Sahel-Saharan States (CEN-SAD), encompassing Niger, Chad, Benin, and Nigeria; the Economic Community of Central African States (ECCAS), which includes both Cameroon and Chad; and the Economic Community of West African States (ECOWAS), to which Niger, Benin, and Nigeria also belong.

economic performance, which exerts a positive impact on Niger's economic performance (Abdo, 2008: 19). Also, Chad relies heavily on Nigeria for imports, reinforcing its dependence on Nigeria's economic production. Additionally, the Cameroonian route also serves as an essential axis for importing goods and services to Chad (Abdoulaye & Zakaria, 2022: 28). Thus, economic relations between Benin, Niger, and Nigeria resemble a form of market-driven regional economic integration, based on national monetary and fiscal policy disparities creating opportunistic trade and efficient allocation of resources to consumers in these countries (Bio Goura, 1994). Concerning the finance-growth nexus, numerous studies agree that financial development promotes economic growth (King & Levine, 1993: 717; Beck et al., 2000: 261; Levine et al., 2000: 31; Panizza, U., 2014: 39). Moreover, in the context of African countries, (Stephen H., 2008: 2) argues that one of the main causes of the stagnation of the African economies is Africa's inadequate financial systems including many Africa's banking systems recurrent crises or too low average ratio of private credit to GDP (20 % in Sub-Saharan Africa while being 110 % in the OECD region in 2006). Various studies have been conducted on the impact of financial development on African economies, including, specifically, Nigeria and/or its neighboring countries often with divergent results. Financial development has varied effects on economic growth across different African regions, with some exhibiting a bidirectional causal link between finance and growth across Western, Central, Eastern, and Southern African economies, as well as a one-way causal association in Northern Africa (Haibo et al., 2023: 1). Additionaly, according to (El Menyari, 2019: 190), foreign bank penetration positively impacts economic growth in North and Southern African countries, but has a negative and rarely significant impact in West, Central, and East Africa. Interestingly, results suggested that the development of financial markets has a positive and significant effect on economic growth only in the Southern African region. Moreover, the finance-growth relationships has been investigated for ten countries[2] in sub-Saharan Africa, suggesting that financial development is cointegrated with economic growth in all ten countries and that Nigeria shows unidirectional causality, while Chad displays bidirectional causality (Akinlo & Egbetunde, 2010: 22). Also, Nigeria and South Africa's economic shocks spill over into surrounding regional bodies CEMAC, SADC, and ECOWAS[3] via trade channels, but financial spillovers are weaker, except between South Africa and the SADC region (Omoshoro-Jones & Bonga-Bonga, 2022: 251). Finally, a broader global study finds that financial market development strongly correlates with economic development in emerging countries in Sub-Saharan Africa, reinforcing bidirectional causality (Borlea et al., 2016: 6). Furthermore, the same authors stated that up to 30% of over 70 studies on the finance-growth nexus they reviewed suggest that financial development influences economic growth in emerging countries, including those in sub-Saharan Africa (only 5% supported the opposite). To sum up, Nigeria plays a dominant economic role in West and Central Africa, with neighboring countries, such as Benin, Niger, Cameroon or Chad, relying on its economic stability for trade, financial flows, and general socio-economic development. The finance-growth relationship literature further underscores the importance of robust financial systems in sustaining long-term economic growth across African countries and regional bodies.

[2] Central African Republic, Congo Republic, Gabon, Nigeria, Zambia, Kenya, Chad, South Africa, Sierra Leone and Swaziland.
[3] Central African Economic and Monetary Union (CEMAC), Southern African Development Community (SADC), and Economic Community of West African States (ECOWAS).

No existing study has employed a VECMX model to examine regional economic integration through GDP interactions and assess the impact of financial development on the five selected economies. Furthermore, the majority of studies have treated countries and regions as homogeneous entities or unified bodies rather than addressing the economic disparities among nations within the same economic community. In fact, the World Bank, in a report, explored a similar topic of financial and economic integration but it was about countries surrounding Lake Chad (Cameroon, Chad, Niger, and Nigeria), and highlighted the economic and social linkages, as well as the challenges facing the Lake Chad region (persistent underdevelopment, territorial and infrastructure development challenges, climate change, and insecurity), along with some policy recommendation such as investment in infrastructure, trade facilitation, governance reforms and natural resource management (Granguillhome, R., et al, 2021). Thus, this study includes Benin, in addition to the countries of Lake Chad region, and employs a different econometric approach to finally profer very similar policy recommendations. The study enriches, then, the limited empirical literature on countries south of the Sahara, such as Nigeria and its neighbors, by analyzing their economic integration and the finance-growth nexus.

3. DATA AND METHODOLOGY

3.1. Data

The research utilized annual data from 1970 to 2018, retrieved from the World Development Indicators (WDI) database (World Bank, 2024a, 2024b, 2024c). Real GDP is used as a proxy for economic growth, while Broad Money (BM) and Domestic Credit to Private Sector (DC) ratios to GDP serve as proxies for financial development (see Table 1).

Table 1. Variables Presentation

Indicator Name	Mnemonic	Measurement	Data Source
GDP per capita (constant 2015 US$)	GDP	GDP per capita is gross domestic product divided by midyear population. GDP 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. Data are in constant 2015 U.S. dollars.	(World Bank, 2024a; World Bank, 2024b; World Bank, 2024c)
Domestic credit to private sector (% of GDP)	DC	Domestic credit to the private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, trade credits, and other accounts receivable, that establish a claim for repayment.	
Broad money (% of GDP)	BM	Broad money 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.	
GDP per country	BNGDP, CMGDP, CDGDP, NEGDP, & NGGDP.	Real income or GDP, often referred to as the economy of, or simply, Benin, Cameroon, Chad, Niger and Nigeria.	

DC per country	BNDC, CMDC, CDDC, NEDC, & NGDC.	DC of Benin, Cameroon, Chad, Niger and Nigeria, respectively.	
BM per country	BNBM, CMBM, CDBM, NEBM, & NGBM.	BM of Benin, Cameroon, Chad, Niger and Nigeria, respectively.	

Source: Authors' design

The GDP variables are the endogenous variables, whereas the indicators of financial development are the exogenous variables. The variables are presented in their natural logarithmic form. The descriptive statistics of those variables are as in Table 2 below:

Table 2. Simple Summary Statistics

Variable	Type	N	Mean	Standard D.	Min	Max
lBNGDP	Dependent	49	6,73513	0,13466	6,53385	7,01322
lCMGDP	Dependent	49	7,13727	0,17335	6,82033	7,51394
lCDGDP	Dependent	49	6,19972	0,25007	5,83243	6,65664
lNEGDP	Dependent	49	6,18477	0,17964	5,96378	6,62686
lNGGDP	Dependent	49	7,53407	0,21745	7,25007	7,89341
lBNDC	Independent	49	2,64004	0,52232	1,57551	3,46072
lCMDC	Independent	49	2,63268	0,52451	1,70986	3,44177
lCDDC	Independent	49	1,88641	0,59635	0,79539	3,05464
lNEDC	Independent	49	2,11076	0,55110	0,97867	2,87163
lNGDC	Independent	49	2,11324	0,35395	1,54747	2,97683
lBNBM	Independent	49	3,04183	0,25488	2,38642	3,43350
lCMBM	Independent	49	2,83917	0,22935	2,32960	3,16405
lCDBM	Independent	49	2,48564	0,26475	1,92536	3,07079
lNEBM	Independent	49	2,46595	0,37591	1,63768	2,99861
lNGBM	Independent	49	2,72678	0,34276	2,20424	3,35429

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

3.2. Methodology

The study followed the methodology of the VARMAX procedure (SAS Institute Inc., 2014: 2426). So, all results were obtained using the software 'SAS Viya for Learners 4 (VFL4)'. Compared to a VAR model, a vector error correction model (VECM) can provide a more insightful understanding of the nature of nonstationary series and yield more accurate longer-term forecasts. VECM is a restricted VAR model used on nonstationary but cointegrated time series datasets. It can estimate the short-term and long-term effects of the series.

The VECM(p) form with the cointegration rank r (≤ k) is written as:

$$\Delta y_t = \delta + \Pi y_{t-1} + \sum_{i=1}^{p-1} \phi_i^* \Delta y_{t-1} + \epsilon_t \quad (1)$$

where Δ is the differencing operator, such that $\Delta y_t = y_t - y_{t-1}$; $\Pi = a\beta'$ here a and β are k x r matrices; ϕ_i^* is a k x k matrix.

It has an equivalent VAR(p) representation as follows:

$$y_t = \delta + (I_k + \Pi + \phi_1^*) y_{t-1} + \sum_{i=2}^{p-1} (\phi_i^* - \phi_{i-1}^*) y_{t-i} - \phi_{p-1}^* y_{t-p} + \epsilon_t \quad (2)$$

where I_k is a k x k identity matrix.

Some stationary exogenous variables, along with some of their lags, can also be included in the VECM model (Usman et al., 2022: 93):

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-p} + \sum_{i=0}^{s} \phi_1 x_{1,t-i} + \sum_{i=0}^{s} \phi_2 x_{2,t-i} + \epsilon_t \quad (3)$$

where y_(t-1) is the vector of an endogenous variable at lag −1, ϵ_t is the k × 1 vector white noise, Π=aβ^t is the matrix coefficient of cointegration, α = matrix adjustment (k × r) and β = matrix cointegration (k × r), Γi = matrix coefficient (k × k) for i variable dependent, and Φi = matrix coefficient (r × k) for i variable exogenous x_i.

Consequently, Y is the vector of dependent variables (GDP by country: BNGDP, CMGDP, CDGDP, NEGDP, NGGDP), and X is the vector of exogenous variables (Domestic Credit and Broad Money by country: BNDC, CMDC, CDDC, NEDC, NGDC & BNBM, CMBM, CDBM, NEBM, NGBM).

The study provided results for:

- Variables descriptive statistics;
- Dickey-Fuller unit root tests;
- Test for VAR Optimum Lag based on Corrected Akaike Information Criterion (AICC), Hannan-Quinn information criterion (HQC), Akaike Information Criterion (AIC), Schwarz Bayesian information criterion (SBIC) and Final Prediction Error Criterion (FPEC);
- Johansen Cointegration test;
- VECMX (3,0) parameters estimation;
- Diagnostic Check for the Residuals, including Univariate Model ANOVA, White Noise, and AR Diagnostics; and test for Weak Exogeneity;
- Stability test of the model relying on (Viren, R., 2022; Christopher, F. B., 2013: 57)'s methodology;
- Granger causality Wald tests;
- Plots of the Model and forecasts for the dependent variables.

4. EMPIRICAL RESULTS

4.1. Stationarity Test

Based on the Dickey-Fuller Unit Root Tests (for zero mean, single mean, and trend) summarized in Table 3 of Appendix A, all variables exhibit unit roots at a 5% significance level for the Rho and Tau test statistics. Nevertheless, all the variables become stationary at the first difference at a 5% significance level, except for the lNGGDP, for which the tau statistic for only the test with 'trend' is significant at 10%. Thus, the stationary forms of the variables are considered for analysis.

4.2. Model Selection: Test for Optimum Lag

Up to 3 out of the five information criteria (AICC, AIC, and FPEC) indicate lag 3 for the VAR part of the model based on their smallest value (marked with *). Thus, VAR (3) is selected, and the cointegration test is conducted accordingly.

Table 4. Criteria for Optimal Lag p of the VAR Model

Information criteria	VAR(1)	VAR(2)	VAR(3)	VAR(4)	VAR(5)
AICC	903,67	-1578,91	-1640,57*	-1570,96	-1528,21
HQC	-1134,5*	-1116,01	-1129,53	-1108,04	-1098,34
AIC	-1166,32	-1164,74	-1225,47*	-1188,86	-1163,41
SBIC	-1082,12*	-1035,23	-966,76	-972,05	-989,69
FPEC	1,02E-13	6,43E-14	6,6E-15*	1,72E-14	4,24E-14

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

4.3. Cointegration Test

The results of the Johansen cointegration test are displayed in Table 5 below. The test for H0: rank = 3 is not rejected (P-value for rank r = 3 > 0,05). So, we reject the alternative hypothesis that is H1: rank > r (r = 3), meaning cointegration exists and there are at least three cointegrating vectors (independent linear combinations of the variables that are stationary), indicating at least three underlying long-term equilibrium relationships among the variables in the system despite short-run fluctuations.

Table 5. Cointegration Rank Test Using Trace

H0: Rank=r	H1: Rank>r	Eigenvalue	Trace	Pr > Trace	Drift in ECM
0	**0**	0,7715	1244,618	<,0001	Constant
1	**1**	0,4204	565,462	0,0063	
2	**2**	0,3803	314,585	0,0316	
3	**3**	0,1842	94,473	0,3257*	
4	**4**	0,0017	0,0801	0,7774	

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

4.4. VECMX Model Selection

As seen in Table 6, all four information criteria considered have the smallest value (indicated with *) for VECMX (3,0), meaning lag 3 for endogenous variables and contemporaneous values for exogenous variables. Thus, VECMX (3,0) is considered as the best model.

Table 6. Selection of the Best VECMX (p,s)

Information criteria	AICC	HQC	AIC	SBC
VECMX (1,0)	-1575,36	-1126,06	-1182,63	-1032,94
VECMX (1,1)	-1622,94	-1120,65	-1212,58	-969,322
VECMX (3,0)	-1953,94*	-1347,97*	-1471,28*	-1142,12*
VECMX (3,1)	-1686,86	-1197,1	-1286,15	-1048,43
VECMX (5,0)	-1855,11	-1260,39	-1379,49	-1058,33

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

4.5. Parameters Estimation of VECMX (3,0)

VECMX (3,0) with three cointegrating vectors selected as the best model is estimated. The short-run dynamics, which represent deviations from the long-run equilibrium, are presented in Table 7a (Appendix B). In a VECM model, the same lagged variable can have both positive and negative signs in the parameter estimates; that is, it can have both positive (in some short-run periods) and negative effect (in other periods) on another variable, indicating complex interactions between the variables when multiple cointegrating relationships exist, and where the overall effect of a lagged variable can be a combination of positive and negative effects (SAS Institute Inc., 2014: 2426).From Table 7a, it can be seen that:

Effects on Benin's Economy (BNGDP): The financial development (FD) of Benin (both BNDC & BNBM) does have a negative impact on Benin's economy, but the effect is statistically not significant (P value > 5%). FD of Chad (CDBM) has a positive and statistically significant effect on Benin's economy. Benin's economy (at lag 1 & 3), Niger's economy (at lag 2), and Chad's economy (at lag 3) have a statistically significant negative impact on Benin's economy. The economies of Cameroon, Chad, and Nigeria (lagged 1) all have a statistically significant positive impact on Benin's economy. Overall, Benin itself, Chad, and Niger have negative effects on the Beninese economy, while Cameroon, Nigeria, and Chad have a positive impact on Benin's economy.

Effects on Cameroon's Economy (CMGDP): The financial development (FD) of Cameroon has a negative impact (if domestic credit (CMDC) is considered) and a positive effect (if broad money (CMBM) is considered) on Cameroon's economy. Additionally, the FD (domestic credit as an indicator) of Chad, Niger, and Nigeria has a positive impact on Cameroon's economy. In contrast, FD (broad money as an indicator) of Benin, Niger, and Nigeria has a negative effect on Cameroon's economy. Cameroon's economy (lagged 1 & 3), Benin's & Nigeria's economies (at lag 3), and Niger's economy (lagged 1) have a negative impact on Cameroon's economy. Cameroon and Niger economies (lagged 2), Nigeria & Chad (lagged 1) have a positive impact on Cameroon's economy. Overall, Cameroon itself, Benin, and Nigeria impact negatively, while Niger and Chad impact positively the Cameroonian economy.

Effects on Chad's Economy (CDGDP): The financial development (FD) of Cameroon has a significant positive impact on Chad's economy. Also, the FD (broad money as an indicator) of Chad and Nigeria has a negative effect. In contrast, the FD (broad money as an indicator) of Niger and Cameroon has a positive effect on Chad's economy. Nigeria's economy (lagged 2), Cameroon's economy (at lag 2 & 3), and Benin's economy (lagged 1) positively impact Chad's economy. Benin's economy (lagged 2); Cameroon, Niger, and Nigeria (lagged 1); Chad (at lag 1, 2, & 3) have a negative impact on Chad's economy. Overall, Nigeria, Cameroon, and Benin

have a positive impact on the Chadian economy, while Niger and Chad itself have a negative impact.

Effect on Niger Economy (NEGDP): There is no statistically significant financial development (FD) effect on Niger's economy through either domestic credit or broad money. Nigeria's and Cameroon's economies (at lag 1) and Benin's economy (at lags 2 and 3) have a significant positive impact on Niger's economy. The economies of Benin, Chad, and Niger (lagged 1); Cameroon (lagged 3); and Nigeria (lagged 2 and 3) have a significant negative impact on Niger's economy. Overall, Nigeria, Cameroon, Chad, and Niger itself have a negative effect on the Nigerien economy, whereas Benin positively impacts Niger's economy.

Effect on Nigerian Economy (NGGDP): Financial development (Domestic Credit as an indicator) of Chad and Niger; and FD (broad money as an indicator) of Benin have a significant negative effect on the Nigerian economy. Additionally, the FD (broad money as an indicator) of Chad, Niger, and Nigeria has a significant positive effect on Nigeria's economy. Moreover, the economies of Niger (lagged 1) and Nigeria (lagged 3) have a positive impact on Nigeria's economy. Niger's economy (at lag 2 & 3) and Nigeria's (at lag 1) have a negative impact on Nigeria's economy. Overall, Niger's economy has a negative effect on Nigeria, while the Nigerian economy has a positive impact on itself.

Table 7b presents the alpha (α) values (Adjustment Coefficients) indicating for each variable how much of the deviation from the long-run equilibrium is corrected in each period (per year), and beta (β) values (the vector of coefficients that define long-run relationships). Multiple beta values indicate that there exist multiple, distinct long-term relationships between the variables. Multiple alpha values represent the long-run adjustment coefficients in each cointegrating equation. A cointegrating equation with multiple alpha and beta values, including those with opposite signs, can still converge to an equilibrium (SAS Institute Inc., 2014: 2426; Susmel, R., 2015: 31).

4.6. VECMX Model Goodness of Fit

4.6.1. Testing Weak Exogeneity

The null hypothesis of the test for Weak Exogeneity is rejected for all dependent variables, implying endogeneity of all five variables (Table 8). All the dependent variables are not the weak exogeneity of each other, meaning that no dependent variable should be excluded from the system of equations. Additionally, these results suggest that the models are appropriate for the data and that the resulting estimates and inferences are valid.

Table 8. Testing Weak Exogeneity of Each Dependent Variable

Variable	DF	Chi-Square	Pr > ChiSq
lBNGDP	3	10,61	0,0141
lCMGDP	3	40,36	<,0001
lCDGDP	3	40,02	<,0001
lNEGDP	3	44,13	<,0001
lNGGDP	3	7,87	0,0488

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

4.6.2. Univariate Model ANOVA Diagnostic

Table 9 presents the univariate test results for the dependent variables (GDP of the selected countries). From the F-tests and P-values obtained, all the univariate models are significant (P < 0,05) and have relatively good R-squares (74-84%), except for the Benin GDP model. However, the model remains acceptable within the VECM system, based on its R-squared of almost 60% and its white noise error terms.

Table 9. Univariate Model ANOVA Diagnostics

Variable	R-Square	Standard Deviation	F Value	Pr > F
lBNGDP	0,5978	0,01878	1,19	0,3498
lCMGDP	0,8176	0,02335	3,59	0,0025
lCDGDP	0,8474	0,03319	4,44	0,0006
lNEGDP	0,8215	0,02425	3,68	0,0021
lNGGDP	0,7435	0,02793	2,32	0,0294

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

4.6.3. Univariate Model Autocorrelation, Normality and Homoscedasticity Diagnostics

As shown in Table 10, the Durbin Watson (DW) statistics have values close to two (2,00), indicating there is no autocorrelation in the residuals from the VECMX model, and it shows that the null hypothesis of the normality of the error terms cannot be rejected, meaning that the residuals of the five models are normally distributed. Additionally, Engle's ARCH test (Engle, 1982) results suggest that the null hypothesis is accepted, indicating that the residuals exhibit no autoregressive conditional heteroscedasticity (no ARCH effects). These results show that the error terms are white noise, and the estimated parameters are efficient.

Table 10. Autocorrelation, Normality, and Homoscedasticity Diagnostics

Variable	Durbin Watson	Normality		ARCH	
		Chi-Square	Pr > ChiSq	F Value	Pr > F
lBNGDP	2,57328	1,35	0,5081	2,61	0,1136
lCMGDP	2,18388	1,48	0,4782	1,35	0,2516
lCDGDP	2,15187	1,39	0,4997	0,75	0,3899
lNEGDP	2,30607	0,12	0,9414	0,00	0,9565
lNGGDP	2,26495	2,16	0,3388	0,19	0,6688

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

4.6.4. Univariate Model AR Effects Diagnostic

Based on Table 11, all the p-values, from lag 1 to even lag 4 for all the equations, are > 5%. This means there are no autoregressive (AR) effects on the residuals, which thus behave like white noise.

Table 11. Univariate Models AR Diagnostics

Variable	AR1		AR2		AR3		AR4	
	F Value	Pr > F	F Value	Pr > F	F Value	Pr > F	F Value	Pr > F
lBNGDP	3,88	0,0554	2,02	0,1462	2,02	0,1268	1,60	0,1943
lCMGDP	0,39	0,5347	3,11	0,0552	2,61	0,0650	2,44	0,0635
lCDGDP	0,25	0,6200	0,44	0,6449	2,21	0,1023	2,21	0,0873
lNEGDP	1,19	0,2810	1,22	0,3048	0,77	0,5162	0,56	0,6948
lNGGDP	0,78	0,3820	1,37	0,2665	1,20	0,3241	1,18	0,3361

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

4.7. Testing for Stability of the Model

The VECM model's stability condition differs from that of the VAR model.

According to (Viren, R., 2022; Christopher, F. B., 2013: 57), for a K endogenous variables VECM model with r cointegrating vectors, to meet the stability condition, the model would have K-r unit eigenvalues or moduli, and the remaining moduli should be strictly less than one. The estimated VECMX (3,0) model has five endogenous variables and three cointegrating relationships, meaning that it should have exactly 2 (K-r=5-3=2) moduli with a value of 1, and the remaining ones should be less than 1. Table 12 shows that there are precisely 2 unit moduli, which proves that the estimated model is stable and thus suitable for forecasting and other analyses.

Table 12. Roots of AR Characteristic Polynomial

Index	Real	Imaginary	Modulus	Radian	Degree
1	1,00000	0,00000	1,0000	0,0000	0,0000
2	1,00000	0,00000	1,0000	0,0000	0,0000
3	0,78204	0,00000	0,7820	0,0000	0,0000
4	0,75596	0,58227	0,9542	0,6563	37,6046
5	0,75596	-0,58227	0,9542	-0,6563	-37,6046
6	0,36972	0,41407	0,5551	0,8419	48,2380
7	0,36972	-0,41407	0,5551	-0,8419	-48,2380
8	0,15852	0,74597	0,7626	1,3614	78,0027
9	0,15852	-0,74597	0,7626	-1,3614	-78,0027
10	-0,14969	0,78839	0,8025	1,7584	100,7508
11	-0,14969	-0,78839	0,8025	-1,7584	-100,7508
12	-0,34936	0,44338	0,5645	2,2382	128,2369
13	-0,34936	-0,44338	0,5645	-2,2382	-128,2369
14	-0,59767	0,15103	0,6165	2,8941	165,8185
15	-0,59767	-0,15103	0,6165	-2,8941	-165,8185

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

4.8. Analysis of Granger Causality Wald Tests Results (Short-Run Relationships)

The null hypothesis in the Granger causality Wald test is that Group 1 is influenced by itself rather than by Group 2. That is, there is no causality from Group 2 towards group 1. Based on Tables 13a, 13b, 13c, 13d, and 13e (see Appendix C):

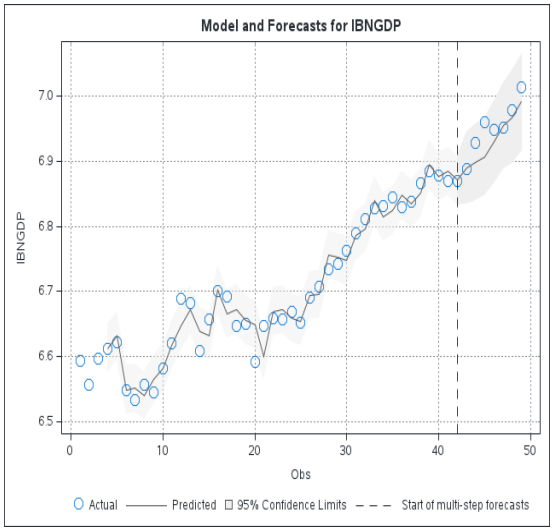
a) There is causality from Niger's economy to Benin's.
b) Financial development (both indicators) in Cameroon does granger cause Cameroon's economy.
c) Nigeria's economy granger-causes Cameroon's
d) Benin, Chad, Niger & Nigeria's economies as a group granger causes Cameroon's
e) Benin's economy granger causes Chad's
f) Niger's economy granger causes Chad's
g) Benin, Cameroon, Niger & Nigeria's economies as a group granger causes Chad's
h) Niger's Financial development (broad money as an indicator) does granger-cause Niger's economy. However, this effect is statistically not significant.
i) Nigeria's economy granger-causes Niger's

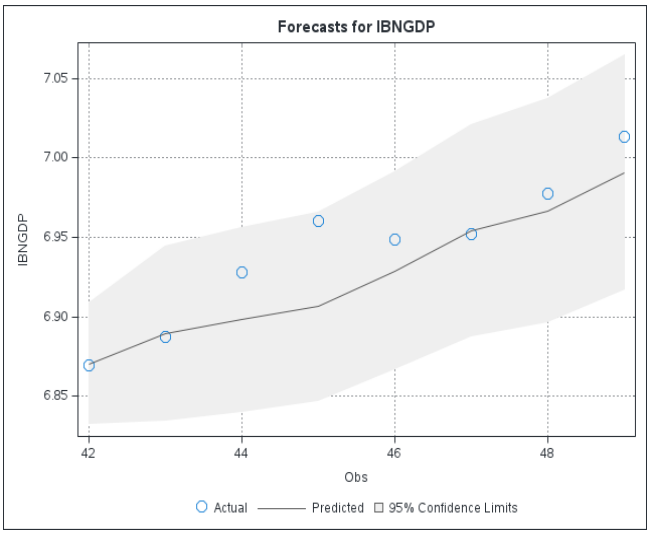
j) Benin, Cameroon, Chad & Nigeria's economies, as a group, granger causes Niger's
k) Chad, Niger and Benin's economies individually granger causes Nigeria's economy, even though the individual effects, except for Niger, are not statistically significant.
l) Benin, Cameroon, Chad, and Niger's economies, as a group, granger causes Nigerian economy.

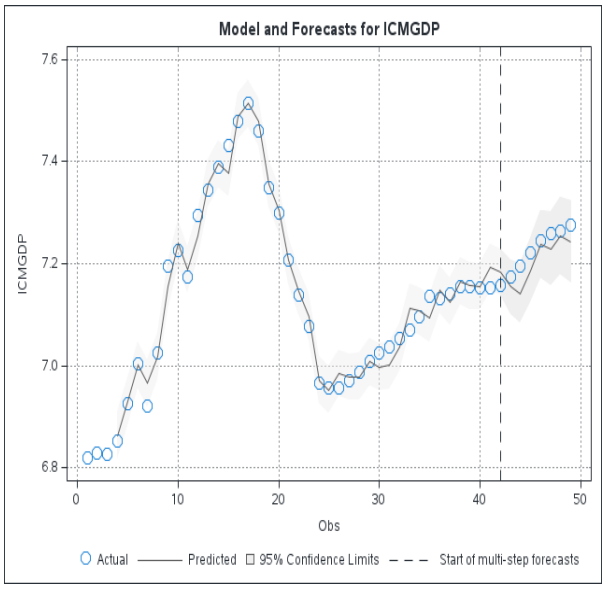
4.9. Forecasting

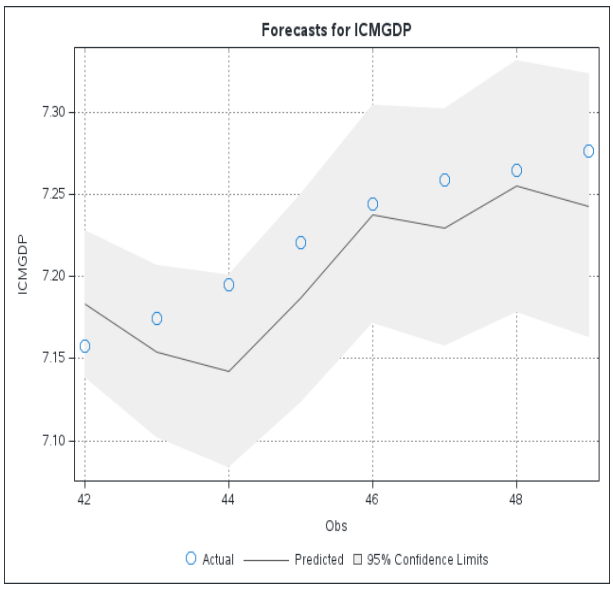
Table 14 (see Appendix D) shows that all forecasts for the next 8 years for all the endogenous variables are within the 95% Confidence Limit. The model is good because the forecast and actual values are very close (see Figure 1).

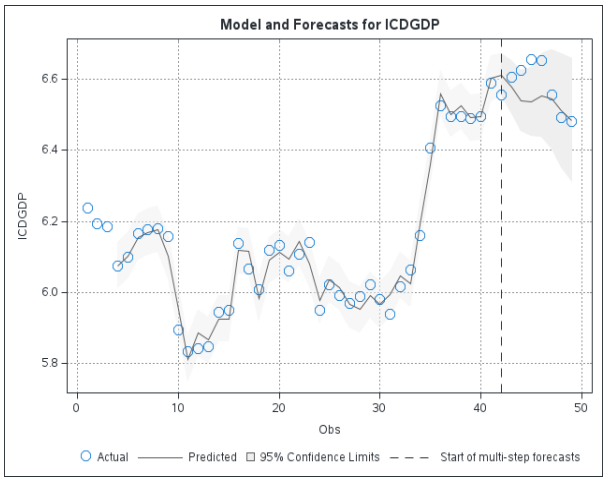
Moreover, it can be seen from Figure 1 that, overall, there are increasing trends for the next 8 years' forecasts for all countries except Chad, which exhibits a decreasing trend, and the confidence intervals widen, even though slightly, with the forecast periods.

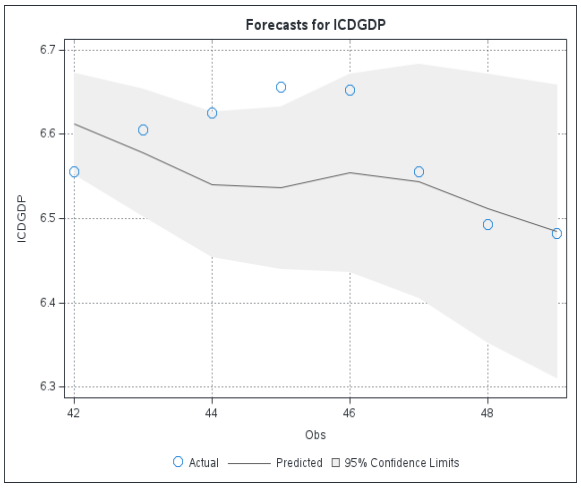


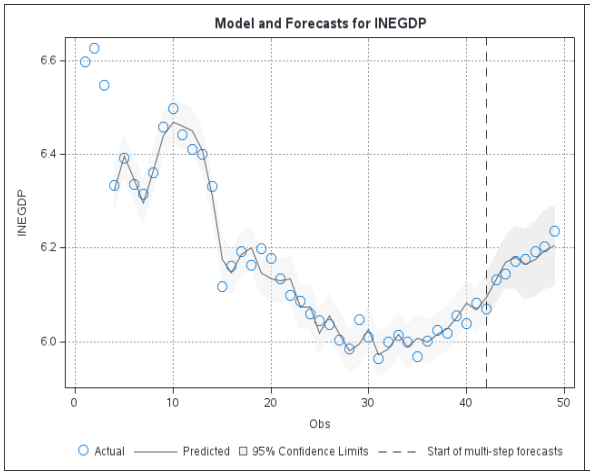


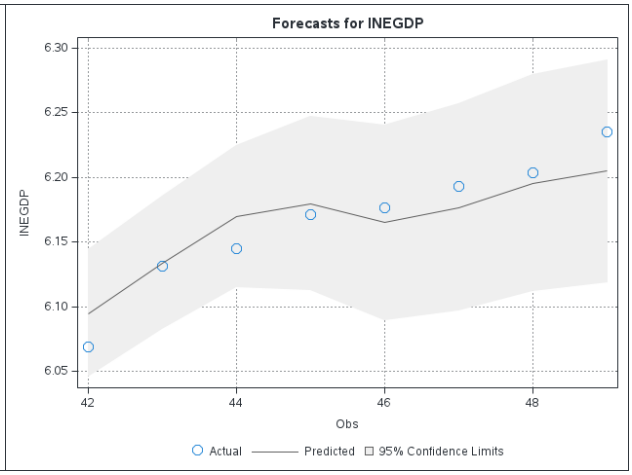


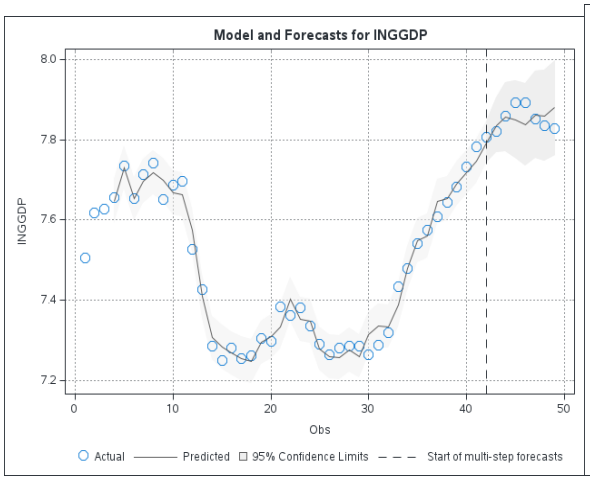












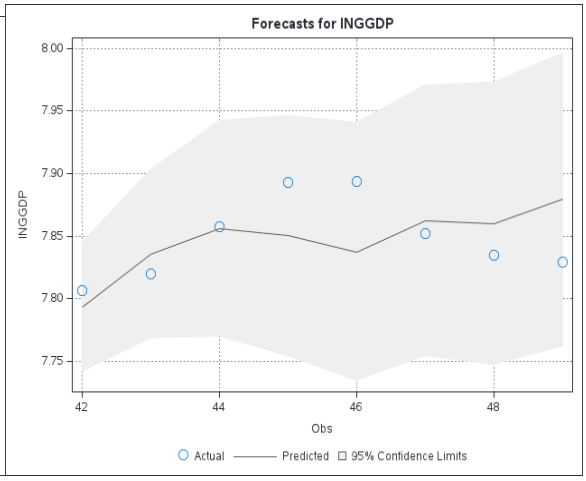


Figure 1. (a) Model and forecasting and **Figure 1.** (b) Forecasting

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

5. CONCLUSION AND POLICY IMPLICATIONS

The Granger causality test results are consistent with those of the model estimation (estimates), and the forecasting power of our estimated VECMX (3,0) model is very good.

Moreover, often due to geographical proximity and economic relations between two countries, if country A's economy (GDP/income) Granger causes country B's, this indicates that economic and financial policies and/or other economic activities (commerce) in or from country A affect the performance of country B's economy (Amidi & Fagheh Majidi, 2020: 49). In fact, from the results of our analysis, we can conclude that Benin's economy is negatively affected by Niger and positively influenced by Nigeria and Cameroon. But Chad has a mixed effect depending on the lag considered. Benin's economy is negatively affected, while Chad's positively affects Cameroon's. The Nigerian and Nigerien economies have a mixed impact on the Cameroonian economy, depending on the considered lag. Apart from Niger which has a negative impact on the Chadian economy, Nigeria, Cameroon, and Benin have mixed effects on the Chadian economy. Apart from Chad, which has a negative effect on the Nigerien economy, Nigeria, Cameroon, and Benin have mixed impacts on the Nigerien economy. Probably due to the Nigerian economy size and the nature of the Niger's economy, only the Nigerien economy has a statistically significant mixed effect on the Nigerian economy. Nonetheless, when considered as a group, the economies of Benin, Cameroon, Chad, and Niger Granger cause the Nigerian economy. As for financial development, Broad Money has a positive impact, while Domestic Credit has a negative impact on Cameroon; however, the cumulative effect is positive. In Benin and Niger, there is no evidence of FD's significant impact via either Broad Money or Domestic Credit. In Chad, FD (Broad Money as an indicator) has a negative effect, while Domestic Credit has no significant impact. Financial development in Nigeria (Broad Money as an indicator) positively affects the economy, while domestic credit has no statistically significant impact. We also notice some spillover effects of FD among countries via indirect transmission mechanisms. Overall, this demonstrates the economic and financial interdependencies and the need for a certain level of coordination in policies and regulatory measures among these economies to ensure efficiencies in intra-Africa trade and financial systems. Additionally, at the individual country level, authorities need to adjust their monetary and fiscal policies to facilitate or ease access to resources (domestic credits), especially for SMSE (Small & Medium Scale Enterprises), including cooperatives and village groups. This will foster positive effects of FD on the entire economy. At the African Union level, to promote economic and financial integration, individual country's disparities and specificities shall be considered in designing or revisiting the strategic development objectives of the Union as recalled in our introduction; for example, by taking into account the theory of comparative advantage (David Ricardo, 1817) by allowing each country to specialize in the production for which it has a "comparative advantage", compared to its partners. Of course, this can only be feasible if only there is political stability, peace, good governance, basic infrastructure, skilled human capital, and comprehensive policy coordination in all involved African countries or regional communities.

AUTHORS' STATEMENTS

Funding: No funds, grants, or other support was received.

Conflict of interest: The authors declare that they have no conflict of interest

Data availability: The data will be presented when it is needed.

Ethical approval and consent to participate: Scientific content and ethical rules have been obeyed in this study.

Consent for publication: All authors give their consent for the publication.

Authors' contributions: All authors contributed to the study within the framework of ethical rules. A joint study was conducted to collect the data, test the data, and evaluate statistical results.

REFERENCES

Abdo, H. M. (2008, 3 – 4 novembre). *Les échanges transfrontières : L'influence asymétrique du Nigeria sur le Niger dans le commerce des produits céréaliers*. [Communication au colloque]. Intégration des marchés et sécurité alimentaire dans les pays en développemen, Clermont-Fd, France.

Abdoulaye, A., & Zakaria, B. (2022). Les échanges commerciaux dans le bassin du lac Tchad entre décadence et défi sécuritaire de Boko Haram: Le cas de Kousseri (Cameroun) et N'djamena (Tchad), *Akofena, 8*(1), 25-38.

Akinlo, A. E., & Egbetunde, T. (2010). Financial development and economic growth: The experience of 10 sub-Saharan African countries revisited, *The Review of Finance and Banking*, *2*(1), 017-028.

Amidi, S., & Fagheh Majidi, A. (2020). Geographic proximity, trade, and economic growth: A spatial econometrics approach. *Annals of GIS*, *26*(1), 49–63.

Banque Mondiale. (2022, January 31). *Secteur financier*. https://www.worldbank.org/en/topic/financialsector/overview (Access Date: 10.12.2024).

Beck, T., Levine, R., & Loayza, N. (2000). Finance and the sources of growth, *Journal of Financial Economics*, *58*(1–2), 261-300.

Bio Goura, S. (1994). *Echanges régionaux et régulation des marchés agricoles: Le cas du Benin et du Niger en relation avec le Nigeria*. [Pubished doctoral dissertation]. Montpellier, ENSA.

Borlea, S. N., Mare, C., Achim, M. V., & Puscas, A. (2016). Direction of causality between financial development and economic growth: Evidence for developing countries, *Studia Universitatis "Vasile Goldis" Arad. Economics Series*, *26*(2), 1–22

Christopher, F. B., (2013). *VAR, SVAR and VECM models*. Boston College. http://fmwww.bc.edu/EC-C/S2013/823/EC823.S2013.nn10.slides.pdf (Access Date: 21.05.2025).

David Ricardo. (1817). *On the principles of political economy and taxation (Chapter 7: On Foreign Trade)*. John Murray.

ECA. (2023, August). *The AfCFTA, boosting regional integration through trade*. https://www.uneca.org/stories/the-afcfta%2C-boosting-regional-integration-through-trade#:~:text=Stockholm%2C%20Sweden%2C%2029%20August%202023,Karingi%20said (Access Date: 22.05.2025).

El Menyari, Y. (2019). Financial development, foreign banks and economic growth in Africa. *African Development Review*, *31*(2), 190-201.

Engle, R. F. (1982). Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation. *Econometrica*, *50*(4), 987–1007.

Granguillhome, R., Hernandez, M., Lach, S., Masaki, T., & Rodriguez, C. (2021). *Lake Chad regional economic memorandum: Development for peace.* The World Bank.

Haibo, C., Manu, E. K., & Somuah, M. (2023). Examining finance-growth nexus: Empirical evidence from the sub-regional economies of Africa. *Sage Open*, *13*(1), 1-18.

Kako Nubukpo. (2021). *Du franc CFA à l'Eco: Demain, la souveraineté monétaire ?*, Fondation Jean-Jaurès éditions / éditions de l'Aube.

King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics, 108*(3), 717-738.

Landreth, H., & Colander, D. C. (2002). *History of economic thought, (4th ed.).* Houghton Mifflin Company

Levine, R., Loayza, N., & BECK, T. (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics, 46*(1), 31-77.

Moussa, A. (2018). Does agricultural sector contribute to the economic growth in case of republic of Benin? *Journal of Social Economics Research*, *5*(2), 85–93.

Omoshoro-Jones, O. S., & Bonga-Bonga, L. (2022). Intra-regional spillovers from Nigeria and South Africa to the rest of Africa: New evidence from a FAVAR model. *World Economy*, *45*(1), 251-275.

Panizza, U. (2014). Financial development and economic growth: Known knowns, known unknowns, and unknown unknowns. *Revue d'Economie du Développement*, *22*(HS02), 35-65.

Saifaddin, G. (2024, March 25). *Population in Africa 2023, by country*. Statista. https://Www.Statista.Com/Statistics/1121246/Population-in-Africa-by-Country/ (Access Date: 05.10.2024).

SAS Institute Inc. (2014). *SAS/ETS ® 13.2 user's guide: The VARMAX procedure (chapter 35)*. https://support.sas.com/documentation/onlinedoc/ets/132/varmax.pdf (Access Date: 07.09.2025).

Sêgnon, A., & Baudoin, K. (2024). Effets du ralentissement des échanges transfrontaliers entre le Bénin et le Nigéria sur l'économie béninoise. *Revue Ouest Africaine de Sciences Economiques et de Gestion, 14*(1). *1-22*.

Smith, A. (1776). *The wealth of nations: An inquiry into the nature and causes of the wealth of nations.* W. Strahan and T. Cadell, London.

Stephen, H. (2008, 04-05 March). The finance-growth nexus: Theory, evidence, and implications for Africa [Conference presentation]. Conference on African finance for the 21st century, Tunis, Tunisia.

Susmel, R. (2015, August). *Econometrics II: Quantitative methods in finance II (FINA 8397) lecture 18 - multivariate time series: Cointegration.* C.T. Bauer College of Business. https://www.bauer.uh.edu/rsusmel/phd/ec2-7.pdf (Access Date: 04.06.2025).

The World Bank. (2025, May). *World Bank Country and Lending Groups*. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (Access Date: 2,.2025).

Union Africaine. (2023). *L'état de l'intégration régionale et continentale en Afrique. https://portal.africa-union.org/DVD/Documents/DOC-AU-WD/MYCM%20AU%203%20(V)%20_F.pdf* (Access Date: 31.10.2024).

Usman, M., Loves, L., Russel, E., Ansori, M., Warsono, W., Widiarti, W., & Wamiliana, W. (2022). Analysis of some energy and economics variables by using VECMX model in Indonesia. *International Journal of Energy Economics and Policy*, *12*(2), 91–102.

Viren, R. (2022, May 10). *VAR-VECM goodness of fit.* Spur Economics. https://spureconomics.com/var-vecm-goodness-of-fit/ (Access Date: 03.06.2025).

World Bank, (2024a). *Broad money (% of GDP)* [Data set]. WDI. https://databank.worldbank.org/source/world-development-indicators (Access Date: 30.09.2024).

World Bank, (2024b). *Domestic credit to private sector (% of GDP)* [Data set]. WDI. https://databank.worldbank.org/source/world-development-indicators (Access Date: 30.09.2024).

World Bank, (2024c). *GDP per capita (constant 2015 US$)* [Data set]. WDI. https://databank.worldbank.org/source/world-development-indicators (Access Date: 30.09.2024).

World Economic Outlook. (2024, October). *GDP, current prices*. https://Www.Imf.Org/External/Datamapper/PPPGDP@WEO/DZA/ZAF/MAR/NGA/EGY/AFQ (Access Date: 05.10.2024).

APPENDIX A

Table 3. Unit Root Test

Dickey-Fuller Unit Root Tests		First Difference				At Level			
Variable	**Type**	**Rho**	**P-value**	**Tau**	**P-value**	**Rho**	**P-value**	**Tau**	**P-value**
lBNGDP	**Zero Mean**	-54,88	<,0001	-5,06	<,0001	0,07	0,6936	2,14	0,9913
	Single Mean	-70,69	0,0004	-5,73	0,0001	0,11	0,9595	0,07	0,9599
	Trend	-75,52	<,0001	-5,91	<,0001	-14,82	0,1448	-2,52	0,3165
lCMGDP	**Zero Mean**	-26,99	<,0001	-3,59	0,0006	0,06	0,6917	0,72	0,8670
	Single Mean	-28,60	0,0004	-3,66	0,0079	-7,40	0,2288	-2,17	0,2191
	Trend	-29,63	0,0023	-3,69	0,0334	-7,22	0,6173	-2,08	0,5449
lCDGDP	**Zero Mean**	-41,26	<,0001	-4,43	<,0001	0,04	0,6879	0,39	0,7925
	Single Mean	-41,91	0,0004	-4,42	0,0009	-3,11	0,6316	-1,08	0,7160
	Trend	-44,36	<,0001	-4,45	0,0048	-8,65	0,4955	-2,26	0,4457
lNEGDP	**Zero Mean**	-49,55	<,0001	-4,93	<,0001	-0,07	0,6630	-0,97	0,2897
	Single Mean	-52,15	0,0004	-4,96	0,0002	-6,51	0,2875	-2,80	0,0661

	Trend	-70,06	<,0001	-5,69	0,0002	-5,20	0,7915	-1,54	0,8002
lNGGDP	**Zero Mean**	-20,51	0,0007	-3,20	0,0020	0,02	0,6828	0,29	0,7657
	Single Mean	-20,75	0,0045	-3,16	0,0285	-2,18	0,7489	-0,85	0,7940
	Trend	-23,66	0,0145	-3,39	0,0658	-3,22	0,9217	-1,30	0,8743
lBNDC	**Zero Mean**	-34,47	<,0001	-4,10	0,0001	0,10	0,7006	0,20	0,7413
	Single Mean	-34,88	0,0004	-4,07	0,0025	-3,37	0,5992	-1,33	0,6104
	Trend	-35,09	0,0003	-4,02	0,0147	-4,03	0,8763	-1,51	0,8129
lCMDC	**Zero Mean**	-30,20	<,0001	-3,81	0,0003	-0,16	0,6435	-0,25	0,5904
	Single Mean	-30,20	0,0004	-3,77	0,0058	-5,00	0,4167	-1,53	0,5112
	Trend	-30,24	0,0019	-3,73	0,0303	-7,35	0,6062	-1,79	0,6949
lCDDC	**Zero Mean**	-50,31	<,0001	-4,93	<,0001	-0,25	0,6222	-0,23	0,5977
	Single Mean	-50,54	0,0004	-4,89	0,0003	-6,21	0,3102	-1,64	0,4555
	Trend	-52,13	<,0001	-4,87	0,0014	-7,89	0,5587	-1,67	0,7508
lNEDC	**Zero Mean**	-33,65	<,0001	-4,01	0,0002	-0,01	0,6759	-0,01	0,6737
	Single Mean	-33,99	0,0004	-3,97	0,0033	-5,35	0,3839	-1,65	0,4484
	Trend	-34,04	0,0005	-3,93	0,0185	-6,14	0,7124	-1,81	0,6849
lNGDC	**Zero Mean**	-44,81	<,0001	-4,56	<,0001	0,09	0,6981	0,13	0,7202
	Single Mean	-45,62	0,0004	-4,52	0,0007	-9,80	0,1206	-2,24	0,1940
	Trend	-45,59	<,0001	-4,47	0,0045	-18,75	0,0560	-2,90	0,1709
lBNBM	**Zero Mean**	-44,69	<,0001	-4,70	<,0001	0,21	0,7281	0,86	0,8928
	Single Mean	-47,84	0,0004	-4,77	0,0004	-6,67	0,2763	-2,08	0,2523
	Trend	-48,57	<,0001	-4,74	0,0021	-7,87	0,5610	-2,08	0,5411
lCMBM	**Zero Mean**	-46,91	<,0001	-4,71	<,0001	0,09	0,6977	0,34	0,7803
	Single Mean	-47,50	0,0004	-4,69	0,0004	-4,63	0,4543	-1,41	0,5707
	Trend	-47,56	<,0001	-4,65	0,0027	-4,74	0,8272	-1,36	0,8583
lCDBM	**Zero Mean**	-68,86	<,0001	-5,73	<,0001	0,19	0,7220	0,46	0,8093
	Single Mean	-72,11	0,0004	-5,79	0,0001	-11,25	0,0810	-2,65	0,0894
	Trend	-73,78	<,0001	-5,81	0,0001	-11,18	0,3137	-2,54	0,3064
lNEBM	**Zero Mean**	-39,58	<,0001	-4,36	<,0001	0,22	0,7295	0,45	0,8087
	Single Mean	-41,56	0,0004	-4,37	0,0010	-6,81	0,2667	-2,04	0,2708
	Trend	-42,07	<,0001	-4,35	0,0062	-6,72	0,6609	-1,94	0,6180
lNGBM	**Zero Mean**	-54,49	<,0001	-5,11	<,0001	0,21	0,7261	0,38	0,7906
	Single Mean	-56,01	0,0004	-5,11	0,0002	-11,01	0,0865	-2,22	0,2021
	Trend	-56,23	<,0001	-5,06	0,0008	-13,82	0,1814	-2,49	0,3334

SOURCE: Authors' estimates from SAS VİYA FOR LEARNERS 4

APPENDIX B

Table 7a. Model Parameter Estimates

Equation	Parameter	Estimate	Standard Error	t Value	P Value	Variable
D_lBNGDP	CONST1	-1,35884**	0,60536	-2,24	0,0363	1
	XL0_1_1	-0,04355	0,02865	-1,52	0,1441	lBNDC(t)
	XL0_1_2	-0,06554	0,03927	-1,67	0,1107	lCMDC(t)
	XL0_1_3	-0,00660	0,01778	-0,37	0,7144	lCDDC(t)
	XL0_1_4	-0,03545	0,03173	-1,12	0,2771	lNEDC(t)
	XL0_1_5	-0,00190	0,02672	-0,07	0,9440	lNGDC(t)
	XL0_1_6	-0,03769	0,03233	-1,17	0,2573	lBNBM(t)
	XL0_1_7	0,04820	0,05467	0,88	0,3884	lCMBM(t)
	XL0_1_8	0,08166**	0,03144	2,60	0,0172	lCDBM(t)
	XL0_1_9	-0,03317	0,03307	-1,00	0,3277	lNEBM(t)
	XL0_1_10	0,01126	0,03897	0,29	0,7755	lNGBM(t)
	AR1_1_1	-0,36565**	0,09816	-3,73	0,0013	lBNGDP(t-1)

	AR1_1_2	0,31385**	0,08709	3,60	0,0018	lCMGDP(t-1)
	AR1_1_3	0,02676*	0,01357	1,97	0,0626	lCDGDP(t-1)
	AR1_1_4	0,00209	0,07840	0,03	0,9790	lNEGDP(t-1)
	AR1_1_5	0,21482**	0,06767	3,17	0,0048	lNGGDP(t-1)
	AR2_1_1	0,13168	0,14023	0,94	0,3589	D_lBNGDP(t-1)
	AR2_1_2	-0,02471	0,10642	-0,23	0,8187	D_lCMGDP(t-1)
	AR2_1_3	-0,03633	0,05852	-0,62	0,5417	D_lCDGDP(t-1)
	AR2_1_4	-0,18816**	0,08976	-2,10	0,0490	D_lNEGDP(t-1)
	AR2_1_5	-0,09357	0,09738	-0,96	0,3481	D_lNGGDP(t-1)
	AR3_1_1	-0,24830*	0,14050	-1,77	0,0924	D_lBNGDP(t-2)
	AR3_1_2	-0,06141	0,09535	-0,64	0,5268	D_lCMGDP(t-2)
	AR3_1_3	-0,10199**	0,04148	-2,46	0,0232	D_lCDGDP(t-2)
	AR3_1_4	0,04278	0,09728	0,44	0,6648	D_lNEGDP(t-2)
	AR3_1_5	-0,05851	0,09165	-0,64	0,5305	D_lNGGDP(t-2)
D_lCMGDP	CONST2	4,74098**	0,75265	6,30	<,0001	1
	XL0_2_1	-0,00417	0,03562	-0,12	0,9080	lBNDC(t)
	XL0_2_2	-0,13702**	0,04882	-2,81	0,0109	lCMDC(t)
	XL0_2_3	0,09226**	0,02210	4,17	0,0005	lCDDC(t)
	XL0_2_4	0,16702**	0,03945	4,23	0,0004	lNEDC(t)
	XL0_2_5	0,11590**	0,03322	3,49	0,0023	lNGDC(t)
	XL0_2_6	-0,07800*	0,04019	-1,94	0,0665	lBNBM(t)
	XL0_2_7	0,37231**	0,06797	5,48	<,0001	lCMBM(t)
	XL0_2_8	0,00531	0,03909	0,14	0,8933	lCDBM(t)
	XL0_2_9	-0,10969**	0,04111	-2,67	0,0148	lNEBM(t)
	XL0_2_10	-0,37306**	0,04845	-7,70	<,0001	lNGBM(t)
	AR1_2_1	-0,12127	0,12204	-0,99	0,3322	lBNGDP(t-1)
	AR1_2_2	-0,42101**	0,10828	-3,89	0,0009	lCMGDP(t-1)
	AR1_2_3	0,05407**	0,01687	3,20	0,0045	lCDGDP(t-1)
	AR1_2_4	-0,50487**	0,09748	-5,18	<,0001	lNEGDP(t-1)
	AR1_2_5	0,25877**	0,08414	3,08	0,0060	lNGGDP(t-1)
	AR2_2_1	0,05863	0,17435	0,34	0,7401	D_lBNGDP(t-1)
	AR2_2_2	0,24413*	0,13231	1,85	0,0799	D_lCMGDP(t-1)
	AR2_2_3	-0,11980	0,07276	-1,65	0,1153	D_lCDGDP(t-1)
	AR2_2_4	0,52041**	0,11160	4,66	0,0001	D_lNEGDP(t-1)
	AR2_2_5	-0,03939	0,12108	-0,33	0,7483	D_lNGGDP(t-1)
	AR3_2_1	-0,39392**	0,17469	-2,25	0,0355	D_lBNGDP(t-2)
	AR3_2_2	-0,25323**	0,11855	-2,14	0,0452	D_lCMGDP(t-2)
	AR3_2_3	0,02103	0,05158	0,41	0,6878	D_lCDGDP(t-2)
	AR3_2_4	0,20210	0,12095	1,67	0,1103	D_lNEGDP(t-2)
	AR3_2_5	-0,56734**	0,11395	-4,98	<,0001	D_lNGGDP(t-2)
D_lCDGDP	CONST3	7,29402**	1,06979	6,82	<,0001	1
	XL0_3_1	0,02432	0,05062	0,48	0,6362	lBNDC(t)
	XL0_3_2	0,12208*	0,06939	1,76	0,0938	lCMDC(t)
	XL0_3_3	0,05087	0,03141	1,62	0,1210	lCDDC(t)
	XL0_3_4	0,03576	0,05607	0,64	0,5308	lNEDC(t)
	XL0_3_5	0,03244	0,04722	0,69	0,4999	lNGDC(t)
	XL0_3_6	0,08688	0,05713	1,52	0,1440	lBNBM(t)
	XL0_3_7	0,38090**	0,09661	3,94	0,0008	lCMBM(t)
	XL0_3_8	-0,35945**	0,05556	-6,47	<,0001	lCDBM(t)
	XL0_3_9	0,19430**	0,05843	3,33	0,0034	lNEBM(t)
	XL0_3_10	-0,25249**	0,06886	-3,67	0,0015	lNGBM(t)
	AR1_3_1	0,83910**	0,17346	4,84	0,0001	lBNGDP(t-1)
	AR1_3_2	-0,73846**	0,15391	-4,80	0,0001	lCMGDP(t-1)

	AR1_3_3	-0,20718**	0,02398	-8,64	<,0001	lCDGDP(t-1)
	AR1_3_4	-0,83378**	0,13855	-6,02	<,0001	lNEGDP(t-1)
	AR1_3_5	-0,27944**	0,11959	-2,34	0,0300	lNGGDP(t-1)
	AR2_3_1	-0,69805**	0,24781	-2,82	0,0107	D_lBNGDP(t-1)
	AR2_3_2	0,77686**	0,18806	4,13	0,0005	D_lCMGDP(t-1)
	AR2_3_3	-0,24724**	0,10341	-2,39	0,0268	D_lCDGDP(t-1)
	AR2_3_4	0,12117	0,15862	0,76	0,4538	D_lNEGDP(t-1)
	AR2_3_5	0,32011*	0,17209	1,86	0,0776	D_lNGGDP(t-1)
	AR3_3_1	-0,36972	0,24830	-1,49	0,1521	D_lBNGDP(t-2)
	AR3_3_2	0,53244**	0,16850	3,16	0,0049	D_lCMGDP(t-2)
	AR3_3_3	-0,16103**	0,07331	-2,20	0,0400	D_lCDGDP(t-2)
	AR3_3_4	0,16750	0,17192	0,97	0,3415	D_lNEGDP(t-2)
	AR3_3_5	0,01242	0,16196	0,08	0,9396	D_lNGGDP(t-2)
D_lNEGDP	CONST4	4,52907**	0,78175	5,79	<,0001	1
	XL0_4_1	0,04091	0,03699	1,11	0,2819	lBNDC(t)
	XL0_4_2	0,06457	0,05071	1,27	0,2175	lCMDC(t)
	XL0_4_3	0,03316	0,02296	1,44	0,1640	lCDDC(t)
	XL0_4_4	-0,02564	0,04097	-0,63	0,5385	lNEDC(t)
	XL0_4_5	-0,00798	0,03451	-0,23	0,8195	lNGDC(t)
	XL0_4_6	-0,21303**	0,04175	-5,10	<,0001	lBNBM(t)
	XL0_4_7	-0,10568	0,07060	-1,50	0,1500	lCMBM(t)
	XL0_4_8	0,05314	0,04060	1,31	0,2054	lCDBM(t)
	XL0_4_9	-0,03161	0,04270	-0,74	0,4678	lNEBM(t)
	XL0_4_10	0,02246	0,05032	0,45	0,6601	lNGBM(t)
	AR1_4_1	-0,56591**	0,12676	-4,46	0,0002	lBNGDP(t-1)
	AR1_4_2	0,19741*	0,11247	1,76	0,0945	lCMGDP(t-1)
	AR1_4_3	-0,05416**	0,01752	-3,09	0,0058	lCDGDP(t-1)
	AR1_4_4	-0,93733**	0,10125	-9,26	<,0001	lNEGDP(t-1)
	AR1_4_5	0,60459**	0,08739	6,92	<,0001	lNGGDP(t-1)
	AR2_4_1	0,57747**	0,18109	3,19	0,0046	D_lBNGDP(t-1)
	AR2_4_2	-0,23403	0,13743	-1,70	0,1041	D_lCMGDP(t-1)
	AR2_4_3	-0,12865	0,07557	-1,70	0,1042	D_lCDGDP(t-1)
	AR2_4_4	0,05803	0,11592	0,50	0,6221	D_lNEGDP(t-1)
	AR2_4_5	-0,44770**	0,12576	-3,56	0,0020	D_lNGGDP(t-1)
	AR3_4_1	0,46591**	0,18145	2,57	0,0184	D_lBNGDP(t-2)
	AR3_4_2	-0,33303**	0,12313	-2,70	0,0136	D_lCMGDP(t-2)
	AR3_4_3	-0,05046	0,05357	-0,94	0,3575	D_lCDGDP(t-2)
	AR3_4_4	-0,17072	0,12563	-1,36	0,1893	D_lNEGDP(t-2)
	AR3_4_5	-0,30425**	0,11836	-2,57	0,0182	D_lNGGDP(t-2)
D_lNGGDP	CONST5	-2,05373**	0,90031	-2,28	0,0336	1
	XL0_5_1	0,03774	0,04260	0,89	0,3863	lBNDC(t)
	XL0_5_2	0,02231	0,05840	0,38	0,7065	lCMDC(t)
	XL0_5_3	-0,08888**	0,02644	-3,36	0,0031	lCDDC(t)
	XL0_5_4	-0,13704**	0,04718	-2,90	0,0088	lNEDC(t)
	XL0_5_5	-0,03165	0,03974	-0,80	0,4351	lNGDC(t)
	XL0_5_6	-0,17923**	0,04808	-3,73	0,0013	lBNBM(t)
	XL0_5_7	0,01187	0,08130	0,15	0,8854	lCMBM(t)
	XL0_5_8	0,18677**	0,04676	3,99	0,0007	lCDBM(t)
	XL0_5_9	0,10188*	0,04918	2,07	0,0514	lNEBM(t)
	XL0_5_10	0,23556**	0,05795	4,06	0,0006	lNGBM(t)
	AR1_5_1	0,20411	0,14598	1,40	0,1774	lBNGDP(t-1)
	AR1_5_2	0,02281	0,12953	0,18	0,8620	lCMGDP(t-1)
	AR1_5_3	-0,01561	0,02018	-0,77	0,4482	lCDGDP(t-1)

	AR1_5_4	0,27959**	0,11660	2,40	0,0264	lNEGDP(t-1)
	AR1_5_5	-0,21362**	0,10064	-2,12	0,0465	lNGGDP(t-1)
	AR2_5_1	-0,26284	0,20855	-1,26	0,2221	D_lBNGDP(t-1)
	AR2_5_2	0,04825	0,15827	0,30	0,7636	D_lCMGDP(t-1)
	AR2_5_3	-0,01405	0,08703	-0,16	0,8734	D_lCDGDP(t-1)
	AR2_5_4	-0,57012**	0,13349	-4,27	0,0004	D_lNEGDP(t-1)
	AR2_5_5	0,11520	0,14483	0,80	0,4357	D_lNGGDP(t-1)
	AR3_5_1	-0,06334	0,20896	-0,30	0,7649	D_lBNGDP(t-2)
	AR3_5_2	0,16136	0,14180	1,14	0,2686	D_lCMGDP(t-2)
	AR3_5_3	0,07995	0,06170	1,30	0,2098	D_lCDGDP(t-2)
	AR3_5_4	-0,39581**	0,14468	-2,74	0,0127	D_lNEGDP(t-2)
	AR3_5_5	0,50600**	0,13630	3,71	0,0014	D_lNGGDP(t-2)

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

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

Table 7b. Alpha and Beta Parameter Estimates

Alpha and Beta Parameter Estimates						
Equation	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Variable**
D_lBNGDP	ALPHA1_1	-0,00085	0,00277	-0,31	0,7629	Beta[,1]'*_DEP_(t-1)
	ALPHA1_2	-0,00094	0,00277	-0,34	0,7391	Beta[,2]'*_DEP_(t-1)
	ALPHA1_3	0,01061***	0,00277	3,83	0,0010	Beta[,3]'*_DEP_(t-1)
	BETA1_1	2,83257				lBNGDP(t-1)
	BETA1_2	12,16023				lBNGDP(t-1)
	BETA1_3	-33,17448				lBNGDP(t-1)
D_lCMGDP	ALPHA2_1	0,01639***	0,00344	4,76	0,0001	Beta[,1]'*_DEP_(t-1)
	ALPHA2_2	-0,02559***	0,00344	-7,43	<,0001	Beta[,2]'*_DEP_(t-1)
	ALPHA2_3	-0,00433	0,00344	-1,26	0,2235	Beta[,3]'*_DEP_(t-1)
	BETA2_1	-11,09115				lCMGDP(t-1)
	BETA2_2	4,43047				lCMGDP(t-1)
	BETA2_3	29,09437				lCMGDP(t-1)
D_lCDGDP	ALPHA3_1	-0,02811***	0,00489	-5,74	<,0001	Beta[,1]'*_DEP_(t-1)
	ALPHA3_2	-0,01620***	0,00489	-3,31	0,0035	Beta[,2]'*_DEP_(t-1)
	ALPHA3_3	-0,03363***	0,00489	-6,87	<,0001	Beta[,3]'*_DEP_(t-1)
	BETA3_1	3,99450				lCDGDP(t-1)
	BETA3_2	-0,03399				lCDGDP(t-1)
	BETA3_3	2,83871				lCDGDP(t-1)
D_lNEGDP	ALPHA4_1	-0,01718***	0,00358	-4,80	0,0001	Beta[,1]'*_DEP_(t-1)
	ALPHA4_2	-0,02960***	0,00358	-8,28	<,0001	Beta[,2]'*_DEP_(t-1)
	ALPHA4_3	0,00474	0,00358	1,33	0,1997	Beta[,3]'*_DEP_(t-1)
	BETA4_1	10,68120				lNEGDP(t-1)
	BETA4_2	26,00533				lNEGDP(t-1)
	BETA4_3	3,34296				lNEGDP(t-1)
D_lNGGDP	ALPHA5_1	-0,00241	0,00412	-0,59	0,5646	Beta[,1]'*_DEP_(t-1)
	ALPHA5_2	0,01199***	0,00412	2,91	0,0086	Beta[,2]'*_DEP_(t-1)
	ALPHA5_3	-0,00196	0,00412	-0,48	0,6390	Beta[,3]'*_DEP_(t-1)
	BETA5_1	-3,42796				lNGGDP(t-1)
	BETA5_2	-15,45426				lNGGDP(t-1)
	BETA5_3	18,61666				lNGGDP(t-1)

*****: significant at 1% level**

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

APPENDIX C

Table 13a. Granger Causality Wald Test

Test	Group variables	D.Freedom	Chi-square	P-value	Conclusion
1	Group 1 Variables:lBNGDP Group 2 Variables:lBNDC	3	1,52	0,6769	Cannot Reject Ho
2	Group 1 Variables:lBNGDP Group 2 Variables:lBNBM	3	1,32	0,7253	Cannot Reject Ho
3	Group 1 Variables:lBNGDP Group 2 Variables:lBNDC lBNBM	6	5,41	0,4919	Cannot Reject Ho
4	Group 1 Variables:lBNGDP Group 2 Variables: lCMGDP	3	0,29	0,9619	Cannot Reject Ho
5	Group 1 Variables:lBNGDP Group 2 Variables: lCDGDP	3	3,23	0,3572	Cannot Reject Ho
6	Group 1 Variables:lBNGDP Group 2 Variables: lNEGDP	3	10,81**	0,0128	Can Reject Ho
7	Group 1 Variables:lBNGDP Group 2 Variables: lNGGDP	3	1,55	0,6711	Cannot Reject Ho
8	Group 1 Variables: lBNGDP Group 2 Variables: lCMGDP lCDGDP lNEGDP lNGGDP	12	20,27	0,0621	Cannot Reject Ho

****: significant at 5% level**

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

Table 13b. Granger Causality Wald Test

0	Group variables	D.Freedom	Chi-square	P-value	Conclusion
1	Group 1 Variables:lCMGDP Group 2 Variables:lCMDC	3	5,63	0,1311	Cannot Reject Ho
2	Group 1 Variables:lCMGDP Group 2 Variables:lCMBM	3	6,97	0,0727	Cannot Reject Ho
3	Group 1 Variables:lCMGDP Group 2 Variables:lCMDC lCMBM	6	12,98**	0,0434	Can Reject Ho
4	Group 1 Variables:lCMGDP Group 2 Variables: lBNGDP	3	6,11	0,1065	Cannot Reject Ho
5	Group 1 Variables:lCMGDP Group 2 Variables: lCDGDP	3	2,22	0,5288	Cannot Reject Ho
6	Group 1 Variables:lCMGDP Group 2 Variables: lNEGDP	3	7,00	0,0718	Cannot Reject Ho
7	Group 1 Variables:lCMGDP Group 2 Variables: lNGGDP	3	9,01**	0,0291	Can Reject Ho
8	Group 1 Variables: lCMGDP Group 2 Variables: lBNGDP lCDGDP lNEGDP lNGGDP	12	31,80**	0,0015	Can Reject Ho

****: significant at 5% level**

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

Table 13c. Granger Causality Wald Test

Test	Group variables	D.Freedom	Chi-square	P-value	Conclusion
1	Group 1 Variables:lCDGDP Group 2 Variables:lCDDC	3	5,70	0,1271	Cannot Reject Ho
2	Group 1 Variables:lCDGDP Group 2 Variables:lCDBM	3	3,32	0,3445	Cannot Reject Ho
3	Group 1 Variables:lCDGDP Group 2 Variables:lCDDC lCDBM	6	9,44	0,1504	Cannot Reject Ho
4	Group 1 Variables:lCDGDP Group 2 Variables: lBNGDP	3	16,76**	0,0008	Can Reject Ho
5	Group 1 Variables:lCDGDP Group 2 Variables: lCMGDP	3	2,24	0,5236	Cannot Reject Ho
6	Group 1 Variables:lCDGDP Group 2 Variables: lNEGDP	3	17,24**	0,0006	Can Reject Ho
7	Group 1 Variables:lCDGDP Group 2 Variables: lNGGDP	3	4,14	0,2467	Cannot Reject Ho
8	Group 1 Variables: lCDGDP Group 2 Variables: lBNGDP lCMGDP lNEGDP lNGGDP	12	72,03**	<0,0001	Can Reject Ho

****: significant at 5% level**

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

Table 13d. Granger Causality Wald Test

Test	Group variables	D.Freedom	Chi-square	P-value	Conclusion
1	Group 1 Variables:lNEGDP Group 2 Variables:lNEDC	3	3,41	0,3323	Cannot Reject Ho
2	Group 1 Variables:lNEGDP Group 2 Variables:lNEBM	3	8,59**	0,0353	Can Reject Ho
3	Group 1 Variables:lNEGDP Group 2 Variables:lNEDC lNEBM	6	9,72	0,1369	Cannot Reject Ho
4	Group 1 Variables:lNEGDP Group 2 Variables: lBNGDP	3	1,57	0,6670	Cannot Reject Ho
5	Group 1 Variables:lNEGDP Group 2 Variables: lCMGDP	3	2,13	0,5456	Cannot Reject Ho
6	Group 1 Variables:lNEGDP Group 2 Variables: lCDGDP	3	6,54	0,0881	Cannot Reject Ho
7	Group 1 Variables:lNEGDP Group 2 Variables: lNGGDP	3	10,56**	0,0144	Can Reject Ho
8	Group 1 Variables: lNEGDP Group 2 Variables: lBNGDPl CMGDP lCDGDP lNGGDP	12	63,82**	<0,0001	Can Reject Ho

****: significant at 5% level**

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

Table 13e. Granger Causality Wald Test

Test	Group variables	D.Freedom	Chi-square	P-value	Conclusion
1	Group 1 Variables:lNGGDP Group 2 Variables:lNGDC	3	2,75	0,4311	Cannot Reject Ho
2	Group 1 Variables:lNGGDP Group 2 Variables:lNGBM	3	4,35	0,2256	Cannot Reject Ho
3	Group 1 Variables:lNGGDP Group 2 Variables:lNGDC lNGBM	6	10,60	0,1014	Cannot Reject Ho

4	Group 1 Variables:lNGGDP Group 2 Variables: lBNGDP	3	12,31**	0,0064	Can Reject Ho
5	Group 1 Variables:lNGGDP Group 2 Variables: lCMGDP	3	2,47	0,4803	Cannot Reject Ho
6	Group 1 Variables:lNGGDP Group 2 Variables: lCDGDP	3	13,47**	0,0037	Can Reject Ho
7	Group 1 Variables:lNGGDP Group 2 Variables: lNEGDP	3	10,94**	0,0121	Can Reject Ho
8	Group 1 Variables: lNGGDP Group 2 Variables: lBNGDP lCMGDP lCDGDP lNEGDP	12	50,04**	<0,0001	Can Reject Ho

****: significant at 5% level**

Source: Authors'computations from SAS VIYA FOR LEARNERS 4

APPENDIX D

Table 14. Forecasts for the Next 8 Years

Variable	Obs	Forecast	Standard Error	95% Confidence Limits		Actual	Residual
lBNGDP	**42**	6,87047	0,01950	6,83225	6,90870	6,86979	-0,00069
	43	6,88954	0,02820	6,83427	6,94482	6,88763	-0,00191
	44	6,89836	0,02967	6,84020	6,95652	6,92808	0,02972
	45	6,90646	0,03034	6,84699	6,96593	6,96045	0,05399
	46	6,92901	0,03186	6,86656	6,99145	6,94856	0,01956
	47	6,95386	0,03406	6,88709	7,02062	6,95192	-0,00194
	48	6,96692	0,03608	6,89622	7,03763	6,97762	0,01070
	49	6,99090	0,03784	6,91674	7,06506	7,01322	0,02232
lCMGDP	**42**	7,18324	0,02266	7,13883	7,22765	7,15740	-0,02585
	43	7,15436	0,02680	7,10183	7,20688	7,17447	0,02012
	44	7,14211	0,02987	7,08357	7,20065	7,19508	0,05297
	45	7,18684	0,03230	7,12354	7,25014	7,22035	0,03351
	46	7,23774	0,03379	7,17152	7,30396	7,24400	0,00625
	47	7,22954	0,03681	7,15740	7,30169	7,25843	0,02889
	48	7,25479	0,03902	7,17832	7,33126	7,26489	0,01010
	49	7,24297	0,04084	7,16292	7,32302	7,27605	0,03308
lCDGDP	**42**	6,61240	0,03047	6,55267	6,67213	6,55553	-0,05687
	43	6,57847	0,03867	6,50268	6,65427	6,60576	0,02728
	44	6,54045	0,04404	6,45414	6,62677	6,62562	0,08517
	45	6,53626	0,04933	6,43958	6,63294	6,65664	0,12039
	46	6,55401	0,05998	6,43645	6,67156	6,65210	0,09810
	47	6,54433	0,07114	6,40491	6,68376	6,55602	0,01169
	48	6,51179	0,08153	6,35198	6,67159	6,49243	-0,01936
	49	6,48417	0,08923	6,30929	6,65906	6,48211	-0,00206
lNEGDP	**42**	6,09477	0,02522	6,04534	6,14420	6,06911	-0,02565
	43	6,13389	0,02643	6,08209	6,18569	6,13130	-0,00259
	44	6,16959	0,02818	6,11437	6,22481	6,14490	-0,02469
	45	6,17964	0,03444	6,11215	6,24714	6,17140	-0,00825
	46	6,16487	0,03850	6,08940	6,24033	6,17610	0,01123
	47	6,17661	0,04084	6,09656	6,25667	6,19325	0,01664
	48	6,19539	0,04282	6,11147	6,27931	6,20378	0,00839
	49	6,20492	0,04404	6,11861	6,29124	6,23553	0,03061

lNGGDP	**42**	7,79306	0,02655	7,74102	7,84511	7,80619	0,01312
	43	7,83569	0,03444	7,76818	7,90320	7,82012	-0,01557
	44	7,85605	0,04428	7,76926	7,94284	7,85773	0,00168
	45	7,85010	0,04912	7,75382	7,94638	7,89264	0,04254
	46	7,83723	0,05276	7,73382	7,94063	7,89341	0,05618
	47	7,86222	0,05532	7,75380	7,97063	7,85203	-0,01018
	48	7,85991	0,05766	7,74690	7,97292	7,83479	-0,02512
	49	7,87922	0,05996	7,76170	7,99674	7,82887	-0,05035

Source: Authors'computations from SAS VIYA FOR LEARNERS 4