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Macroeconomic Determinants of Economic Complexity in Selected Sub-Sahara Africa: (2007 to 2024)

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Abstract

The persistent challenges faced by Sub-Saharan African economies in achieving structural transformation and moving toward more sophisticated, knowledge-intensive production systems motivated this paper. This research investigated the macroeconomic determinants of economic complexity in fifteen selected Sub-Sahara African countries—Burkina Faso, Botswana, Côte d'Ivoire, Cameroon, Congo Dem. Rep., Gabon, Ghana, Guinea, Malawi, Namibia, Niger, Nigeria, Senegal, Togo, and Uganda—from 2007 to 2024. Using the Panel Corrected Standard Errors, the paper examined how Gross Domestic Product per capita growth, unemployment, foreign direct investment inflows and broad money supply influence economic complexity. The empirical findings revealed that gross domestic product per capita growth has a negative (–0.0021) and insignificant (p = 0.548) effect on economic complexity. Unemployment has a negative (–0.0177) effect that is highly significant (p = 0.000) on economic complexity, indicating that unemployment significantly reduces the economy's complexity. Foreign direct investment showed a negative (–4.40e-11) and insignificant (p = 0.062) effect on economic complexity. Also, the outcomes revealed that broad money had a negative (–0.0077) and significant (p = 0.000) effect on economic complexity in Sub-Saharan Africa. The study concludes that the influence of macroeconomic variables on economic complexity is not only strong but also highly conditional within Sub-Saharan Africa. The study recommends that the goal of lowering unemployment should be the top priority of the region's policymakers as the number one macroeconomic objective. It entails active labour market measures, such as investing in technical and vocational education and training that is relevant to the emerging sectors; incentives for firms to create jobs requiring higher skills; and the elimination of structural barriers that prevent large portions of the workforce from escaping informality and underemployment, to unleash human potential needed to value-add the complex production of goods and services.

Keywords: *Economic Complexity, Macroeconomic Determinants, Sub-Saharan Africa, Panel Data Analysis, Industrialization*

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Background to the Study

Economic complexity, defined as the knowledge intensity and diversity embedded in a country's productive structure, has emerged as a critical indicator of long-term economic growth and development. The Economic Complexity Index (ECI), often derived from trade data classified under the Standard International Trade Classification (SITC), captures the sophistication of a nation's export basket and its capacity to produce a wide array of complex products. For Sub-Saharan Africa (SSA), a region characterized by diverse economic trajectories and persistent development challenges, understanding the macroeconomic determinants of economic complexity is both timely and essential. The selected countries Burkina Faso, Botswana, Côte d'Ivoire, Cameroon, Democratic Republic of Congo, Gabon, Ghana, Guinea, Malawi, Namibia, Niger, Nigeria, Senegal, Togo, and Uganda represent a cross-section of SSA economies with varying resource endowments, institutional frameworks, and integration into global markets. Despite notable progress in some areas, many of these countries continue to grapple with low levels of economic complexity, often reflected in their reliance on primary commodities and limited diversification of exports (Maxwele *et al.* 2024). This structural limitation constrains their ability to achieve sustainable growth, withstand external shocks, and foster inclusive development.

Recent literature underscores the importance of macroeconomic variables in shaping economic complexity. GDP per capita growth, for instance, is closely linked to a country's ability to accumulate knowledge, invest in human capitaland upgrade its productive capabilities (Nguéda, & Kelly, 2022; Maxwele *et al.* 2024). Higher income levels can facilitate the adoption of advanced technologies and support the diversification of exports, thereby enhancing economic complexity. Conversely, persistent unemployment may signal underutilization of labor resources and hinder the development of new industries, limiting the expansion of complex economic activities (Araby & Nawar, 2024). Foreign direct investment (FDI) is another pivotal factor, as it can introduce new technologies, managerial expertise, and access to international markets. Empirical evidence from SSA suggests that FDI positively influences economic complexity by fostering product diversification and innovation (Nguéda, & Kelly, 2022. However, the Impact of FDI is contingent upon the quality of institutions, absorptive capacity, and the alignment of investment with national development priorities (Okoh, 2024). In some contexts, FDI has been associated with enclave development, where benefits are confined to specific sectors without broader spillovers to the domestic economy (Sindze *et al.* 2020).

Broad money, representing the liquidity available in the economy, is also integral to economic complexity. An adequate money supply can stimulate investment, facilitate trade, and support the growth of new industries. Studies from Nigeria and other SSA countries indicate that broad money positively affects per capita income and, by extension, the resources available for economic upgrading Nwuju *et al.* 2024; Araby & Nawar, 2024).). Nevertheless, excessive liquidity without corresponding productive investment may fuel inflation and undermine macroeconomic stability. The interplay of these macroeconomic variables is further complicated by external and internal shocks, such as commodity price volatility, political instability, and global economic downturns. The COVID-19 pandemic, for example, has

exposed vulnerabilities in SSA economies, highlighting the need for resilient and diversified productive structures (Olabisi & Akeju, 2025). Policymakers are thus increasingly focused on strategies that promote economic complexity, including investment in education, infrastructure, and institutional reforms.

Despite growing interest, empirical research on the macroeconomic determinants of economic complexity in SSA remains limited, particularly for the period 2007–2024 and for the specific set of countries under study. Existing studies have primarily examined the determinants of economic growth or FDI inflows, with less attention to how these factors collectively influence economic complexity (Jaiblai & Shenai, 2019; Batrancea *et al.* 2021; Gafsi & Bakari, 2025). This gap underscores the need for a comprehensive analysis that integrates GDP per capita growth, unemployment, FDI, and broad money as key explanatory variables. This paper aims to fill this gap by systematically investigating the macroeconomic determinants of economic complexity in selected SSA countries over the period 2007–2024. By employing SITC-based trade data and robust econometric techniques, the paper seeks to provide nuanced insights into the drivers of economic sophistication in the region. The findings are expected to inform policy interventions aimed at fostering structural transformation, enhancing resilience, and promoting sustainable development across Sub-Saharan Africa.

Literature Review

Economic Complexity

Economic complexity is a multifaceted concept that captures the diversity, sophistication, and interconnectedness of an economy's productive capabilities. It has become a central framework for understanding economic growth, development, and structural transformation. According to Hidalgo (2021) described economic complexity as a set of methods and metrics—most notably the Economic Complexity Index (ECI)that quantify the knowledge intensity and diversity embedded in a country's productive structure. These metrics use trade data to reveal how the variety and sophistication of exported products reflect the underlying capabilities of an economy. Economic complexity methods have proven predictive variations in income, growth, inequality, and other macroeconomic outcomes. Economic complexity is rooted in the idea that visible economic outcomes—such as growth, technological change, and inequality are the result of hidden systemic interactions. The field leverages big data and machine learning to uncover how the structure of economic activities and their interdependencies shape development. Economic complexity thus provides a paradigm for understanding and predicting socioeconomic processes beyond what traditional indicators like GDP can offer (Balland, *et al.* 2022).

Sciarra *et al.* (2020) highlighted that economic complexity aims to summarize a country's productive knowledge in a single measure, using network-based approaches. By analyzing the network of countries and the products they export, economic complexity measures (such as the Method of Reflections and Fitness-Complexity algorithms) estimate both the complexity of countries and products, offering insights into innovation potential and growth dynamics (Sciarra *et al.* 2020; Mealy *et al.* 2017; Morrison *et al.* 2017). Arthur (2021) in the complexity

economics tradition argued that economic complexity reflects the economy as an evolving, adaptive system. Unlike static equilibrium models, complexity economics views the economy as constantly forming and reforming through the interactions of diverse agents, leading to emergent patterns and novel structure (Veblen & Simon, 2021; Arthur, 2021). Economic complexity has been widely adopted by institutions such as the World Bank and OECD for policy analysis, as it helps identify pathways for diversification, innovation, and sustainable development (Balland *et al.* 2022; Hidalgo, 2022). The ECI and related measures are used to explain differences in GDP per capita, resilience, and the capacity for structural change (Mealy *et al.* 2017) Economic complexity, as defined by leading scholars, is a powerful analytical framework that links the diversity and sophistication of economic activities to broader development outcomes. It provides both a theoretical and empirical basis for understanding how economies grow, adapt, and innovate in an interconnected world

Macroeconomic Determinants

Macroeconomic determinants are broad economic factors and conditions that shape the performance, growth, and stability of entire economies. These determinants influence key outcomes such as GDP growth, unemployment, inflation, investment, and the standard of living. Macroeconomic determinants are seen by Chirwa and Odhiambo (2016) as the principal economic variables and policies that drive or hinder economic growth at the national level. In developing countries, these include foreign aid, foreign direct investment (FDI), fiscal policy, investment, trade, human capital development, demographics, monetary policy, natural resources, and various regional, political, and financial factors. In developed countries, physical capital, fiscal policy, human capital, trade, demographics, monetary policy, and technological factors are emphasized. Khare and Mugenya (2021) highlighted that macroeconomic determinants differ between developing and developed economies. For developing countries, key determinants include FDI, foreign aid, investment, human capital, trade, and fiscal policy, while developed countries focus more on technology, physical capital, demographics, and monetary policy. Some determinants, such as human capital and fiscal policy, are shared across both contexts. Chaurasia *et al.* (2023) noted that macroeconomic determinants are the economic variables that influence broader economic outcomes, such as stock market development. Commonly studied determinants include inflation, interest rates, economic growth, foreign investment, and exchange rates. These factors interact to affect the financial and real sectors of the economy. Grzega (2018) framed macroeconomic determinants as the foundational economic conditions—such as the level and rate of economic growth, labor market dynamics, national policy, and global economic trends—that indirectly and often gradually shape the standard of living and the ability of populations to meet their needs

GDP Per Capita Growth

GDP per capita growth approach it as a core measure of economic progress and living standards. Specifically, Safiyanu (2025) examined it as the dependent variable impacted by macroeconomic factors, while and Nwuju *et al.* (2024) treated per capita income growth synonymously with improvements in individual economic welfare, analyzing how select variables influence this metric in Nigeria. From a capital inflows perspective, several authors

link it to GDP per capita growth. Sindze *et al.* (2020) and Adediran (2023) posit that Foreign Direct Investment (FDI) stimulates this growth by enhancing productivity and capital accumulation. Similarly, Ezekwe *et al.* (2025) frame it as a critical outcome of cross-border capital flows, directly tied to the enhancement of living standards within the ECOWAS region. Institutional and structural factors are also emphasized. Okoh (2024) argued that sustainable GDP per capita growth in emerging African economies is contingent on institutional quality, which channels FDI effectively. Furthermore, Maxwele *et al.* (2024) and Nguéda & Kelly (2022) introduced the lens of economic complexity (drawing on Hidalgo, 2021, and Balland *et al.,* 2022), suggesting that growth in GDP per capita is driven by a nation's productive capabilities and the diversity of its exports. Finally, Batrancea *et al.* (2021) and Gafsi & Bakari (2025) provided a macroeconomic determinants framework, identifying variables like gross capital formation, trade openness, and macroeconomic stability (as echoed in the review by Chirwa & Odhiambo, 2016) as fundamental drivers of growth in GDP per capita across African panels.

Unemployment, Total

Unemployment, total is consistently defined by authors as a critical macroeconomic indicator, though its specific contextual role varies. Elina (2025) provided a direct conceptual definition, treating total unemployment as a measure of the portion of the labor force that is without work but is available for and actively seeking employment. This standard definition underpins its use as an independent variable affecting economic growth in OIC countries. Several authors frame it as a key challenge and consequence of economic performance. Safiyanu (2025) and Olabisi & Akeju (2025) analyzed total unemployment as a pivotal macroeconomic variable whose levels significantly impact, and are impacted by, economic growth dynamics in Sub-Saharan Africa, especially following the COVID-19 shock. Similarly, Nyiramahoro *et al.* (2025) implicitly define it through its relationship with other dynamics, investigating how GDP growth and population changes interact with unemployment rates in Uganda. Furthermore, unemployment is positioned as a central component of social welfare and development outcomes. Ezekwe *et al.* (2025) link it directly to living standards within the ECOWAS region, implying that high total unemployment signifies poor developmental health and reduced well-being. This perspective is reinforced by the theoretical foundation of Grzega (2018), who classifies unemployment as a fundamental macroeconomic determinant of the standard of living. total unemployment is fundamentally defined as the share of the active labor force that is jobless and searching for work. However, it is operationalized variably as: a standard explanatory variable for growth, a core symptom and cause of macroeconomic health and a direct inverse indicator of societal living standards and development progress.

Foreign Direct Investment, Net Inflows

The World Development Indicators (2025) defined FDI net inflows as the value of inward direct investment made by non-resident investors in the reporting economy, minus disinvestment. It includes equity capital, reinvestment of earnings, and other long-term and short-term capital as shown in the balance of payments, with the key criterion being the investor's lasting interest and significant influence (typically owning 10% or more of voting stock) in an enterprise operating in an economy other than that of the investor. Jaiblai & Shenai

(2019) described it as cross-border investment establishing a lasting interest. Sindze *et al*. (2020) and Adediran (2023) defined these inflows as a vital external source of finance that supplements domestic savings and stimulates growth through capital formation and technology transfer. Furthermore, scholars evaluate its qualitative impact. Okoh (2024) framed it as a potential catalyst for sustainable economic growth, contingent on strong host-country institutions, while Karangwa & Su (2023) advocated for a multidimensional definition that assesses inflows by their broader developmental effect on structural transformation and productive capacity, not just their monetary value.

Broad Money

Broad money, as defined by major international organizations, is a comprehensive measure of the total money supply within an economy, encompassing more than just physical currency. The International Monetary Fund (IMF) (2023), in its Monetary and Financial Statistics Manual, defined broad money as the sum of currency outside depository corporations, transferable deposits, electronic money, and other deposits. It represents the stock of financial assets that can be used to make payments or be readily converted into means of payment, serving as a key indicator of overall liquidity. Similarly, the World Bank (2025), through its World Development Indicators, defines broad money as the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This aggregate is used to gauge the depth of financial intermediation and the resources available for domestic investment. The European Central Bank (ECB) (2025) refers to it as M3, a broad monetary aggregate including currency in circulation, overnight deposits, deposits with an agreed maturity of up to two years, deposits redeemable at notice up to three months, repurchase agreements, money market fund shares/units, and debt securities with a maturity of up to two years. the Bank for International Settlements (BIS) analyzeed broad money as the widest measure of the money stock, capturing the liabilities of the financial system to domestic residents. This concept is central to its analysis of global liquidity, financial cycles, and the transmission of monetary policy, linking money supply growth to inflation and economic activity over the medium term.

Theoretical Framework

The "Capabilities and Diversification" theory, formally articulated as the core of Economic Complexity Theory, was initially propounded and developed in a seminal series of papers published around 2007-2009 by economists César A. Hidalgo and Ricardo Hausmann, with key publications solidifying the framework in 2009. Their pivotal paper, "The Building Blocks of Economic Complexity," published in the Proceedings of the National Academy of Sciences in 2009, established the formal model and mathematics behind the theory. This theory posited that a nation's economic development is driven not by isolated factors but by the diversity and sophistication of its non-tradable productive capabilities—the collective knowledge, skills, institutions, and infrastructure embedded in its firms and networks. A country's economy is viewed as a collective learning system; its export basket reveals its underlying capability set. Development is thus a path-dependent process of accumulating these capabilities to diversify into related, more complex products, visualized through networks like the Product Space. The

theory is operationalized through the Economic Complexity Index (ECI), derived from an iterative algorithm (the Method of Reflections) applied to international trade data. The mathematics begin with a binary matrix M_{cp}, where 1 indicates country c is a significant exporter of product p.

The core iterative equations are:

$$k_{c,n} = \frac{1}{k_{c,0}} \sum_p M_{cp} \cdot k_{p,n-1} \quad \text{and}$$

$$k_{p,n} = \frac{1}{k_{p,0}} \sum_c M_{cp} \cdot k_{c,n-1} \,,$$

Where: $k_{c,0}$ and $k_{p,0}$ are initial diversification and ubiquity measures. ECI is derived from the eigenvector associated with the second-largest eigenvalue of this system.

This theory is the foundational framework for analyzing the macroeconomic determinants of economic complexity in Sub-Saharan Africa. It provides the causal logic for linking the selected independent variables to the dependent variable—the Economic Complexity Index (ECI), derived from SITC trade data. According to the theory, a country's ECI reflects its accumulated productive capabilities. Therefore, macroeconomic variables that enhance or hinder capability development should directly influence complexity. GDP per capita growth signals the effective deployment of existing capabilities for income generation. Low unemployment indicates a labor market that is utilizing human capabilities efficiently. Foreign direct investment is a critical vector for importing new technologies, skills, and managerial capabilities. Broad money represents financial depth and the availability of capital necessary to fund the investments in infrastructure, education, and innovation that underpin new capabilities. Thus, the paper tests the hypothesis that positive trends in these macroeconomic determinants from 2007 to 2024 facilitate the accumulation of the broader and more sophisticated capability base required for increased economic complexity in the selected African nations.

Empirical Review

Safiyanu (2025) investigated the impact of macroeconomic variables on economic growth in 7 Sub-Saharan African (Angola, Chad, Equatorial Guinea, Gabon, Libya, Nigeria and Sudan) countries from 1990 to 2023. Using the Augmented Mean Group (AMG) estimator, the results showed that inflation and unemployment rates negatively affect economic growth, while export, gross capital formation, and human capital have a positive impact. Real effective exchange rate and labor force participation rate have a negative but insignificant effect.

Ezekwe*et al.* (2025) investigated the link between cross-border capital flows and living standards, measured by GNI per capita growth, in ten ECOWAS countries from 1990 onward. The objective was to assess how different types of foreign capital affect living standards in a region increasingly seen as a destination for foreign investment. The authors employed the

pooled mean group (PMG) estimator and the Hausman test on panel data from the World Bank and IMF. The results showed that FDI inflows, remittances, and Official Development Assistance (ODA) all had a significant positive effect on GNI per capita, contributing to improved living standards. Conversely, external debt had a significant negative effect, failing to translate into better living standards.

Olabisi and Akeju (2025) revisited the macroeconomic determinants of economic growth in Sub-Saharan Africa (SSA) from 1990 to 2023, with a specific focus on the context of the COVID-19 pandemic. The study's core objective was to identify the key drivers of growth during this transformative period. The authors employed the Pooled Mean Group (PMG) estimator within an autoregressive distributed lag (ARDL) framework and conducted Dumitrescu-Hurlin panel causality tests. Their key findings indicated that foreign direct investment (FDI), trade openness, human capital, and population growth all had a positive and significant effect on economic growth in SSA. The causality analysis revealed complex interrelationships, including a bi-directional causal link between FDI and GDP.

Nyiramahoro*et al.* (2025) investigated the macroeconomic dynamics and relationships among GDP growth, gross capital formation (GCF), population growth, and foreign direct investment (FDI) net inflows in Uganda from 2000 to 2022, guided by endogenous growth theory. The study employed a quantitative approach, utilizing descriptive statistics, stationarity tests, cointegration analysis, and an Autoregressive Distributed Lag (ARDL) model. Key findings confirmed a long-run cointegrating relationship among the variables. The ARDL estimation revealed that GCF had a strong, immediate positive effect on GDP growth, while FDI and population growth exerted significant influence only after a lag. The study also highlighted challenges of volatile GCF and periods of negative FDI net inflows.

Azenui and Batmaz (2025) examined the short-run and long-run effects of FDI, corruption, and economic complexity on environmental degradation in 25 Sub-Saharan African countries from 1996 to 2018. The core objective was to test the Pollution Haven Hypothesis and the Environmental Kuznets Curve in the region. The authors employed a dynamic panel data model. Their key findings indicated that higher economic complexity, low-quality FDI, and corruption all significantly exacerbated environmental degradation, providing broad support for the pollution haven hypothesis. Specifically, the Economic Complexity Index (ECI) was associated with rising environmental harm. The study concludes that the pursuit of economic sophistication, when coupled with weak governance and unsustainable FDI, carries environmental costs.

Elina (2025) investigated the impact of FDI, unemployment, carbon emissions, and inflation on economic growth in 18 selected Organization of Islamic Cooperation (OIC) countries from 2014 to 2023. The objective was to analyze both direct effects and the moderating role of inflation within frameworks of Neoclassical Growth Theory and economic resilience. Methodologically, the study utilized static panel regression (Fixed Effects), dynamic panel regression (Generalized Method of Moments - GMM), and Moderated Regression Analysis (MRA). The key findings were mixed: FDI had a positive effect in static models but a negative

effect in dynamic models, suggesting potential long-term crowding-out. Unemployment consistently exerted a significant negative impact on growth, while carbon emissions showed a positive association, highlighting a growth-environment trade-off. Inflation positively influenced growth and acted as a quasi-moderator.

Gafsi and Bakari (2025) investigated the macroeconomic determinants of economic growth across all 54 African countries from 1999 to 2023. The study's core objective was to provide a holistic, continent-wide analysis of the drivers and constraints to growth. Employing a comprehensive panel data approach, the authors analyzed a wide range of variables. Their key findings identified domestic investment, final consumption expenditure, and exports as the most significant positive drivers of economic growth. However, the study highlighted several challenges: import dependency had a negative effect, and the contributions from the labor force, financial development, urbanization, and digitalization were found to be weak or limited. A notable finding was the positive association between carbon dioxide emissions and growth, indicating a critical development-environment trade-off.

Nwuju *et al.* (2024) examined the influence of selected macroeconomic factors on per capita income in Nigeria from 1990 to 2022. The study's core objective was to determine how variables such as broad money supply, inflation, unemployment, and interest rates impact income levels amidst Nigeria's low and declining per capita income relative to peers. Methodologically, the authors employed time series data and the Dynamic Ordinary Least Squares (DOLS) technique to analyze long-run relationships. Key findings indicated that broad money supply had a substantial positive effect on per capita income, whereas unemployment, inflation, and interest rates significantly impeded it.

Nzasabayezu *et al.* (2024) to investigated the macroeconomic stability factors impacting GDP per capita in five African countries (Botswana, DRC, Egypt, Nigeria, Rwanda) from 1992 to 2022. The objective was to identify country-specific significant drivers. The methodology involved applying a multilinear regression model using SPSS 25 on World Development Indicators data. Findings were country-specific but consistently showed that key sectors (agriculture, industry, services) and infrastructure (e.g., railways) had significant positive relationships with GDP per capita. The rule of law was also a significant positive factor in Egypt, Nigeria, and Rwanda. A critical cross-cutting finding was that corruption and political instability significantly hindered GDP per capita across all countries studied.

Maxwele*et al.* (2024) investigated the short-run and long-run relationships between economic complexity and good governance in 27 Sub-Saharan African countries from 1996 to 2019. The objective was to address a gap in the literature regarding how economic sophistication and governance interact. The methodology utilized the Pooled Mean Group-Autoregressive Distributed Lag (PMG-ARDL) model. The findings revealed a significant long-run relationship: economic complexity, foreign aid, and the Gini coefficient (income inequality) all had a positive and statistically significant impact on good governance. In the short run, however, economic complexity and foreign aid had an insignificant negative impact.

Okoh (2024) examined the effect of institutional quality and foreign direct investment (FDI) on sustainable economic growth in eight emerging African economies (Nigeria, Botswana, Ghana, Kenya, Mozambique, Tanzania, Uganda, and Zambia) from 1990 to 2020. The study employed a panel data methodology and, based on the results of the Hausman test, adopted a fixed effects regression model. Key variables included GDP per capita, FDI, domestic investment, corruption perception index (CPI), political stability, and exchange rate. The findings concluded that institutional quality (proxied by lower corruption and greater political stability) and FDI inflows both had a significant positive relationship with sustainable economic growth.

Nguéda and Kelly (2022) explored the relationship between economic complexity and foreign direct investment (FDI) in Sub-Saharan African countries from 1998 to 2019. The paper's core objective was to determine the impact of FDI on a region's economic sophistication. The authors employed the Ordinary Least Squares (OLS) technique, reinforced by fixed effects estimations and quantile regression. The key finding was that FDI had a positive and statistically significant effect on economic complexity in the region. The paper also found that GDP, trade openness, urbanization, and education contributed to economic sophistication.

Batrancea *et al.* (2021) investigated the macroeconomic determinants of economic growth across 34 diverse African economies from 2001 to 2019. The core objective was to identify the key drivers of GDP growth across a spectrum of income and development levels. The authors employed a multimodal panel data modelling approach. Their key findings showed that economic growth was substantially and positively influenced by imports, exports, gross capital formation, and gross domestic savings. They also found that foreign direct investment (FDI) inflows and outflows played a significant role in capital accumulation and savings dynamics. The paper concluded that these factors are crucial levers for growth.

Data and Method

This paper employed secondary panel data for 15 selected Sub-Saharan African countries: Burkina Faso, Botswana, Côte d'Ivoire, Cameroon, Congo (Dem. Rep.), Gabon, Ghana, Guinea, Malawi, Namibia, Niger, Nigeria, Senegal, Togo, and Uganda. The analysis covers the period from 2007 to 2024. The data for the independent variables are GDP per capita growth (GPG), unemployment rate (UPT), net foreign direct investment inflows (FDI), and broad money supply (BMY) which was sourced from the World Bank's World Development Indicators (WDI) database while the dependent variable, the Economic Complexity Index (ECX), which measures the diversity and sophistication of a country's productive structure, was derived from international trade data based on the Standard International Trade Classification (SITC) system, as calculated by the Harvard Growth Lab's Atlas of Economic Complexity. To ensure the robustness of the econometric analysis, panel unit root, variance inflation factor, heteroscedasticity, normality and autocorrelation tests were conducted. The paper employed a Panel Corrected Standard Errors (PCSEs) estimation model to ensure efficient parameter estimation.

Model Specification

The model for the paper is hinged upon the theoretical framework and adopted model is based on the paper of Aslam *et al.* (2022) that examined the driver role of financial development on the economic complexity: empirical evidence from 33 BRI Participation Countries from 2000-2020. The model applied in the paper is of the form:

$$\mathrm{ECI}_{it} = \beta_0 + \beta_1 ECI_{(t-1)} + \beta_2 LGE_{it} + \beta_3 FDI * INS_{it} \\ \beta_4 LPCY_{it} + \beta_5 INS_{it} + \beta_6 FDI_{it} \quad (1)$$

Where;

The dependent variable is Economic Complexity Index which is denoted as ECI while the independent variables are; LGE= log of government expenditures, FDI*INS = Interaction term of financial development and institutions, LPCY= Log of per capita income, INS= Institutional index, FDI= Financial development index, ε = Error term for the model, `i` and `t` subscripts in equation (1) showed the countries/entities time period respectively.

However, the above model was modified. Thus, the modified model is presented as follows:

$$ECX_{it} = \beta_0 + \beta_1 GPG_{it} + \beta_2 UPT_{it} + \beta_3 FDI_{it} + \beta_4 BMY_{it} + \varepsilon_{it} \quad (2)$$

Where: ECX = Economic Complexity variables in country i at time t for dependent variable, whereas GPG = GDP per capita growth (annual %) in country i at time t, UPT=Unemployment, total (% of total labor force) (modeled ILO estimate) in country i at time t, FDI =Foreign direct investment, net inflows (BoP, current US$) in country i at time t, BMY =Broad money (% of GDP) in country i at time t captured the independent variables, ε = error term, β_0 = intercept, $\beta_1 - \beta_4$ = Coefficients of the explanatory variables

In line with theoretical expectations, macroeconomic fundamentals such as GDP per capita growth, unemployment, foreign direct investment, and broad money supply are expected to influence economic complexity across countries. GDP per capita growth and FDI are theoretically expected to exert a positive effect on a country's economic complexity, while unemployment and broad money may have directionally mixed or ambiguous effects depending on structural characteristics of each economy.

This paper adopted a panel data modelling framework, consistent with Baltagi (2011), to exploit both the cross-sectional (15 Sub-Saharan African countries) and time-series (2007–2024) dimensions of the data. The general form of the panel data model is expressed as:

$$ECX_{it} = \beta_0 + \beta_1 GPG_{it} + \beta_2 UPT_{it} + \beta_3 FDI_{it} + \beta_4 BMY_{it} + \varepsilon_{it}$$

Given the interconnectedness among African economies where shocks in one country can spill over into others this paper first conducted descriptive analysis. Next, panel unit root tests were conducted to determine the order of integration of the variables. The paper applied the

common tests widely recommended in the literature, including Levin, Lin and Chu (LLC) (2002), Im, Pesaran and Shin (IPS) (2003), ADF-Fisher (Maddala & Wu, 1999), and PP-Fisher (Choi, 2001). The ADF-Fisher test, in particular, allows for heterogeneous variances and higher-order autocorrelation across countries (Yilgor, 2008). The IPS test performs individual DF tests for each country, while the Fisher-type tests combine the p-values of individual unit root tests, allowing full heterogeneity in dynamics.

The paper estimated both the Fixed Effects Model (FEM) and Random Effects Model (REM) to determine the appropriate estimator for analysing the macroeconomic determinants of economic complexity. The choice between FEM and REM was guided by the Hausman (1978) specification test, which assesses whether the unique country-specific effects are correlated with the regressors. The Hausman test result supported the use of the Random Effects Model, indicating that the random individual-specific effects are uncorrelated with the explanatory variables, and REM is therefore consistent and efficient. Based on the presence of heteroscedasticity and autocorrelation, panel corrected standard errors (PCSEs) estimation was performed to ensure efficiency of the parameters.

Variables Description and Measurements

Table 1 gives specific summary of variables description, and source of data.

Table 1: Variables Description and Measurements

Variable	Acronym	Description	Measurement / Unit	Source
Economic Complexity Index	ECX	Measures the knowledge intensity and productive capabilities embedded in a country's export structure	Economic Complexity Index score	Atlas of Economic Complexity (Harvard Growth Lab)
GDP Per Capita Growth	GPG	Reflects the rate at which a country's economic output per capita grows over time	Annual % growth rate	World Bank World Development Indicators (WDI)
Unemployment Rate	UPT	Measures the percentage of the labour force that is unemployed and actively seeking work	Unemployment rate (%)	World Bank WDI / National Statistical Offices
Foreign Direct Investment	FDI	Tracks net inflows of investment made by foreign entities into domestic productive sectors	FDI net inflows (% of GDP or US$)	UNCTAD / World Bank WDI
Broad Money Supply	BMY	Indicates the level of liquidity in the economy, including currency, demand deposits, and quasi money	Broad Money (% of GDP or local currency units)	IMF IFS / World Bank WDI / Central Banks

Source: Researchers' Compilation, 2025

Results and Discussions

Table 2: Descriptive Results

Variable	Obs	Mean	Std. Dev.	Min	Max
ECX	269	-1.048833	.4801321	-2.42	.2
GPG	269	1.828054	3.086498	-15.89971	11.33704
UPT	269	7.021885	6.697565	.316	23.615
FDI	269	1.07e+09	1.39e+09	-3.19e+08	8.84e+09
BMY	269	28.3775	13.6729	7.000762	72.6054

Source: Author's Computation from STATA (2026)

From Table 2, the results indicate economic complexity average –1.0488, with dispersion (Std. Dev. of 0.4801), showed that the productive structures in the region are mostly simple. The indicator's 0.4801 score and range between -2.42 and 0.2 highlight continued technological and knowledge-based weaknesses. GDP per capita growth (GPG) has a relatively small mean growth of 1.83 per cent with very high standard deviation (Std. Dev. of 3.0864). The range was from -15.90 to 11.34 per cent, indicating that there was a wide variation in countries' economic performance. The unemployment rate (UPT) is on average 7.02 per cent of the labour force, but with a high standard deviation of 6.70 per cent and a broad range (0.32 to 23.62 per cent), signifying the existence of significant labour market disparities. Average FDI inflows (FDI) are $1.07 billion with a rather large standard deviation of $1.39 billion. Broad money (BMY) is 28.38 per cent of GDP on average. The average figure is 13.67% (range: 7.00% to 72.61%), which represents different degrees of financial deepening. These outcomes suggest that economic complexity in SSA is determined in a context of very unequal growth, labour market characteristics, capital flows and monetary depth, and that any systematic influence of these factors on productive sophistication is likely to be contingent upon the very strong structural asymmetries that exist in the region between fragile and emerging economies.

Table 3: Shapiro-Wilk Test Result

Variable	Obs	W	V	z	Prob>z
ECX	269	0.96071	7.601	4.736	0.00000
GPG	269	0.92392	14.717	6.279	0.00000
UPT	269	0.69311	59.370	9.536	0.00000
FDI	269	0.70577	56.919	9.437	0.00000
BMY	269	0.89572	20.173	7.015	0.00000

Source: Author's Computation from STATA (2026)

Table 3 revealed that the variables are not normally distributed, as the probability values of the Shapiro–Wilk test for all the variables are 0.0000, which strongly rejects the null hypothesis of normality for all the variables. The economic complexity (ECX, W = 0.9607), GDP per capita growth (GPG, W = 0.9239), unemployment (UPT, W = 0.6931), foreign direct investment (FDI, W = 0.7058) and broad money (BMY, W = 0.8957) variables show substantial deviation from the Gaussian distribution. These non-normalities are indicative of extreme values, structural breaks and asymmetric patterns in the data, which are consistent with a region

where rapid growth, sudden capital surges, chronic joblessness and shallow financial markets coexist. The skewness suggests that the relationship between macroeconomic variables and economic complexity is not likely to be linear and that ordinary least-squares regression-based inference methods may be sensitive to outliers and therefore be difficult to interpret, and should be treated with caution and robust estimation techniques such as the panel corrected standard errors be used instead.

Table 4 Heteroskedasticity Results

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of ECX
chi2(1) = 9.32
Prob > chi2 = 0.0023

Source: Author's Computation from STATA (2026)

Table 4 yielded a test statistic of $\chi^2(1) = 9.32$ and a probability of 0.0023, which strongly rejects the hypothesis of homoskedasticity. This result is consistent with the conclusion that there is heteroscedasticity in the error terms, as the variability of economic complexity is not equal across the sample. The heteroscedasticities suggest that the impact of GDP per capita growth, unemployment, FDI and broad money on productive sophistication is likely to be size-dependent across different levels of development or institutional context. Thus, the panel corrected standard errors resulting from the estimation makes valid inferences about the macroeconomic determinants of economic complexity in the Sub-Saharan African states.

Table 5: VIF Results

Variable	VIF	1/VIF
GPG	1.07	0.933852
UPT	1.40	0.714908
FDI	1.04	0.963744
BMY	1.34	0.747294
Mean VIF	1.21	

Source: Author's Computation from STATA (2026)

The variance inflation factors diagnostic is used in Table 5, showing that all variables are well within acceptable threshold of 5. All of the VIFs are small (VIF = 1.07, 1.40, 1.04 and 1.34), and the average VIF = 1.21 indicates there is no troubling multicollinearity. This finding ensures the independence of the regressors to make sure that the separate impacts of economic growth, the labour market, financial depth and capital inflows on economic complexity are not mixed up.

Table 6: Autocorrelation Results

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	264.1798	Prob. F(2,262)	0.0000
Obs*R-squared	179.8279	Prob. Chi-Square(2)	0.0000

Source: Author's Computation from STATA (2026)

Table 6 demonstrated an F-statistic of 264.18 (Prob.>F 0.00; F = 0.0000) and the Obs*R-squared of 179.83 (Prob.). The null hypothesis of no autocorrelation is rejected with the Chi-Square = 0.0000. This means that the errors from the model are correlated over time, which suggests that the errors have a time-dependent structure. The fact of autocorrelation implies that the contemporaneous specifications might lack dynamic modifications, lags, or inertial effects in the manner in which economic complexity is influenced by GDP growth, unemployment, FDI and broad money. The problem of serial correlation which might undermines the efficiency of the estimates was corrected using the panel correction standard errors to capture the true time dependence in the macroeconomic drivers of productive complexity in sub-Saharan Africa.

Table 7: Fisher-Type Results

Variable	Statistic	P-value	Comment
ECX	151.9028	0.0000	Stationary
GPG	213.6275	0.0000	Stationary
UPT	51.8606	0.0079	Stationary
FDI	114.7834	0.0000	Stationary
BMY	65.7624	0.0002	Stationary

Source: Author's Computation from STATA (2026)

Fisher-type unit root test results at all series are stationary at level, as shown in table 7. Economic complexity (statistic 151.90, p = 0.0000), GDP per capita growth (213.63, p = 0.0000), unemployment (51.86, p = 0.0079), FDI (114.78, p = 0.0000), and broad money (65.76, p = 0.0002) each reject the presence of a unit root at standard significance levels. The stationarity property implies that the variables are non-stochastic trends and are mean reversion, which makes the relationship that exists between them non-spurious. The result suggests that for Sub-Saharan Africa, high or low economic complexity, economic growth, unemployment, capital inflows, and monetary depth tend to return to long-run equilibria determined by the structural policies and institutional regularities.

Table 8: Hausman Test Results

	(b) Fixed	(B) Random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
GPG	.0003162	.0003456	-.0000294	.0005179
UPT	-.0104997	-.0116065	.0011068	.0058656
FDI	9.12e-12	7.87e-12	1.26e-12	2.21e-12
BMY	-.0053856	-.0055054	.0001198	.0005976
Chi2 (3)	0.08			
Prob>chi2	0.9946			

Source: Author's Computation from STATA (2026)

The Hausman test statistic in table 8 is 0.08, and the Hausman probability value is 0.9946. This result does not lead to rejection of the null hypothesis that the random effects estimator is consistent and efficient, which favours a random effects specification over a fixed effects specification. The result suggests that the random effects model is the right model to analyse the effects of GDP per capita growth, unemployment, FDI, and broad money on economic complexity because the unobserved heterogeneity is not systematically related to the regressors, country by country and time by time. It proposes that the structural determinants of productive complexity in Sub-Saharan Africa are embedded in a context in which differences between countries are reasonably summarised by the macroeconomic variables used and that the random effects modelling approach can efficiently provide inferences about the long-run determinants of economic complexity in the region.

Table 9: Panels Corrected Standard Errors (PCSEs) Results

ECX	Coef.	Panel-corrected Std. Err.	Z	P>z	[95% Conf.	Interval]
GPG	-.0020958	.0034914	-0.60	0.548	-.0089387	.0047471
UPT	-.0177217	.0049644	-3.57	0.000	-.0274518	-.0079916
FDI	-4.40e-11	2.36e-11	-1.87	0.062	-9.02e-11	2.17e-12
BMY	-.0076504	.0019262	-3.97	0.000	-.0114257	-.003875
_cons	-.5862139	.0542858	-10.80	0.000	-.6926121	-.4798157
Wald chi2(3)	91.00					
Prob > chi2	0.0000					
R-Squared	0.7472					

Source: Author's Computation from STATA (2026)

The outcome in Table 9 unearthed that the intercept coefficient, –0.5862 (p = 0.000), is significantly lower than zero, suggesting that a lack of productive capabilities is deeply entrenched in the region of Sub-Saharan African countries as a whole. The model corresponds to an R^2 of 0.7472, which indicates that about 74.7 per cent of the variation in economic complexity is explained by the model, indicating that the macroeconomic variables specified are relevant. Furthermore, the joint statistical significance of the regressors is confirmed by the Wald chi-square statistic equal to 91.00 with a probability > chi^2 of 0.0000, suggesting that the model is sound in terms of explaining the systematic determinants of economic complexity in Sub-Saharan Africa.

The coefficient of the GDP per capita growth (GPG) is negative (–0.0021), which is not statistically significant (p = 0.548). This implies that short-run changes in aggregate income growth are not systematically related to the development of productive capabilities as envisioned by the capabilities and diversification theory. In this context, economic growth is not a driver of structural transformation, any more than economic recession is a driver of it; this can be as a result of the capacity to exploit existing capabilities, and natural resource rents which are one of the most important examples of existing capabilities. This is consistent with the findings of Gafsi and Bakari (2025), which showed that the key factors of development in Africa were not GDP growth but domestic investment and exports. It is therefore a signal to alter the focus of the policy from growth of GDP to composition and quality of economic activity should it wish to increase the economy's complexity.

The coefficient of unemployment (UPT) is negative (–0.0177) and highly significant (p = 0.000), indicating that unemployment significantly reduces the economy's complexity. This is directly in line with the capabilities and diversification theory, where unemployment is seen as underutilisation of one of the most important non-tradable capabilities – human capital. When workers are idle, tacit knowledge and skills in the labour force are not utilized in the production of complex products. This finding is in line with those of Safiyanu (2025), who noted a negative relationship between unemployment and growth in SSA, and Elina (2025), who observed that unemployment had a consistently negative impact on growth in OIC countries. It also helps to validate the economic intuition that many unemployed individuals are those that, as per Hidalgo and Hausmann (2009), are required to advance towards sophisticated, high value-added production. Labour market strategies designed to boost employment and improve skills development are therefore important for developing skills for increased economic complexity.

The coefficient of foreign direct investment (FDI) is negative (–4.40e-11) and is not significant (p = 0.062). The outcomes are consistent with the capability's theory, which noted that the purpose of FDI is to increase the complexity and enhance the capabilities of the host country through the transfer of foreign knowledge, technology and managerial know-how. Consistent with the empirical evidence for this positive channel, as Nguéda and Kelly (2022) established that FDI positively and significantly affected economic complexity in SSA, and Olabisi and Akeju (2025) and Ezekwe *et al.* (2025) recorded a positive effect of FDI on growth and living standards, respectively. But this negative trend is not consistent with this positive narrative. This could reflect the dominance of low-quality and resource-seeking FDI with limited knowledge spillover effects, which are associated with environmental degradation of the region (Azenui & Batmaz, 2025). FDI can take place at the expense of domestic investment or potentially not create the forward and backward linkages needed to foster productive capabilities in fragile institutional environments. This implies that it is not enough to have just a lot of foreign investments; the quality, sectoral composition, and the regulatory regime that govern foreign investment are the most critical factors to ensure economic complexity.

The coefficient of broad money (BMY) is negative (–0.0077) with a significant value (p = 0.000). Financial deepening, proxied as broad money, should help fund productive

investments that are at the heart of capability accumulation, and the capabilities theory sees access to finance as a key component of the enabling infrastructure for economic complexity. However, the negative impact indicates that in the Sub-Saharan African context, the growth of monetary aggregates has not been directed to the activities that foster capabilities. Rather, it has worsened the speculative pressure, drive currency volatility, lead to excessive consumption, or reflect a monetary overhang in economies with fragile transmission mechanisms. The result is different to the result of Nwuju *et al*. (2024), which reported a significant positive relationship between broad money supply and per capita GDP in Nigeria. It further complicates the evidence of Batrancea *et al.* (2021), who had already noted gross capital formation and savings as being central to growth in the region since the growth of broad money seems largely out of phase with productive capital formation. The finding is not surprising, as Maxwell *et al*. (2024) found that the path toward structural transformation in the long run is not simply a matter of financial liquidity but also a robust institutional framework, which is still lacking in many Sub-Saharan African states. As such, the expansion of money without the institutional quality and effective credit allocation mechanisms is counterproductive for economic complexity.

Conclusion and Recommendations

The macroeconomic influences on economic complexity, as this paper shows, are not only strong but also highly conditional within Sub-Saharan Africa. Unemployment is an unequivocal downward force on the accumulation of productive capabilities, and thus on the collective knowledge and know-how that forms the basis of economic complexity in the capabilities and diversification theory. By contrast, the growth of broad money and, on a marginal basis, foreign direct investment have not brought any added complexity and suggest a very high level of disconnect between financial deepening, capital inflows and the transformation of productive structures. It is also important to note that short-run GDP per capita growth is not significant, further reinforcing the idea that income growth without capability growth can move economies to more complex and higher value activities. This requires a well-designed policy architecture, one that emphasises human capital deployment, tightly targets financial flows on productive investment, filters foreign investment for the transfer of real knowledge and enacts all these measures within solid institutional structures for sustainable economic complexities. The path dependence and patient nature of capability accumulation can only be captured by linking macroeconomic policies to the path of development in Sub-Saharan African countries towards more resilient, knowledge-intensive development.

The goal of lowering unemployment, in turn, should be the top priority of the region's policymakers as the number one macroeconomic objective. It entails active labour market measures, such as investing in technical and vocational education and training that is relevant to the emerging sectors; incentives for firms to create jobs requiring higher skills; and the elimination of structural barriers that prevent large portions of the workforce from escaping informality and underemployment, to unleash human potential needed to value-add the complex production of goods and services. At the same time financial sector regulators need to refine monetary and credit policies to ensure that broad money growth coincides with efficient

intermediation and capability building, which could include new forms of directed credit schemes for innovation-intense small and medium enterprises, increased supervision to avoid speculative distortions in money and credit, and more development of long-term financing instruments for infrastructure and research. Foreign direct investment: Host governments should go beyond attracting a quantity of FDI and establish robust screening processes and laws, favouring greenfield, technology transfer-intensive and linkage-rich FDI over extractive and rent-seeking FDI, and introduce local content rules that include FDI in local supplier networks. All these measures are worthless without institutional strengthening, as improved governance (transparency and rules) and strong enforcement of contracts are essential for executing all these measures and developing the institutional capacity needed to sustain financial resources and foreign capital into productive capacity, which depends ultimately on economic complexity.

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