Foreign Direct Investment and Growth in ECOWAS:An ARDL Panel Analysis

Abstract

This study examines the impact of core macroeconomic indicators on growth across Sixteen (16) West African countries using the Pooled Mean Group (PMG) estimation technique within a Panel ARDL framework. The analysis covers variables such as Foreign Direct Investment (FDI), Gross Capital Formation, percentage of working population growth, access to electricity, and inflation. The findings reveal that the effects of FDI on growth are mixed, while FDI positively impacts real GDP growth in some countries such as Benin, Cabo Verde, and Mauritania. However, its effects are negative in others such as Nigeria and Gambia. Gross capital formation, on the other hand, consistently supports short-run growth across most countries, while inflation emerges as a destabilizing factor. The speed of adjustment toward long-run equilibrium varies significantly, with countries such as Guinea-Bissau and Nigeria correcting economic shocks faster than others. This study contributes to the literature on economic growth dynamics in Africa by showing the heterogeneous responses of these countries to similar macroeconomic factors. It validates the need for country-specific policies that focus on stabilizing inflation, optimizing domestic investment, and effectively leveraging foreign direct investment. Also, improvements in infrastructure and access to markets are crucial for facilitating long-term growth across the region. The study provides valuable insights for policymakers and stakeholders aiming to achieve sustainable growth in the ECOWAS region.

Keywords: Growth, FDI, Inflation, Gross Capital Formation, Panel ARDL Model, ECOWAS
JELCode: O47, F21, E31, E22, C33

1. Introduction

The Economic Community of West African States (ECOWAS) is a regional political and economic union of fifteen countries within the West Africa region. The Bloc, comprising Benin, Burkina Faso, Cabo Verde (Cape Verde), Côte d'Ivoire (Ivory Coast), Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo, andincluding Mauritania has witnessed fluctuating trends in Foreign Direct Investment (FDI) over the past few decades, with some countries experiencing significant inflows while others struggle to attract investment. Over this past decade, Countries in ECOWAS have experienced a notable rise in Foreign Direct Investment (FDI) inflows spurred by political stability, economic reforms, and the region's vast natural resources. Countries like Nigeria, Ghana, and Côte d'Ivoire have attracted significant investments in oil and gas, agriculture, and telecommunications.

However, this growth in FDI has been unevenly distributed across the region, with certain countries benefiting more than others. Key sectors driving FDI in West Africa include natural resources, especially oil and gas, which remains a significant draw in countries like Nigeria and Angola. The region has also seen notable investments in agriculture and mining as countries aim to leverage their resource wealth for economic expansion. The telecommunications sector has also attracted substantial investment, driven by the rapid growth of mobile technology, enhancing connectivity and information access. Attracting foreign investments into an economy will invariably help transform domestic firms through several channels. The technology of local firms may improve as foreign firms demonstrate new technologies, provide technological assistance to their local suppliers and customers, and train workers whom local firms may later employ. Furthermore, the competitive pressures from foreign firms may force local firms to operate more efficiently and stimulate them to introduce new technologies. Despite the potential benefits of FDI, such as technology transfer, job creation, and infrastructure development, the impact of these investments on economic growth in the ECOWAS region has remainedquestionable with many perceptions that most economies within the region have not harnessed the expected benefits of opening up their economies for foreign investments.

For instance, the contribution of FDI as a percentage of GDP in Benin, Cape Verde, Ghana,and Burkina Faso grew slowly from 0.05, 0.08, 0.25, and 0.02 percent in 1990 to about 1.54, 5.28, 2.02 and 0.64 percent, respectively.Meanwhile, Nigeria experienced a negative growth from 5.79 percent to -0.05 percent. This implies that the inflow of investments into the economies in the region may not support growth.

However, several factors may have contributed to this ambiguity, which include political instability, regulatory challenges, low level of infrastructure, and varying levels of economic development across the region. Also, the existing literature presents mixed findings on the relationship between FDI and growth, with some studies indicating a positive correlation while others suggest negligible or even negative effects. Consequently, it is essential to thoroughly analyze the FDI-growth nexus in West Africa using the arcane ARDL panel approach. This methodology allows for examining both short-term and long-term relationships between variables, providing a holistic understanding of how FDI influences economic growth in the region.

The problem statement thus centers on the need to clarify the dynamics of FDI and its impact on economic growth in West Africa, with the following key questions:What is the nature of the relationship between FDI and economic growth in ECOWAS countriesand are the influx of foreign direct investments beneficial to economies within the region?Are there significant differences in this relationship across different countries within the region?What role do macroeconomic factors play in mediating the effects of FDI on growth?

By assessing these pertinent questions, this study aims to contribute verifiable insights for policymakers and stakeholders in West Africa, facilitating informed decision-making to enhance economic growth through strategic FDI attraction and management.

Despite the potential benefits, several challenges hinder the effective contribution of FDI to economic growth in West Africa. Issues such as political instability, inadequate infrastructure, and regulatory barriers can deter foreign investors. A study by Anyanwu (2012) revealed that while FDI inflows have increased, the region still faces significant challenges that limit the realization of its full economic potential.

Also, much of the empirical research focused on the short to medium-term impacts of FDI (Kong et al., 2024 and Matsumoto, 2022), with limited assessment of its long-term consequences. Moreover, while institutional quality is frequently cited as a key determinant of FDI success, more research is needed to understand the specific mechanisms through which institutional reforms can enhance FDI outcomes in different sectors. However, while these studies provide valuable insights, they often overlook the long-term social and environmental consequences of FDI, particularly in developing economies where regulatory frameworks may be weak.

Thus, the problem is to determine under what conditions FDI drives sustainable economic growth in West Africa and to identify specific policy interventions that can optimize FDI's benefits across the region. This research aims to inform bespoke policy solutions that maximize the benefits of FDI and address economic disparities within the ECOWAS region, hence the research questions for this study:

1. How does Foreign Direct Investment (FDI) impact short-term versus long-term economic growth in individual West African countries within the ECOWAS region?
2. What roles do macroeconomic factors, such as inflation, population growth, and access to electricity, play in moderating the effects of FDI on economic growth across ECOWAS member states?
3. How do country-specific policies influence the effectiveness of FDI in promoting economic growth, particularly in economies with varying levels of infrastructure and political stability within West Africa?

However, the impact of FDI on economic growth, particularly in relation to gross domestic product (GDP) growth, access to electricity, population growth, inflation, and gross capital formation (domestic investment), remains unclear, thus the objective of this study is to investigate the relationship between the variables of interests. The influence of these factors on FDI inflows raises critical questions about the conditions under which FDI fosters

sustainable economic growth and whether its effects are uniformly positive across different economic frameworks. For instance, while FDI is expected to boost GDP growth by enhancing productivity and creating employment opportunities, the relationship is not always straightforward, for example, Sahu (2021) showed a positive impact of FDI on GDP growth, but this effect may be influenced by the causal macroeconomic conditions, such as inflation and trade openness. In some instances, FDI inflows may be directed towards less productive sectors, leading to suboptimal growth outcomes.

Again, adequate infrastructure, particularly access to electricity, is a crucial determinant of the effectiveness of FDI in promoting economic growth. Countries with poor electricity infrastructure may struggle to attract high-quality FDI or fully leverage its benefits for industrial development. Akpanke et al. (2023) noted the importance of renewable energy (RE) as an alternative that could mitigate the negative environmental impact of FDI while improving energy access, a factor critical for sustained economic development. Population dynamics also play a significant role in determining the effects of FDI. Rapid population growth, particularly in developing economies, can put pressure on existing infrastructure and public services, potentially weakening the positive impact of FDI on GDP growth. Large populations can create labour market advantages but may also lead to increased demand for energy, housing, and other public goods, making difficult the management of FDI inflows. More so, high inflation rates can deter FDI inflows by creating economic instability and uncertainty for investors. As noted by Azam and Haseeb (2021), inflation was found to have a negative impact on FDI inflows in BRICS countries, suggesting that macroeconomic stability is essential for attracting and sustaining foreign investment.

Inflation can erode the purchasing power of consumers and increase the costs of doing business, thereby diminishing the impact of FDI on growth. More so, trade openness is generally considered to enhance the effects of FDI by facilitating the movement of goods, services, and capital across borders. However, as Osabohien et al. (2022) found, trade openness does not automatically translate into inclusive growth, and the impact of FDI on the balance of trade can be mixed. FDI that leads to significant imports of intermediate goods might worsen the trade balance, especially if it does not result in a corresponding increase in exports. This raises the question of whether trade liberalization policies are sufficient or if more targeted interventions are necessary to ensure FDI contributes to a favourable balance of trade. The relationship between FDI and gross capital formation is another critical area of concern. FDI is often seen as a complement to domestic investment, spurring local firms to invest more in innovation and capacity-building. However, there is also the risk that FDI might crowd out domestic investment if foreign firms dominate the market and local companies struggle to compete. Studies like Mugableh (2015) indicate that domestic factors such as exchange rates, trade, and gross capital formation play a vital role in attracting FDI, but there remains a need to investigate how FDI can better complement domestic investment for long-term economic growth. The rest of the paper is structured into sections covering a review of relevant literature, methodology, results and discussions, and a conclusion with key insights and recommendations for enhancing the positive impact of FDI on growth in the ECOWAS region.

2. Review of Literature

Several theories explain the relationship between FDI and growth. The Neoclassical Growth Theory introduced in the 1950s by Robert Solow and Trevor Swan holds that capital accumulation, including FDI, is essential for economic growth. Also, the Endogenous Growth Theory points to the role of technology and innovation, inferring that FDI can lead to knowledge spillovers that enhance productivity. The Institutional theory stresses the importance of strong institutions in attracting FDI and ensuring that it translates into sustainable economic growth.Evidence from literature shows that Foreign Direct Investment (FDI) plays a significant role in economic growth across West Africa.

Numerous studies have documented the positive impacts of FDI on economic growth in West Africa as well. For instance, a study by Asiedu (2002) found that FDI significantly contributes to economic growth in African countries, with a more considerable effect in countries with better governance and infrastructure. Similarly, a report by the United Nations Conference on Trade and Development (UNCTAD) indicated that FDI inflows have been associated with increased GDP growth rates in several West African nations. Therefore, the influx of foreign capital not only provides the necessary funding for infrastructure and industrial development but also facilitates technology transfer enhances productivity and creates job opportunities.

However, the impact of FDI on economic growth is not uniform across the region, as various factors such as governance, political stability, and economic policies play a significant role in determining the effectiveness of FDI. Panel ARDL analyses reveal that FDI has a positive long-run impact on economic growth and gross domestic savings while reducing unemployment in selected West African nations (Onuoha et al., 2018). Similarly, a study of five developing African economies found that FDI positively influences economic growth, along with trade openness, inflation, and labour (Appiah, 2019). However, conflicting evidence suggests that FDI may have a negative effect on economic growth in some West African countries, with primary sector investments being less effective than secondary and tertiary sectors in driving growth (Velonjara&Gondje-Dacka, 2019). Key determinants of FDI in West Africa include natural resources, labour availability, GDP per capita, market size, and official exchange rates (Kudaisi, 2014).

The relationship between foreign direct investment (FDI) and economic growth in ECOWAS countries has been extensively studied, yielding mixed results. While some research suggests that FDI has an insignificant or negative impact on growth (Alege& Ogundipe, 2014; Alege& Ogundipe, 2013), others find it to be a principal driver of economic growth (Ozekhome, 2017; Orji et al., 2021). Factors such as trade openness, human capital, and institutional quality are identified as important determinants of growth (Ozekhome, 2017). Foreign aid is found to have a negative impact on growth, possibly due to diminishing returns (Ozekhome, 2017). Financial development, particularly net domestic credit, is positively associated with economic growth (Orji et al., 2021). Policy recommendations include a cautious approach to openness in extractive industries, encouraging manufacturing FDI, and domestic investment of repatriated capital (Alege& Ogundipe, 2014; Alege& Ogundipe, 2013). Additionally,

creating a conducive socio-political and economic environment for foreign investors is suggested (Orji et al., 2021).

Srinivasan et al. (2011) provide foundational insights into the causal relationship between FDI and economic growth within SAARC countries, utilizing the Johansen cointegration test and the vector error correction model (VECM). Their findings indicate a long-run bidirectional causal link between GDP and FDI, except in India, where the relationship is one-sided. This suggests the necessity for differentiated policy frameworks within the SAARC region. Conversely, a more recent study by Mohd Thas Thaker et al. (2024) on Afghanistan presents a contrasting outcome, showing a significant long-run negative impact of FDI on economic growth. This brings to light questions about the absorptive capacity of the host economy and the effectiveness of governance structures in facilitating beneficial investment.

Considering institutional and human capital factors, Adegbite and Ayadi (2010) recognize the importance of human capital in mediating the effects of FDI on growth in Nigeria. Their OLS regression analysis indicates that while FDI can stimulate economic growth, its impact is contingent upon the level of human capital and infrastructural development. This study complements the findings of Alfaro (2017), who identified the role of absorptive capacities in maximizing the benefits of FDI. According to Alfaro (2017), local conditions, such as market structures and factor reallocations are crucial in determining the extent to which FDI translates into economic growth, particularly in developing countries. The findings by Dao et al. (2023) in Vietnam further reinforce the notion of positive spillover effects from FDI to domestic firms, suggesting that the productivity of FDI enterprises can enhance output growth. These findings conform with the notion of inter-firm linkages as a mechanism for growth, thereby endorsing the prescription that policy frameworks should encourage synergistic relationships between foreign and domestic enterprises.

In terms of asymmetries in FDI impact across regions, Karahan and Çolak (2024) investigate the nonlinear causality between FDI and economic growth in RCEP countries, providing a fresh perspective on the causal dynamics. Their use of asymmetric causality tests reveals that positive shocks in FDI significantly influence economic growth, whereas negative shocks do not exhibit the same strength, by implication, policymakers should focus on creating an environment conducive to stable FDI inflows. In a regional context, Sun and Chai (1998) analyse the effects of FDI on economic growth across different provinces in China, revealing disparities that stem from varying regional investment environments. From this, we see the importance of localized policy interventions tailored to specific economic contexts to harness the full potential of FDI.

Further, Kong et al. (2024) provide an analysis of the dynamic relationship between FDI inflows and technological innovation in emerging economies, with a focus on China. Their work revealed the positive spillover effects of FDI in promoting local firms' research and development (R&D) activities, aligning with earlier findings that validate the role of FDI in enhancing technological capacity. However, they also point out that this relationship is highly conditional upon the host country’s absorptive capacity, suggesting that the benefits of FDI

are not automatic but rather dependent on factors such as human capital and infrastructure. Similarly, Hoa et al. (2024) extend this discourse by focusing on the global south, where institutional quality plays a critical role in mediating the effects of FDI on local economies. They argue that in countries with weak governance structures, the potential gains from FDI are often undermined by corruption and inefficiency. Their study builds on prior studies that highlight the mixed results of FDI in developing countries, further advancing the argument by introducing a political economy perspective that links FDI effectiveness to institutional reform. Also, Appiah-Otoo et al. (2023) investigate the renewable energy sector and its relationship with FDI, particularly in sub-Saharan Africa. They find that FDI has been a significant driver of renewable energy investments, contributing to economic diversification and sustainability. However, their findings are also tempered by concerns over environmental degradation, suggesting a dual-edged impact of FDI depending on the regulatory frameworks governing environmental standards.

The role of FDI in industrial sectors, particularly in China, has been widely documented. Matsumoto (2022) develops a quantitative model to assess the impact of FDI on China's manufacturing sector, concluding that while FDI enhances productivity and competitiveness, it can also lead to crowding out of domestic firms, especially in sectors with less robust regulatory oversight. This finding reinforces earlier critiques that FDI, while beneficial in some respects, can disrupt local industries that are unable to compete with the technological and financial advantages of multinational corporations. In a similar vein, Huang et al. (2023) observed the role of FDI in shaping China's industrial sector, particularly through its influence on innovation and technology transfer. They revealed that while FDI has been a crucial factor in the modernization of China's industries, the long-term sustainability of these gains is contingent upon continued investment in local innovation ecosystems.

The relationship between FDI, economic growth, and environmental outcomes has been extensively studied. Kivyiro and Arminen (2014) investigated six Sub-Saharan African countries and found that FDI, along with economic growth and energy consumption, contributes to carbon dioxide (CO2) emissions. Their use of an autoregressive distributed lag model (ARDL) suggests that these variables are cointegrated in the long run. Interestingly, their study supports the Environmental Kuznets Curve (EKC) hypothesis for several countries, implying that economic development initially increases environmental degradation, but beyond a certain point, it reduces it. Their findings, however, showed significant variation across countries, with FDI both increasing and decreasing emissions depending on the country's context. This heterogeneity complicates the formulation of universal policy recommendations, supporting the need for bespoke approaches. In contrast, Shahbaz et al. (2015) analyzed the impact of FDI on environmental degradation globally, distinguishing between high-, middle-, and low-income countries. Their findings confirm the pollution haven hypothesis (PHH), where FDI exacerbates environmental degradation in low-income regions. Using a multivariate framework, they observed bidirectional causality between CO2 emissions and FDI, which elaborates the FDI-environmental degradation relationship. While Shahbaz et al. (2015) provide strong empirical evidence for the EKC hypothesis in various income groups, their results suggest that the environmental costs of FDI, particularly in

developing economies, must be carefully managed to avoid exacerbating environmental harm. The study by Sahu (2021) further examined the link between FDI and economic growth, focusing on 45 developing countries. By employing the pooled mean group (PMG) regression method, Sahu found that FDI inflows significantly boost GDP per capita growth both in the short and long run, especially in emerging markets such as Asia and Africa. This study echoes the findings of Shahbaz et al. (2015) by reaffirming the positive economic role of FDI while also leaving room for questions about its broader social and environmental implications. Although the results by Sahu illustrate the macroeconomic benefits of FDI, they also raise concerns regarding sustainability and equity, especially in regions with weaker institutional frameworks.

Several studies have also looked at FDI and renewable energy (RE) development, particularly in developing economies. Akpanke et al. (2023) focused on 15 West African countries, examining the impact of FDI on RE use. Their findings suggest that FDI, along with public sector credit, significantly promotes RE development in the long run, while inflation and broad money supply exert mixed effects. Their study is arcane in its application of second-generation panel econometric methods, ensuring robust results in the presence of cross-sectional dependence. However, despite the long-term benefits of FDI in promoting RE, the study finds no significant impact of GDP on RE use, indicating that economic growth alone may not be sufficient to drive sustainable energy transitions in low-income countries.

Paramati et al. (2016) showed complementary evidence in the role of FDI in clean energy adoption across 20 emerging markets. Their analysis revealed that both FDI inflows and stock market developments significantly enhance clean energy consumption. Their findings encourage policymakers to deepen public-private partnerships and provide incentives for RE investments. This aligns with findings by Akpanke et al. (2023) that FDI can play a pivotal role in achieving sustainability goals, particularly when coupled with supportive government policies. However, the causal pathways between FDI and RE development require further review, as the short-run impact of FDI on clean energy remains less clear.

From an agriculture and inclusive growth perspective, Osabohien et al. (2022) examined the effects of agricultural trade and FDI on inclusive growth in West Africa, using data from 15 ECOWAS countries. Their study found that while agricultural trade positively impacts inclusive growth, the role of FDI is insignificant. Their finding challenges the conventional wisdom that FDI uniformly contributes to economic inclusivity. It also raises important questions about the sectoral specificity of the impact of FDI, particularly in agriculture-dependent economies. The study advocates for more flexible trade policies to enhance resilience, especially in the post-COVID-19 era, indicating that FDI alone may not be a sufficient driver of inclusive growth in all sectors.

Azam and Haseeb (2021) further ascertain the determinants of FDI inflows in BRICS countries, focusing on energy consumption. They found that renewable energy utilization has a more significant positive effect on FDI inflows compared to non-renewable energy. Their result provides critical insights into the importance of clean energy infrastructure in attracting FDI, affirming the notion that countries that invest in renewable energy are more likely to

secure long-term foreign investments. However, economic instability, particularly inflation, continues to act as a deterrent to FDI inflows, affirming the need for macroeconomic stability in these regions.

Gaps in Literature

Some studies such as Alege& Ogundipe (2013)and Onuoha et al (2028), have captured the impact of foreign direct investments in the ECOWAS region using the General Moment Methods (GMM)Panel system approach, but not many have adopted the use of Panel ARDL methods for individual country-specific analysis. Therefore, these studies present a novel casein this area of study as a contribution to the body of knowledge. In terms of variable selections, the level of infrastructural development is key in determining factors affecting foreign direct investment, thus this study included a percentage of the population thathas access to electricity as a variable in the model.

3. Methodology

This study employs an Autoregressive Distributed Lag (ARDL) panel analysis to investigate the impact of foreign direct investment (FDI) on real GDP growth in West Africa. The dependent variable is real GDP growth, while the independent variables include access to electricity, population, inflation, and gross capital formation (domestic investment). Data is collected from reputable sources such as the World Bank and International Monetary Fund, and the study defines each variable to ensure clarity. The ARDL model is selected for its capacity to handle variables of different integration orders (I(0) and I(1)) and for its ability to capture both short-run and long-run dynamics among the variables. The analysis follows a structured approach, beginning with unit root tests to assess the stationarity of the variables, followed by lag length selection using criteria such as the Akaike Information Criterion. Once the appropriate lag structure is established, the ARDL bounds test is employed to determine the existence of a long-run relationship among the variables. The model is then estimated to derive both short-run and long-run coefficients.

Table1: The Description and Sources of data are analysed in the table below

Variable	Description of Measurement	Source
Access to Electricity	Percentage of population with access to electricity; a measure of infrastructure availability	World Bank
Population Growth	Annual percentage growth rate of the population; indicates labour force and market size	World Bank
Inflation	Annual percentage change in Consumer Price Index (CPI); reflects price stability in the economy	International Monetary Fund (IMF)
Gross Capital Formation	Percentage of GDP invested domestically in fixed assets; a measure of domestic investment	World Bank

Foreign Direct Investment (FDI)	Inflow of foreign investment as a percentage of GDP; captures external capital input	World Bank
Real GDP Growth	Annual percentage growth rate of GDP; indicator of economic performance	World Bank

Following Onuoha et al (2018) and Kivyiro&Arminen (2014), this study used the panel Auto-Regressive DistributedLagged(ARDL)model.Theestimatedmodelisspecifiedas:

$$Y_{it} = \sum_{j1} \beta_i Y_{i,t-j} + \sum_{j0} \sigma_{ij} X_{i,t-j} + \theta_i + \epsilon_{itd}$$

Y_{it}isthedependentvariable,$X_{i,t}$isthe vectorofindependentvariablesthatare integrated at different order, i.e.I(0)or
I(1),$\beta_i$isthecoefficientofthelaggeddependentvariable,σ_{ij}arethecoefficientsoftheindependentvariables,θ_i istheunitspecificfixedeffectandϵ_{it}istheerrorterm.
The dependent $(Y_{it})$and independent variables $(X_{i,t})$ arepresentedin table 1 below in a descriptive form for the 16 west African countries on data related to real GDP growth, FDI (% of GDP), gross capital formation, population, access to electricity and inflation rate.

A theoretical justification for using variables like access to electricity, population, inflation, and gross capital formation in growth models can be grounded in several key economic theories. The Solow-Swan growth model points to capital accumulation—reflected here by gross capital formation—as essential for long-term economic growth. According to endogenous growth theories, investments in infrastructure (e.g., access to electricity) support productivity by enabling efficient production processes and innovation. Also, demographic theories suggest that population dynamics influence the labour force and consumption, determining both supply and demand in an economy. The role of inflation is explained by macroeconomic stability theories, which argue that high inflation creates uncertainty, discouraging investment and destabilizing economic growth. These theoretical frameworks provide a rationale for analysing these variables as they capture capital investment, resource availability, labour supply, and economic stability—all critical components of sustainable growth.

4. Results and Discussions

Table 2: Descriptive Statistic

Variable	Mean	Std Dev.	Min.	Max.	*N*
Real GDP Growth (annual %)	3.963809	4.797457	-30.14500	26.52400	544
FDI (% of GDP)	3.560292	8.234202	-10.95400	103.3370	544
Gross Capital formation (annual % growth)	20.02784	10.64579	-2.424000	66.46600	544
Population (%)	53.10589	3.107398	47.68400	68.27000	544
Access to electricity (%)	29.84358	24.75820	-10.03800	96.52100	544
Inflation (%)	6.822960	10.43288	-7.797000	72.83600	544

Table 2 displayed the descriptive statistic of the indicators under review within the West African countries. The mean (average) real GDP growth rate of 3.964 indicates the average annual GDP growth rate for west African countries in the dataset is 3.96%. The mean of inflation rate of 6.823 indicates the average annual percentage change in the overall price level of products and services of west African countries over the stated period is 6.8 percent. Mean of foreign direct investment approximately 3.56% represents the average value of the foreign investment inflows into west African region in the dataset. The mean of domestic investment proxy by gross capital formation of approximately 20% represents the average domestic investment for west African countries in the dataset. The mean population growth rate of approximately 53% represents the average population growth rate for west African nations in the dataset. Access to electricity also showed 29.8%. Indicating that, on the average, only about 30% of households in the region had access to electricity.

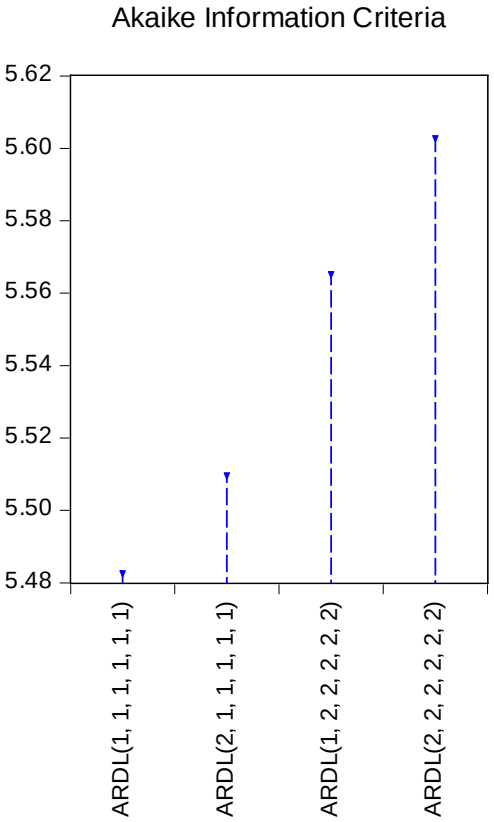
TestsforUnitRoot

The results of the tests for unit root are presented in 3. The results showed that except gross capital formation and population growth rate, all the variables were stationaryatlevel.ThisimpliesthatthevariableswereeitherI(0)orI(1).ThisisthebasicrequirementforusingARDLmodel.

Table 3: Results of the Unit Root test for Stationarity

Variables	Levin, Lin, Chu (2002)	Lm, Pesaran, Shin (2003)	Augmented Dickey-Fuller	Prob.	Order of Integration
Real GDP Growth (annual %)	-14.9624	-14.1615	222.864	0.0000	I(0)
FDI (% of GDP)	-4.34248	-5.23601	89.5805	0.0000	I(0)
Gross Capital formation	-13.3883	-14.3827	245.475	0.0000	I(1)
Population (%)	2.06758	-1.02637	48.4884	0.0310	I(1)
Access to electricity (%)	2.80129	0.90163	51.5496	0.0157	I(0)
Inflation (%)	-3.35494	-4.74009	88.3442	0.0000	I(0)

Figure 1: Model Selection Graph (Lag Selection Criterion)



The figure 1 above shows the estimation at various lag estimations. In determining the ideal lag length, the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hannan-Quinn Criterion (HQC) values and the selected ARDL models. This study adopted the AIC and the decision rule on the ideal lag length is based on the lag length with the least value of information criterion (IC). Therefore, the ARDL order of (1,1,1,1,1,1) is chosen.

Table 4: Panel Heteroscedasticity

Panel Cross-section Heteroskedasticity LR Test			
	Value	df	Probability
Likelihood ratio	177.7182	16	0.0000
LR test summary:			
	Value	df	
Restricted LogL	-1488.157	538	
Unrestricted LogL	-1399.298	538	

The Panel Cross-section Heteroskedasticity Likelihood Ratio (LR) test evaluates whether residuals are homoskedastic, meaning they have a constant variance across cross-sections in the panel data. In this test, the null hypothesis asserts that residuals are homoskedastic. The test yielded an LR statistic of 177.7182 with a probability value of 0.0000, which is well below the conventional 0.05 threshold. This result leads to the rejection of the null hypothesis, indicating clear evidence of heteroskedasticity across cross-sections in the panel

data. The presence of heteroskedasticity across cross-sections, as indicated by the likelihood ratio test, supports the use of a Panel ARDL model with heteroskedasticity adjustments. Panel ARDL models are well-suited for heterogeneous panels where units (e.g., countries) may have individual characteristics that cause heteroskedasticity, and they can handle dynamic relationships by incorporating lagged dependent and independent variables, which is especially useful in macro-econometrics. Also, Panel ARDL models can address heterogeneity across cross-sections by using techniques like Pooled Mean Group (PMG) or Mean Group (MG) estimators, allowing for varied adjustment dynamics and long-run equilibrium relationships across entities.

Table 5: Cross-Sectional Dependency Test

Residual Cross-Section Dependence Test			
Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	146.7392	120	0.0690
Pesaran scaled LM	1.726010		0.0843
Pesaran CD	0.923364		0.3558

The Residual Cross-Section Dependence Test checks for cross-sectional dependence among residuals, which, if present, indicates that shocks in one cross-section (e.g., one country) may impact others. The **Breusch-Pagan LM** statistic is 146.7392 with a probability of 0.0690, which is above the 0.05 significance level, indicating we cannot reject the null hypothesis of no cross-sectional dependence. Similarly, the **Pesaran scaled LM** statistic of 1.7260 has a probability of 0.0843, and the **Pesaran CD** test statistic of 0.9234 has a p-value of 0.3558. These results collectively suggest no significant cross-sectional dependence in the panel. Consequently, it implies that the individual units in the panel are relatively independent, which is an important consideration for model specification, as models that assume independence across cross-sections (like Panel ARDL) are likely appropriate in this case.

Table 6: Panel ARDL Long run Estimation
Dependent Variable: GDP Growth

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.**
FDI	0.061588	0.038582	1.596297	0.1111
GCF	0.118315	0.021680	5.457423	0.0000
POP	0.038815	0.009537	4.069830	0.0001
ACCESS	-0.005683	0.008500	-0.668547	0.5041
INF	-0.014721	0.018658	-0.789025	0.4305

The coefficient for FDI is 0.061588. This suggests that holding other variables constant, a one-unit increase in FDI is associated with an increase of approximately 0.06% in GDP growth rate in West African countries. The coefficient for gross capital formation is 0.118315, t-statistic of 5.457423 and p-values of 0.0000. The coefficient for population growth is

0.038815, with t-statistic value of 4.069830. The coefficient of electricity access is -0.0005683. The coefficient for inflation is -0.014721.

Table 7: Panel ARDL Short run Estimation

Dependent Variable: d(GDP Growth)

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.**
COINTEQ01	-0.846233	0.063306	-13.36729	0.0000
D(FDI)	0.083624	0.126240	0.662419	0.5080
D(GCF)	0.088232	0.068092	1.295767	0.1957
D(POP)	-2.073216	1.716906	-1.207530	0.2279
D(ACCESS)	0.013508	0.022213	0.608110	0.5434
D(INF)	0.016116	0.051519	0.312812	0.7546

The error correction parameter serves as a measure of the speed at which real GDP growth adjusts toward its long-run equilibrium path. A negative and significant estimated error correction parameter of -0.846233 suggests that the system corrects deviations from the long-run equilibrium. This implies that, on average, the GDP growth rate adjusts by approximately 0.84 units toward its long-run equilibrium for every unit of deviation from the equilibrium path in the previous period. The negative sign is appropriate, indicating that the system corrects disequilibria over time. However, the error correction term is highly significant and negative, confirming that the system corrects back to its long-run equilibrium at a rapid pace. This suggests that while short-run fluctuations in the selected variables are minimal, the west African regional economy as a whole adjusts strongly toward long-run stability. From the table, the individual coefficients of the short-run explanatory variables such as Foreign Direct Investment (FDI), Gross Capital Formation (GCF), and Population Growth (POP) are not statistically significant at conventional levels. This suggests that in the short run, these variables may not have a strong influence on Real GDP growth. For instance, the FDI coefficient is positive but statistically insignificant, which aligns with some studies indicating that FDI's effect on growth may be more pronounced in the long run due to the time it takes for investments to translate into productive economic outcomes (Wehncke, Marozva & Makoni, 2023). Although, studies using similar panel ARDL models have shown mixed results for the short-term impact of FDI, but generally support the idea that institutional quality and long-term investments are crucial for realising growth benefits. Also, GCF, which represents domestic investment, often has a delayed effect, as capital investments typically need time to influence output

Table 8: Country-Level - Pooled mean group estimators for the 16 countries

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob. ***
Benin				
COINTEQ01	-0.806248	0.018664	-43.19696	0.0000
D(FDI)	0.453606	0.097951	4.630937	0.0190
D(GCF)	0.091461	0.010097	9.058470	0.0028

D(POP)	1.396489	1.500045	0.930965	0.4205
D(ACCESS)	0.023398	0.007082	3.303956	0.0456
D(INF)	-0.075460	0.000867	-87.08633	0.0000
Cabo Verde				
COINTEQ01	-0.586609	0.024216	-24.22360	0.0002
D(FDI)	0.770314	0.218382	3.527366	0.0387
D(GCF)	-0.040634	0.011101	-3.660496	0.0352
D(POP)	0.496462	3.286299	0.151070	0.8895
D(ACCESS)	0.049835	0.009036	5.514943	0.0117
D(INF)	-0.348422	0.154576	-2.254043	0.1095
Gambia				
COINTEQ01	-0.959095	0.029738	-32.25159	0.0001
D(FDI)	-0.307289	0.103808	-2.960166	0.0595
D(GCF)	0.020080	0.017857	1.124486	0.3427
D(POP)	-2.778572	14.09738	-0.197099	0.8563
D(ACCESS)	0.026915	0.001368	19.66850	0.0003
D(INF)	0.207546	0.034043	6.096564	0.0089
Guinea				
COINTEQ01	-0.743867	0.026705	-27.85488	0.0001
D(FDI)	0.173668	0.009493	18.29460	0.0004
D(GCF)	-0.113398	0.003783	-29.97384	0.0001
D(POP)	0.233832	2.125754	0.110000	0.9194
D(ACCESS)	0.005654	0.001212	4.662989	0.0186
D(INF)	0.006599	0.001634	4.038780	0.0273
Guinea-Bissau				
COINTEQ01	-1.201839	0.020084	-59.83981	0.0000
D(FDI)	1.297716	0.387219	3.351378	0.0440
D(GCF)	-0.255487	0.038010	-6.721494	0.0067
D(POP)	-6.327685	9.329865	-0.678218	0.5463
D(ACCESS)	0.209757	0.086880	2.414341	0.0946
D(INF)	0.294510	0.005956	49.44761	0.0000
Ghana				
COINTEQ01	-0.468441	0.024800	-18.88841	0.0003
D(FDI)	0.346511	0.076836	4.509727	0.0204
D(GCF)	-0.057120	0.011771	-4.852490	0.0167
D(POP)	0.791045	2.028248	0.390014	0.7226
D(ACCESS)	0.011306	0.000712	15.88276	0.0005
D(INF)	-0.012958	0.000980	-13.21797	0.0009
Liberia				
COINTEQ01	-0.776711	0.026270	-29.56639	0.0001
D(FDI)	-0.104880	0.002415	-43.43432	0.0000
D(GCF)	-0.068577	0.010449	-6.562679	0.0072
D(POP)	-2.419340	14.07727	-0.171861	0.8745
D(ACCESS)	-0.046255	0.000588	-78.71612	0.0000
D(INF)	0.186534	0.024094	7.742062	0.0045
Mali				
COINTEQ01	-1.377947	0.026082	-52.83061	0.0000
D(FDI)	0.038926	0.086857	0.448163	0.6844
D(GCF)	0.079198	0.037738	2.098619	0.1267
D(POP)	4.955707	14.07176	0.352174	0.7480
D(ACCESS)	0.041061	0.003094	13.27077	0.0009

D(INF)	0.036326	0.007983	4.550566	0.0199
Nigeria				
COINTEQ01	-0.973875	0.022786	-42.74098	0.0000
D(FDI)	-0.434788	0.151925	-2.861855	0.0645
D(GCF)	0.093213	0.025788	3.614646	0.0364
D(POP)	-25.56746	30.39461	-0.841184	0.4620
D(ACCESS)	-0.066285	0.001786	-37.12342	0.0000
D(INF)	-0.039291	0.001572	-24.99217	0.0001
Niger				
COINTEQ01	-1.030264	0.030994	-33.24116	0.0001
D(FDI)	-0.744684	0.113496	-6.561332	0.0072
D(GCF)	0.499501	0.048762	10.24373	0.0020
D(POP)	-0.308509	18.16044	-0.016988	0.9875
D(ACCESS)	0.033918	0.014581	2.326192	0.1025
D(INF)	-0.031917	0.003588	-8.894340	0.0030
Senegal				
COINTEQ01	-0.713955	0.018352	-38.90268	0.0000
D(FDI)	-0.436088	0.090061	-4.842119	0.0168
D(GCF)	0.366881	0.020590	17.81833	0.0004
D(POP)	-3.286101	3.664371	-0.896771	0.4359
D(ACCESS)	0.024998	0.000485	51.53916	0.0000
D(INF)	-0.107565	0.001641	-65.55583	0.0000
Sierra Leone				
COINTEQ01	-0.970623	0.030536	-31.78651	0.0001
D(FDI)	-0.065404	0.095658	-0.683723	0.5432
D(GCF)	-0.172822	0.069914	-2.471934	0.0899
D(POP)	0.090215	29.55978	0.003052	0.9978
D(ACCESS)	-0.022209	0.109260	-0.203264	0.8519
D(INF)	-0.041059	0.267207	-0.153661	0.8876
Togo				
COINTEQ01	-0.528205	0.050883	-10.38074	0.0019
D(FDI)	-0.079251	0.053575	-1.479256	0.2356
D(GCF)	0.433454	0.132023	3.283180	0.0463
D(POP)	-1.745030	20.84374	-0.083720	0.9386
D(ACCESS)	-0.054772	0.006099	-8.980340	0.0029
D(INF)	0.275368	0.021204	12.98683	0.0010
Burkina Faso				
COINTEQ01	-1.057569	0.030454	-34.72698	0.0001
D(FDI)	0.196705	0.283643	0.693495	0.5379
D(GCF)	0.046838	0.011697	4.004305	0.0279
D(POP)	3.922112	3.774085	1.039222	0.3751
D(ACCESS)	0.076647	0.016658	4.601357	0.0193
D(INF)	-0.049894	0.004613	-10.81671	0.0017
Mauritania				
COINTEQ01	-0.780410	0.018999	-41.07729	0.0000
D(FDI)	-0.188625	0.010217	-18.46252	0.0003
D(GCF)	-0.203877	0.007054	-28.90130	0.0001
D(POP)	-3.400044	8.288824	-0.410196	0.7092
D(ACCESS)	-0.205886	0.013145	-15.66212	0.0006
D(INF)	0.334369	0.070662	4.731967	0.0179

Senegal				
COINTEQ01	-0.564065	0.013798	-40.87949	0.0000
D(FDI)	0.421547	0.571293	0.737882	0.5141
D(GCF)	0.692992	0.035365	19.59527	0.0003
D(POP)	0.775420	3.517237	0.220463	0.8397
D(ACCESS)	0.108042	0.001685	64.13778	0.0000
D(INF)	-0.376833	0.007951	-47.39166	0.0000

It is important to examine country-specific factors in the determination of short-run economic performance, especially as it relates to investments and inflation management. From the above country-level pooled mean group (PMG) estimation for the 16 countries, the speed of adjustment in most cases is negative and significant, indicating strong convergence toward long-run equilibrium. The error correction coefficients suggest rapid adjustment of deviations, particularly in countries like Guinea-Bissau (-1.2018), Mali (-1.3779), and Nigeria (-0.9738), implying that shocks to the system are corrected swiftly. However, the short-run dynamics, reveal varying impacts of explanatory variables: Foreign Direct Investment (FDI) has a positive and significant impact on Real GDP growth in some countries (e.g., Benin, Cabo Verde), but is negative in others (e.g., Nigeria, Gambia). This is consistent with mixed findings in the literature on the short-run effects of FDI, which often depend on institutional quality and market absorptive capacity (Wehncke, Marozva & Makoni, 2023 and Hamid *et al*, 2024). Gross Capital Formation (GCF) is significant and positive for countries like Benin, Senegal, and Niger, indicating the role of domestic investments in short-term growth. On the contrary, it has negative impacts in others like Guinea and Liberia, possibly due to inefficiencies in capital allocation or low productivity returns. More so, Inflation (INF) tends to have a mixed impact, with negative effects on growth in most cases (for instance, Senegal, Guinea-Bissau), implying that high inflation is generally detrimental to short-run growth, as supported by numerous macroeconomic studies on inflation-growth trade-offs.

5. Conclusion

The findings of this study, based on the panel ARDL analysis, reveal key dynamics in the relationship between Foreign Direct Investment (FDI), Gross Capital Formation (GCF), population growth, and inflation across West African countries. The speed of adjustment parameters indicates that deviations from long-run growth paths are corrected at varying speeds, with countries such as Guinea-Bissau, Mali, and Nigeria exhibiting faster adjustments. This suggests that economic shocks are resolved more rapidly in these economies. Foreign Direct Investment exhibited a mixed sign, with positive short-run impacts in some countries - Benin, Cabo Verde, but negative in others - Nigeria and Gambia, indicating the importance of domestic policy conditions in harnessing foreign direct investment for economic growth. Similarly, gross capital formation (domestic investment) shows significant positive effects in several countries, validating the role of domestic investments in driving short-term economic performance. The findings on inflation further

registered its destabilizing role, as higher inflation generally undermines growth in most of the west African countries examined during the period. Consequently, this study contributes to the growing body of literature by demonstrating the heterogeneous responses of West African economies to similar economic stimuli, reflecting core policy concerns that should be considered when policies are formulated. Policymakers should focus on stabilizing price-level, optimizing domestic investment, and leveraging FDI more effectively. More so, improving infrastructure and access to electricity (as indicated by the significant role of the "ACCESS to electricity" variable) can help smooth the adjustment process and ensure sustained long-term growth. It is imperative to recommend the need for customized economic policies, regional cooperation, and a more coordinated e public-private partnerships to promote sustainable growth across the West African region.

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Table 9: Unit Root Test for GDP Growth

Dependent Variable: GDP				
Method: Panel Least Squares				
Date: 10/13/24 Time: 23:44				
Sample: 1990 2023				
Periods included: 34				
Cross-sections included: 16				
Total panel (balanced) observations: 544				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.928538	0.399502	7.330473	0.0000
@TREND	0.062744	0.020811	3.014878	0.0027
R-squared	0.016494	Mean dependent var		3.963809
Adjusted R-squared	0.014679	S.D. dependent var		4.797457
S.E. of regression	4.762116	Akaike info criterion		5.962931
Sum squared resid	12291.34	Schwarz criterion		5.978736
Log likelihood	-1619.917	Hannan-Quinn criter.		5.969110
F-statistic	9.089487	Durbin-Watson stat		1.650606
Prob(F-statistic)	0.002691			

Panel unit root test: Summary				
Series: GDP				
Date: 10/14/24 Time: 10:25				
Sample: 1990 2023				
Exogenous variables: Individual effects, individual linear trends				
Automatic selection of maximum lags				
Automatic lag length selection based on SIC: 0 to 2				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-14.9624	0.0000	16	525
Breitung t-stat	-8.13989	0.0000	16	509
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-	-14.1615	0.0000	16	525

stat				
ADF - Fisher Chi-square	222.864	0.0000	16	525
PP - Fisher Chi-square	298.474	0.0000	16	528
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Table 10: Unit Root Test for FDI

Dependent Variable: FDI				
Method: Panel Least Squares				
Date: 10/14/24 Time: 00:03				
Sample: 1990 2023				
Periods included: 34				
Cross-sections included: 16				
Total panel (balanced) observations: 544				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.155381	0.680893	1.696861	0.0903
@TREND	0.145752	0.035470	4.109177	0.0000
R-squared	0.030213	Mean dependent var		3.560292
Adjusted R-squared	0.028423	S.D. dependent var		8.234202
S.E. of regression	8.116337	Akaike info criterion		7.029305
Sum squared resid	35704.21	Schwarz criterion		7.045110
Log likelihood	-1909.971	Hannan-Quinn criter.		7.035484
F-statistic	16.88533	Durbin-Watson stat		0.631647
Prob(F-statistic)	0.000046			

Panel unit root test: Summary				
Series: FDI				
Date: 10/14/24 Time: 19:53				
Sample: 1990 2023				
Exogenous variables: Individual effects, individual linear trends				
Automatic selection of maximum lags				
Automatic lag length selection based on AIC: 0 to 7				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.34248	0.0000	16	511
Breitung t-stat	-3.35118	0.0004	16	495
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.23601	0.0000	16	511
ADF - Fisher Chi-square	89.5805	0.0000	16	511
PP - Fisher Chi-square	105.843	0.0000	16	528
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Table 11: Unit Root Test for GCF

Dependent Variable: GCF				
Method: Panel Least Squares				
Date: 10/14/24 Time: 10:01				
Sample: 1990 2023				
Periods included: 34				
Cross-sections included: 16				
Total panel (balanced) observations: 544				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.92656	0.870104	18.30420	0.0000
@TREND	0.248563	0.045327	5.483828	0.0000
R-squared	0.052567	Mean dependent var		20.02784
Adjusted R-	0.050819	S.D. dependent var		10.64579

squared			
S.E. of regression	10.37175	Akaike info criterion	7.519719
Sum squared resid	58304.72	Schwarz criterion	7.535524
Log likelihood	-2043.364	Hannan-Quinn criter.	7.525898
F-statistic	30.07237	Durbin-Watson stat	0.329673
Prob(F-statistic)	0.000000		

Panel unit root test: Summary				
Series: D(GCF)				
Date: 10/14/24 Time: 19:55				
Sample: 1990 2023				
Exogenous variables: Individual effects, individual linear trends				
Automatic selection of maximum lags				
Automatic lag length selection based on AIC: 0 to 7				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-13.3883	0.0000	16	482
Breitung t-stat	-5.45583	0.0000	16	466
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-14.3827	0.0000	16	482
ADF - Fisher Chi-square	245.475	0.0000	16	482
PP - Fisher Chi-square	1091.80	0.0000	16	512
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Table 12: Unit Root Test for POP

Dependent Variable: POP				
Method: Panel Least Squares				
Date: 10/14/24 Time: 10:03				
Sample: 1990 2023				
Periods included: 34				
Cross-sections included: 16				
Total panel (balanced) observations: 544				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	50.73310	0.232426	218.2763	0.0000
@TREND	0.143806	0.012108	11.87707	0.0000
R-squared	0.206518	Mean dependent var		53.10589
Adjusted R-squared	0.205054	S.D. dependent var		3.107398
S.E. of regression	2.770549	Akaike info criterion		4.879638
Sum squared resid	4160.361	Schwarz criterion		4.895443
Log likelihood	-1325.262	Hannan-Quinn criter.		4.885817
F-statistic	141.0649	Durbin-Watson stat		0.006965
Prob(F-statistic)	0.000000			

Panel unit root test: Summary				
Series: D(POP)				
Date: 10/14/24 Time: 19:56				
Sample: 1990 2023				
Exogenous variables: Individual effects, individual linear trends				
Automatic selection of maximum lags				
Automatic lag length selection based on AIC: 0 to 7				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	2.06758	0.9807	16	466
Breitung t-stat	7.20541	1.0000	16	450
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-	-1.02637	0.1524	16	466

stat				
ADF - Fisher Chi-square	48.4884	0.0310	16	466
PP - Fisher Chi-square	15.4837	0.9938	16	512
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Table 13: Unit Root Test for ACCESS TO ELECTRICITY

Dependent Variable: ACCESS				
Method: Panel Least Squares				
Date: 10/14/24 Time: 10:05				
Sample: 1990 2023				
Periods included: 34				
Cross-sections included: 16				
Total panel (balanced) observations: 544				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.57196	1.933777	7.535491	0.0000
@TREND	0.925553	0.100737	9.187842	0.0000
R-squared	0.134761	Mean dependent var		29.84358
Adjusted R-squared	0.133165	S.D. dependent var		24.75820
S.E. of regression	23.05088	Akaike info criterion		9.116955
Sum squared resid	287987.9	Schwarz criterion		9.132759
Log likelihood	-2477.812	Hannan-Quinn criter.		9.123134
F-statistic	84.41644	Durbin-Watson stat		0.404778
Prob(F-statistic)	0.000000			

Panel unit root test: Summary				
Series: ACCESS				
Date: 10/14/24 Time: 19:58				
Sample: 1990 2023				
Exogenous variables: Individual effects, individual linear trends				
Automatic selection of maximum lags				
Automatic lag length selection based on AIC: 0 to 5				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	2.80129	0.9975	16	510
Breitung t-stat	1.51808	0.9355	16	494
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.90163	0.8164	16	510
ADF - Fisher Chi-square	51.5496	0.0157	16	510
PP - Fisher Chi-square	113.461	0.0000	16	528
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Table 14: Unit Root Test for Inflation

Dependent Variable: INF				
Method: Panel Least Squares				
Date: 10/14/24 Time: 10:07				
Sample: 1990 2023				
Periods included: 34				
Cross-sections included: 16				
Total panel (balanced) observations: 544				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.844956	0.870192	10.16437	0.0000
@TREND	-0.122545	0.045331	-2.703337	0.0071
R-squared	0.013304	Mean dependent var		6.822960
Adjusted R-squared	0.011484	S.D. dependent var		10.43288
S.E. of regression	10.37280	Akaike info criterion		7.519921

Sum squared resid	58316.50	Schwarz criterion	7.535726
Log likelihood	-2043.419	Hannan-Quinn criter.	7.526100
F-statistic	7.308029	Durbin-Watson stat	0.601883
Prob(F-statistic)	0.007080		

Panel unit root test: Summary				
Series: INF				
Date: 10/14/24 Time: 19:59				
Sample: 1990 2023				
Exogenous variables: Individual effects, individual linear trends				
Automatic selection of maximum lags				
Automatic lag length selection based on AIC: 0 to 7				
Newey-West automatic bandwidth selection and Bartlett kernel				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.35494	0.0004	16	499
Breitung t-stat	-5.08481	0.0000	16	483
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.74009	0.0000	16	499
ADF - Fisher Chi-square	88.3442	0.0000	16	499
PP - Fisher Chi-square	124.783	0.0000	16	528
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

Fig 2: Model Selection Graph

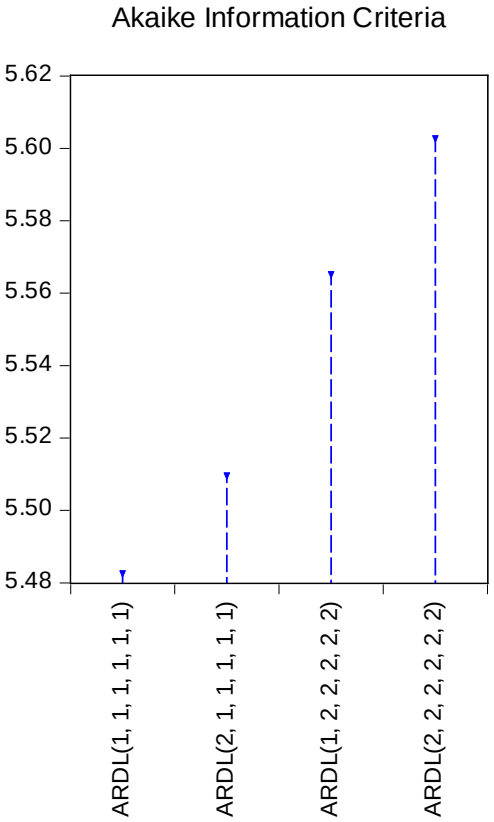

Table 15: Panel Cross-section Heteroskedasticity LR Test

Panel Cross-section Heteroskedasticity LR Test				
Null hypothesis: Residuals are homoskedastic				
Equation: UNTITLED				
Specification: GDP FDI GCF POP ACCESS INF C				
	Value	df	Probability	
Likelihood ratio	177.7182	16	0.0000	
LR test summary:				
	Value	df		
Restricted LogL	-1488.157	538		
Unrestricted LogL	-1399.298	538		
Unrestricted Test Equation:				
Dependent Variable: GDP				
Method: Panel EGLS (Cross-section weights)				
Date: 10/30/24 Time: 17:27				
Sample: 1990 2023				
Periods included: 34				

Cross-sections included: 16				
Total panel (balanced) observations: 544				
Iterate weights to convergence				
Convergence achieved after 6 weight iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI	0.094636	0.024114	3.924536	0.0001
GCF	0.034524	0.014330	2.409239	0.0163
POP	0.096011	0.061094	1.571524	0.1166
ACCESS	-0.000543	0.006444	-0.084298	0.9329
INF	-0.024241	0.012322	-1.967327	0.0497
C	-1.212275	3.099639	-0.391102	0.6959
	Weighted Statistics			
R-squared	0.061380	Mean dependent var		6.039457
Adjusted R-squared	0.052656	S.D. dependent var		4.324584
S.E. of regression	3.761108	Akaike info criterion		5.166537
Sum squared resid	7610.514	Schwarz criterion		5.213951
Log likelihood	-1399.298	Hannan-Quinn criter.		5.185074
F-statistic	7.036333	Durbin-Watson stat		1.479810
Prob(F-statistic)	0.000002			
	Unweighted Statistics			
R-squared	0.041355	Mean dependent var		4.908324
Sum squared resid	7610.515	Durbin-Watson stat		1.440426

Table 16: Cross-Sectional Dependency Test

Residual Cross-Section Dependence Test

Null hypothesis: No cross-section dependence (correlation) in residuals			
Equation: Untitled			
Periods included: 34			
Cross-sections included: 16			
Total panel observations: 544			
Note: non-zero cross-section means detected in data			
Cross-section means were removed during computation of correlations			
Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	146.7392	120	0.0690
Pesaran scaled LM	1.726010		0.0843
Pesaran CD	0.923364		0.3558

Table 17: Panel ARDL

Dependent Variable: D(GDP)				
Method: ARDL				
Date: 10/14/24 Time: 23:03				
Sample: 1991 2023				
Included observations: 528				
Maximum dependent lags: 2 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (2 lags, automatic): FDI GCF POP ACCESS INF				
Fixed regressors:				
Number of models evalulated: 4				
Selected Model: ARDL(1, 1, 1, 1, 1, 1)				
Note: final equation sample is larger than selection sample				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
	Long Run Equation			
FDI	0.061588	0.038582	1.596297	0.1111
GCF	0.118315	0.021680	5.457423	0.0000
POP	0.038815	0.009537	4.069830	0.0001
ACCESS	-0.005683	0.008500	-0.668547	0.5041
INF	-0.014721	0.018658	-0.789025	0.4305

	Short Run Equation			
COINTEQ01	-0.846233	0.063306	-13.36729	0.0000
D(FDI)	0.083624	0.126240	0.662419	0.5080
D(GCF)	0.088232	0.068092	1.295767	0.1957
D(POP)	-2.073216	1.716906	-1.207530	0.2279
D(ACCESS)	0.013508	0.022213	0.608110	0.5434
D(INF)	0.016116	0.051519	0.312812	0.7546
Mean dependent var	0.103688	S.D. dependent var		6.118355
S.E. of regression	4.397676	Akaike info criterion		5.320725
Sum squared resid	8567.423	Schwarz criterion		6.118876
Log likelihood	-1346.237	Hannan-Quinn criter.		5.632779
*Note: p-values and any subsequent tests do not account for model selection.				

Table 18: Pooled mean group estimators for the 16 countries

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Benin				
COINTEQ01	-0.806248	0.018664	-43.19696	0.0000
D(FDI)	0.453606	0.097951	4.630937	0.0190
D(GCF)	0.091461	0.010097	9.058470	0.0028
D(POP)	1.396489	1.500045	0.930965	0.4205
D(ACCESS)	0.023398	0.007082	3.303956	0.0456
D(INF)	-0.075460	0.000867	-87.08633	0.0000

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Cabo Verde				
COINTEQ01	-0.586609	0.024216	-24.22360	0.0002
D(FDI)	0.770314	0.218382	3.527366	0.0387
D(GCF)	-0.040634	0.011101	-3.660496	0.0352
D(POP)	0.496462	3.286299	0.151070	0.8895
D(ACCESS)	0.049835	0.009036	5.514943	0.0117
D(INF)	-0.348422	0.154576	-2.254043	0.1095

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Gambia				
COINTEQ01	-0.959095	0.029738	-32.25159	0.0001
D(FDI)	-0.307289	0.103808	-2.960166	0.0595
D(GCF)	0.020080	0.017857	1.124486	0.3427
D(POP)	-2.778572	14.09738	-0.197099	0.8563
D(ACCESS)	0.026915	0.001368	19.66850	0.0003
D(INF)	0.207546	0.034043	6.096564	0.0089

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Guinea				
COINTEQ01	-0.743867	0.026705	-27.85488	0.0001
D(FDI)	0.173668	0.009493	18.29460	0.0004
D(GCF)	-0.113398	0.003783	-29.97384	0.0001
D(POP)	0.233832	2.125754	0.110000	0.9194
D(ACCESS)	0.005654	0.001212	4.662989	0.0186
D(INF)	0.006599	0.001634	4.038780	0.0273

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Guinea-Bissau				
COINTEQ01	-1.201839	0.020084	-59.83981	0.0000
D(FDI)	1.297716	0.387219	3.351378	0.0440
D(GCF)	-0.255487	0.038010	-6.721494	0.0067
D(POP)	-6.327685	9.329865	-0.678218	0.5463
D(ACCESS)	0.209757	0.086880	2.414341	0.0946
D(INF)	0.294510	0.005956	49.44761	0.0000

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Ghana				
COINTEQ01	-0.468441	0.024800	-18.88841	0.0003
D(FDI)	0.346511	0.076836	4.509727	0.0204

D(GCF)	-0.057120	0.011771	-4.852490	0.0167
D(POP)	0.791045	2.028248	0.390014	0.7226
D(ACCESS)	0.011306	0.000712	15.88276	0.0005
D(INF)	-0.012958	0.000980	-13.21797	0.0009

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Liberia				
COINTEQ01	-0.776711	0.026270	-29.56639	0.0001
D(FDI)	-0.104880	0.002415	-43.43432	0.0000
D(GCF)	-0.068577	0.010449	-6.562679	0.0072
D(POP)	-2.419340	14.07727	-0.171861	0.8745
D(ACCESS)	-0.046255	0.000588	-78.71612	0.0000
D(INF)	0.186534	0.024094	7.742062	0.0045

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Mali				
COINTEQ01	-1.377947	0.026082	-52.83061	0.0000
D(FDI)	0.038926	0.086857	0.448163	0.6844
D(GCF)	0.079198	0.037738	2.098619	0.1267
D(POP)	4.955707	14.07176	0.352174	0.7480
D(ACCESS)	0.041061	0.003094	13.27077	0.0009
D(INF)	0.036326	0.007983	4.550566	0.0199

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Nigeria				
COINTEQ01	-0.973875	0.022786	-42.74098	0.0000
D(FDI)	-0.434788	0.151925	-2.861855	0.0645
D(GCF)	0.093213	0.025788	3.614646	0.0364
D(POP)	-25.56746	30.39461	-0.841184	0.4620
D(ACCESS)	-0.066285	0.001786	-37.12342	0.0000
D(INF)	-0.039291	0.001572	-24.99217	0.0001

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Niger				
COINTEQ01	-1.030264	0.030994	-33.24116	0.0001
D(FDI)	-0.744684	0.113496	-6.561332	0.0072
D(GCF)	0.499501	0.048762	10.24373	0.0020
D(POP)	-0.308509	18.16044	-0.016988	0.9875
D(ACCESS)	0.033918	0.014581	2.326192	0.1025
D(INF)	-0.031917	0.003588	-8.894340	0.0030

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Senegal				
COINTEQ01	-0.713955	0.018352	-38.90268	0.0000
D(FDI)	-0.436088	0.090061	-4.842119	0.0168
D(GCF)	0.366881	0.020590	17.81833	0.0004
D(POP)	-3.286101	3.664371	-0.896771	0.4359
D(ACCESS)	0.024998	0.000485	51.53916	0.0000
D(INF)	-0.107565	0.001641	-65.55583	0.0000

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Sierra Leone				
COINTEQ01	-0.970623	0.030536	-31.78651	0.0001
D(FDI)	-0.065404	0.095658	-0.683723	0.5432
D(GCF)	-0.172822	0.069914	-2.471934	0.0899
D(POP)	0.090215	29.55978	0.003052	0.9978
D(ACCESS)	-0.022209	0.109260	-0.203264	0.8519
D(INF)	-0.041059	0.267207	-0.153661	0.8876

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Togo				
COINTEQ01	-0.528205	0.050883	-10.38074	0.0019
D(FDI)	-0.079251	0.053575	-1.479256	0.2356
D(GCF)	0.433454	0.132023	3.283180	0.0463
D(POP)	-1.745030	20.84374	-0.083720	0.9386
D(ACCESS)	-0.054772	0.006099	-8.980340	0.0029
D(INF)	0.275368	0.021204	12.98683	0.0010

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Burkina Faso				
COINTEQ01	-1.057569	0.030454	-34.72698	0.0001
D(FDI)	0.196705	0.283643	0.693495	0.5379
D(GCF)	0.046838	0.011697	4.004305	0.0279
D(POP)	3.922112	3.774085	1.039222	0.3751
D(ACCESS)	0.076647	0.016658	4.601357	0.0193
D(INF)	-0.049894	0.004613	-10.81671	0.0017

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Mauritania				
COINTEQ01	-0.780410	0.018999	-41.07729	0.0000
D(FDI)	-0.188625	0.010217	-18.46252	0.0003

D(GCF)	-0.203877	0.007054	-28.90130	0.0001
D(POP)	-3.400044	8.288824	-0.410196	0.7092
D(ACCESS)	-0.205886	0.013145	-15.66212	0.0006
D(INF)	0.334369	0.070662	4.731967	0.0179
Variable	Coefficient	Std. Error	t-Statistic	Prob. *
Senegal				
COINTEQ01	-0.564065	0.013798	-40.87949	0.0000
D(FDI)	0.421547	0.571293	0.737882	0.5141
D(GCF)	0.692992	0.035365	19.59527	0.0003
D(POP)	0.775420	3.517237	0.220463	0.8397
D(ACCESS)	0.108042	0.001685	64.13778	0.0000
D(INF)	-0.376833	0.007951	-47.39166	0.0000