**Institutional Quality and Artificial Intelligence Readiness: A Twin Catalyst for Growth in Sub-Saharan Africa**

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**Abstract**

This study examines the interaction between institutional quality, artificial intelligence (AI) readiness, and growth dynamics in Sub-Saharan Africa (SSA). Using Fixed Effects and Bias-Corrected Dynamic Panel models on data spanning from 2000 to 2021, it investigates how quality institutions and technological adoption influence key economic indicators, including private sector credit, gross capital formation, GDP growth, and trade openness. The findings highlight that financial development drives credit expansion, facilitating resource mobilization and global integration. Institutional quality particularly in regulatory frameworks and accountability boosts investment and trade, showcasing the benefits of sound governance. Human capital, measured through education, emerges as a strong determinant of GDP growth, while the synergy between institutional quality and AI readiness positively impacts growth dynamics, illustrating the importance of governance in leveraging technology. The robustness checks further reinforce these findings by focusing on the top-performing countries in terms of institutional development. In these contexts, the interaction between institutional quality and AI readiness shows a stronger and more consistent positive effect on growth, confirming the transformative potential of well-governed environments. Policy recommendations raised on the findings emphasize the need for further institutional reforms to strengthen regulatory quality, foster AI adoption in various sectors of the economy, expand digital literacy, and enhance access to education and financial services in Sub-Saharan Africa. Future research should explore the sector-specific impacts and the interaction between institutional quality, AI, and climate adaptation strategies in Sub-Saharan Countries.

**Keywords:** Institutional Quality, Artificial Intelligence Readiness, Economic Growth

**JEL codes:** **O43,** **O33,** **E61**

1. **Introduction**

Economic growth is a central goal for Sub-Saharan Africa (SSA), yet the region continues to face persistent challenges in translating its potential into sustained, inclusive growth. Despite having abundant natural resources and a youthful population, Sub-Saharan Africa’s economic growth remains constrained by a combination of weak institutions, insufficient infrastructure, and political instability. These factors, compounded by external economic shocks, have often hindered the region’s ability to achieve the levels of growth seen in other emerging markets. While recent years have seen promising growth trajectories in countries such as Rwanda, Ghana, and Ethiopia, SSA as a whole remains plagued by structural challenges, including low levels of financial development, weak governance, and inadequate regulatory frameworks (Deborah, Gael, Michael , & Diane, 2024).

A key determinant of economic performance is institutional quality, which encompasses governance structures, the rule of law, property rights, and regulatory efficiency. Institutions shape the economic environment, influencing the effectiveness of policies, the efficiency of financial markets, and the overall investment climate. Countries with robust institutions tend to experience higher levels of economic growth, improved public service delivery, and more inclusive development outcomes (North, 1990,Acemoglu, Johnson, S, & Robinson,J. A, 2020). Conversely, weak institutions often stymie growth, exacerbate inequality, and reduce a country’s ability to attract investment (Rodrik, 2018). In this context, the role of institutions in fostering an environment conducive to technological advancement and economic transformation is of critical importance.

The digital revolution, powered by innovations such as artificial intelligence (AI), offers substantial opportunities for economic growth, particularly in developing economies. AI holds the potential to transform key sectors such as agriculture, healthcare, education, and finance, driving efficiencies, improving public service delivery, and accelerating poverty reduction (Brynjolfsson & McAfee, A, 2014). However, the capacity of SSA countries to harness the benefits of AI is constrained by their readiness to adopt such technologies, which in turn is heavily influenced by the quality of their institutions. Effective governance, sound legal frameworks, and strong regulatory environments are prerequisites for successfully integrating AI into the economy. In this sense, AI readiness cannot be fully realized without the complementary strength of institutional frameworks capable of fostering innovation and technological adoption (Furman & Teodoridis, 2020).

While both institutional quality and AI readiness have been widely studied in separate contexts, the intersection of these two factors remains underexplored in the literature. Research has typically treated institutional quality and AI adoption as distinct phenomena, either examining the former’s impact on economic performance (Acemoglu, Johnson, S, Robinson, J.A, & Thaicharoen, Y, 2003) or investigating the potential of AI in driving development without adequately considering the institutional environment in which it must operate (Aker & Mbiti, I.M, 2010). This paper seeks to fill this gap by investigating how institutional quality and AI readiness interact to influence economic growth in Sub-Saharan Africa. Specifically, it explores the relationship between these two factors and their combined effect on key economic indicators, including Credit to the private sector, investment, GDP growth, and trade openness.

This research arises from the recognition that the interaction between institutional quality and AI readiness could serve as a critical driver of economic growth in SSA. Countries with strong institutions may be better positioned to leverage AI technologies, accelerating progress in economic growth and it builds on the foundation established by previous studies, which highlight the importance of institutional quality for economic growth (Rodrik, 2018), by introducing the novel concept of how the synergy between institutional frameworks and AI readiness could enhance growth dynamics in the region. To achieve our objective, this paper utilizes a Fixed Effects Panel Model controls for unobserved, time-invariant heterogeneity by focusing on the variation within each country, thus isolating the effect of the explanatory variable (Ignace , Gerdie , & Ilse , 2015). However, in cases of small samples like ours, the FE model may suffer from bias, leading to less reliable estimates. Thus, the Bias-Corrected Dynamic Panel Model (BC-GMM) model addresses this issue by applying bootstrap methods to adjust for small-sample bias, resulting in more accurate and robust estimates (Kripfganz & J. Breitung, 2022). Furthermore, this study isolates the top-performing countries in the sample—those with relatively higher institutional development to allow for a clearer analysis of how AI readiness interacts with strong institutions and better isolate its true growth potential in environments where institutional quality is less constrained as robustness check from the main estimates using robust regression which robust-to-outliers (Verardi & Croux, Christophe, 2008).

The findings of this study have significant policy implications. Understanding how institutional quality and AI readiness interact can inform strategies for fostering an environment that supports technological innovation and accelerates growth in Sub-Saharan Africa. Policymakers in SSA can leverage these insights to prioritize institutional reforms, promote AI adoption, and create a more conducive environment for growth. This research thus provides a valuable contribution to both the academic literature and the practical efforts to enhance the economic performance of Sub-Saharan Africa.

The remainder of this paper is structured as follows: Section 2 reviews the related literature. Section 3 discusses the state of institutions and AI readiness. Section 4 outlines the methodology and data. Section 5 presents the empirical results, and Section 6 concludes the study.

1. **Literature review**

The nexus between institutional quality and economic growth has long been recognized in economic theory. Institutions, defined as the formal and informal rules governing economic, political, and social interactions (North, D. C, 1990), are critical for shaping incentives, reducing uncertainty, and fostering productivity. In regions like Sub-Saharan Africa (SSA), where growth trajectories are often impeded by governance issues, institutional quality plays an indispensable role. Acemoglu & Robinson (2012) argue that inclusive institutions, which provide equitable access to resources and opportunities, are fundamental for sustained growth, contrasting extractive systems that often undermine development.

Artificial intelligence (AI) readiness, meanwhile, represents the capability of a country to adopt and implement AI technologies effectively. AI readiness hinges on factors such as infrastructure, digital literacy, and innovation ecosystems (Insights, 2023). Integrating AI within SSA economies offers potential productivity enhancements, especially in sectors like agriculture, healthcare, and financial services (Bughin, 2018). However, institutional quality often dictates the success of such technological integration by influencing regulatory frameworks, trust, and adaptability within economies (Rodrik, D, 2004). The intersection of institutional quality and AI readiness aligns with theories of endogenous growth (Romer, 1990), which emphasize innovation and technology adoption as key growth drivers. Institutions provide the foundation for such advancements by ensuring property rights, fostering research and development (R&D), and facilitating knowledge diffusion. Thus, the theoretical framework underlines how the synergy between robust institutions and AI readiness can catalyze growth in SSA.

Empirical studies highlight the profound impact of institutional quality on economic outcomes. For instance, studies by Kaufmann, Kraay, A, & Mastruzzi, M. (2011) using the Worldwide Governance Indicators (WGI) show that governance dimensions such as government effectiveness, regulatory quality, and rule of law significantly correlate with GDP per capita growth. In SSA, weak institutional frameworks have been linked to corruption, inefficiency, and policy instability, undermining investor confidence and long-term development (Mishra & Daly, K, 2020).

Furthermore, recent studies on AI readiness in SSA suggest a mixed potential for AI-driven transformation. A report by Institute, McKinsey Global, (2021) found that AI technologies could add $1.2 trillion to the global economy by 2030, with SSA standing to benefit substantially in agriculture and public services. However, inadequate digital infrastructure and skill gaps remain critical barriers. For example, Kone & Islam, M, (2022) emphasize that SSA’s AI readiness is hampered by underfunded education systems and low innovation expenditure. Other several studies explore how institutional quality moderates the adoption and impact of technologies. Andrews & Criscuolo, C,(2013) find that countries with better institutions experience faster technology diffusion due to enhanced policy support and reduced risks for innovators. In SSA, strong institutions facilitate access to international technology partnerships, boost R&D, and enable regulatory reforms conducive to AI integration (Zhao & et al, 2020). In addition, empirical evidence suggests that AI applications have the potential to address key developmental challenges in SSA. For instance, studies by (Aker & Mbiti, I.M, 2010) demonstrate how AI-powered mobile applications have revolutionized financial inclusion and agricultural productivity. However, AI's transformative impact is contingent on institutional frameworks that safeguard data privacy, promote fair competition, and incentivize technological investments (Banga & te Velde, D. W, 2020).

While existing studies highlight the individual contributions of institutional quality and AI readiness, research exploring their interplay is still nascent. Recent work by Yameogo & Senbet, L. W,(2023) underscores that the combination of strong institutions and AI readiness could significantly enhance productivity and growth in SSA by reducing inefficiencies and fostering innovation. Their findings highlight the importance of coordinated policies that integrate governance reforms with technological advancements to maximize developmental outcomes. However, several gaps remain. Firstly, there is limited empirical evidence on the causal pathways linking institutional quality and AI readiness to growth in SSA. Secondly, most studies adopt cross-sectional approaches, overlooking the dynamic and evolving nature of institutions and AI readiness over time. Lastly, the role of specific governance dimensions (e.g., regulatory quality, control of corruption) in moderating AI adoption remains underexplored, thus this study examines role of institutional quality and artificial intelligence readiness on growth in Sub-Saharan Africa.

1. **The state of the Institutions and AI Readiness in Sub-Saharan Countries**

Section 3 examines the relationship between institutional quality and AI readiness in Sub-Saharan African countries. It explores how the strength of governance, regulatory frameworks, and infrastructure influences the region's ability to adopt and integrate artificial intelligence technologies.

**Figure 1: Comparison of aggregated institutional quality indicators between 2000-2005 and 2015-2020**

** Source:** Author’s own computation

Figure 1 compares the institutional quality indicators in Sub-Saharan Africa for the periods 2000-2005 and 2015-2020 indicates varying degrees of progress in governance and institutional reforms. During 2000-2005, many countries faced challenges in areas such as government effectiveness and regulatory quality, reflecting constraints in state capacity and governance systems. By 2015-2020, some improvements were observed in these indicators, possibly linked to reforms in public administration and regulatory frameworks. Countries like Rwanda and Botswana demonstrated progress in enhancing institutional performance, while others, particularly those experiencing prolonged conflict or instability, had more limited advancements.

**Figure 2: Contributions of institutional quality indicators between 2000-2005 and 2015-2020**

 **Source:** Author’s own computation

When we look at figure 2, the contributions of institutional quality indicators between 2000-2005 and 2015-2020 we see mixed progress across different governance dimensions. In the earlier period, challenges such as limited state capacity, weaker regulatory frameworks, and constrained public sector efficiency were prominent across the region. By 2015-2020, certain countries, including Rwanda, Ghana, and Senegal, exhibited notable improvements in some indicators, such as government effectiveness and regulatory quality, attributed to reforms aimed at enhancing public service delivery and fostering a more conducive business environment. For example, Rwanda's focus on administrative efficiency and anti-corruption measures helped streamline public services, while Ghana and Senegal made strides in improving regulatory systems to attract investment and support economic diversification.

Despite observed progress in some indicators, issues such as corruption and challenges in strengthening the rule of law remain areas for further attention. Regional disparities in institutional development point to the need for context-specific approaches to reforms. While certain nations have benefited from increased economic activity and improved governance structures, others may require sustained efforts to address institutional weaknesses.

**Figure 3: Sub-Saharan Africa Artificial Intelligence Reediness and its three Contributions pillars**

 **Source:** Author’s own computation

Figure3 indicates that in 2023, Sub-Saharan Africa's readiness for artificial intelligence (AI) is shaped by three key pillars: infrastructure, human capacity, and governance. Mauritius, South Africa, and Rwanda have made noticeable progress in these areas. Mauritius has worked to strengthen its digital infrastructure, creating an environment that encourages AI innovation and research. South Africa, with its relatively advanced industrial base, has integrated AI into sectors such as healthcare and finance, benefiting from a skilled workforce and research institutions. Rwanda, through its Smart Rwanda Master Plan, has incorporated AI into its national development agenda, focusing on digital transformation and government service delivery. However, challenges still exist across the region. While countries like Rwanda have made efforts to develop governance frameworks for AI, others like South Africa and Mauritius are still working on refining regulations to balance innovation with ethical considerations. Additionally, there are disparities in the availability of digital infrastructure, particularly in more rural areas, which may affect broader access to AI technologies.

**Figure 4: Correlation between institutional quality and AI readiness in sub-Saharan Africa**

**Source:** Author’s own computation

Figure4 illustrates a general trend where higher institutional quality is associated with greater AI readiness in Sub-Saharan Africa. For example, Mauritius, which performs well in both institutional quality and AI readiness, reflects its stable institutional frameworks and proactive policies that have supported AI development. Rwanda, while not at the same level as Mauritius, shows a similar pattern, with improvements in governance and the implementation of the Smart Rwanda Master Plan contributing to progress in AI adoption. This suggests that sound institutions can help create an environment conducive to the development of AI technologies. Similarly, South Africa demonstrates a positive link between institutional quality and AI readiness. The country benefits from solid infrastructure, a skilled workforce, and established research institutions, which have facilitated AI integration across sectors like healthcare and finance. These examples highlight the role of effective institutions in supporting AI initiatives.

In contrast, countries like Sudan, Burundi, and Congo, located towards the lower end of the graph, show lower institutional quality and AI readiness, this points to the importance of governance and regulatory frameworks in advancing AI readiness.

1. **Methodology and data**

**4.1 Econometric approach**

This study utilizes the Fixed Effects (FE) Panel Model to examine the relationship between institutional quality, artificial intelligence (AI) readiness, and growth dynamics in Sub-Saharan Africa. The FE model is widely recognized for its ability to control unobserved, time-invariant heterogeneity by isolating within-entity variation. This study effectively accounts for country-specific factors, such as governance structures or cultural traits, which are constant over time but could otherwise confound the analysis as presented in below equation1:

 (1)

However, the FE model’s reliance on large sample sizes for robust parameter estimation can result in biased and less reliable estimates in small-sample settings, such as the dataset used in this study. To address these limitations, the study incorporates the BC-GMM model, which applies bootstrap methods to correct for small-sample bias. The BC-GMM approach not only improves the precision of parameter estimates but also captures the dynamic aspects of the model, which are not adequately addressed by standard fixed-effects techniques Kripfganz and Breitung (2022). For instance, the inclusion of lagged dependent variables in dynamic panel models accounts for temporal dependencies, allowing the analysis to reflect how past levels of growth dynamics influence current outcomes. This dynamic perspective is essential for understanding persistence, feedback effects, and the gradual adjustment of economies to shocks as indicated the equation 2 below:

(2)

By addressing both small-sample bias and dynamic dependencies, the BC-GMM model significantly enhances the reliability of estimates. Unlike the static FE model, it accommodates the temporal interplay among variables, which is critical in this study’s context. For example, it allows for the investigation of how institutional quality or AI readiness evolves and interacts with growth dynamics over time. Furthermore, this dynamic feature improves the accuracy of inferences, especially in small datasets, by correcting for endogeneity and simultaneity biases introduced by lagged dependent variables.

**4.2 Rationale for variable selection and data**

This study examines the role of institutional quality and artificial intelligence (AI) readiness in driving growth in Sub-Saharan Africa, utilizing variables that reflect economic performance, financial development, and institutional frameworks. The dependent variables Credit to the Private Sector (CPS), Gross Capital Formation (GCF), Gross Domestic Product (GDP), and Trade Openness (Open) capture different dimensions of economic growth sourced from the World Development Indicator (WDI) database. CPS measures the extent of financial intermediation and its capacity to support private-sector investment, which fosters economic expansion (Demirgüç-Kunt, Beck, T, & Honohan, P, 2022). GCF represents investments in physical infrastructure, which is critical for long-term productivity gains and economic resilience (OECD, 2023). GDP serves as a comprehensive indicator of economic performance, while trade openness reflects the ability of economies to leverage global markets for growth through innovation and resource efficiency (Rodrik, 2018).

The independent variables that address key enablers and barriers to growth are also sourced from WDI. Financial Development (Fin\_D) assesses how a robust financial system mobilizes resources for productive investments and complements institutional frameworks to foster innovation and technological readiness (Svirydzenka, 2016). Inflation (Inf) captures macroeconomic stability, as high price volatility undermines investment and consumption (Barro & Ursúa, J. F, 2022). Remittances (Remit) serve as a vital source of external financing for many Sub-Saharan African countries, contributing to poverty reduction and investment in education and small businesses (UNDP, 2023). Education, measured through primary school enrollment rates (Schol\_Prim), emphasizes the importance of human capital development in enabling countries to adopt and integrate AI technologies into their economies (Hanushek & Woessmann, L, 2020).

Institutional quality indicators are sourced from Worldwide Governance Indicators(WGI) including Voice of Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption capture governance and structural elements crucial for sustained growth. Strong institutions foster trust, reduce uncertainties, and enable efficient resource allocation, which is necessary for economic transformation and technological integration (Acemoglu, D; Johnson, S; Robinson,J. A, 2020). Finally, AI readiness index (2023) is included, sourced from OpenAFRICA, to measure the degree of countries' AI readiness and evaluate its linkage with the quality of institutions. AI readiness is closely tied to the quality of institutions because strong institutions provide the governance, infrastructure, and regulatory frameworks necessary for the successful adoption and implementation of AI technologies.

This study is conducted in 30 Sub-Saharan African countries ranging in economies, institutional contexts, and geographical locations spanning from 2000 to 2021. The sample features both low-income countries and middle-income countries, reflecting different stages of economic development. It also includes resource-dependent countries and more diversified economies, offering a broad perspective on various growth drivers. The geographical diversity, including landlocked and island countries, helps to consider different regional factors. Additionally, the sample includes countries with varying levels of institutional quality, from more stable institutions to those with weaker governance structures, providing a more comprehensive view of the potential factors influencing growth dynamics and AI readiness.

1. **Empirical findings and discussions**

**Table 1: Summary statistics**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |
| Variables | N | mean | sd | min | max | skewness | kurtosis |
|  |  |  |  |  |  |  |  |
| CPS | 654 | 18.48 | 17.98 | 0.00154 | 104.8 | 2.251 | 8.389 |
| GCF | 642 | 22.06 | 9.264 | 1.097 | 76.78 | 1.538 | 7.554 |
| GDPG | 660 | 4.005 | 4.108 | -20.81 | 26.52 | -1.143 | 10.68 |
| Open | 659 | 64.53 | 34.34 | 4.128 | 235.8 | 2.035 | 8.511 |
| Fin\_D | 660 | -217.4 | 63.06 | -363.3 | -52.34 | 0.490 | 3.310 |
| Inf | 633 | 8.269 | 29.81 | -4.295 | 513.9 | 13.16 | 193.5 |
| Remit | 642 | 2.985 | 3.715 | 0 | 26.84 | 2.117 | 8.846 |
| Schol\_Prim | 540 | 97.85 | 21.77 | 31.85 | 151.7 | -0.0807 | 2.967 |
| Voic\_acc | 475 | -45.53 | 98.75 | -547.5 | 68.44 | -1.698 | 6.696 |
| Polit\_stab | 464 | -26.20 | 83.81 | -480.4 | 82.56 | -1.798 | 7.856 |
| Gvt\_ef | 417 | -81.18 | 100.1 | -534.2 | 76.57 | -0.925 | 4.663 |
| Regul\_qual | 491 | -72.07 | 93.74 | -480.4 | 78.71 | -1.266 | 5.199 |
| Rule\_law | 449 | -69.28 | 113.2 | -1,251 | 70.51 | -3.515 | 30.45 |
| control\_cor | 449 | -76.07 | 106.6 | -590.5 | 95.57 | -0.851 | 3.976 |
|  |  |  |  |  |  |  |  |

**Source:** Author’s own computation

Table1 reveals significant diversity across the variables and countries in the sample. Credit to the private sector (CPS) and gross capital formation (GCF) show moderate averages (18.48% and 22.06%, respectively) with high variability, as indicated by their large standard deviations, and positive skewness suggests outliers with high values. GDP growth (GDPG) has a mean of 4.005%, but the high kurtosis (10.68) reflects extreme cases of economic contraction or rapid growth. Trade openness (Open) and remittances (Remit) show moderate averages (64.53% and 2.985%, respectively), with positive skewness indicating a concentration of lower values and a few high outliers. Inflation (Inf) demonstrates extreme variability (SD = 29.81), driven by hyperinflation episodes in some countries, as shown by its high skewness (13.16) and kurtosis (193.5). School enrollment (Schol\_Prim) has a high average (97.85%) and near-normal distribution, while institutional quality indicators generally exhibit negative means, reflecting governance challenges typical in many developing countries. Notably, variables like Rule of Law and Government Effectiveness have high kurtosis, indicating a few extreme cases, which may require robust econometric approaches to mitigate the influence of outliers and heterogeneity in the analysis.

**Table 2: Correlation Metrix**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | CPS | GCF | GDPG | Open | Fin\_D | Inf | Remit | Schol\_Prim | Voic\_acc | Polit\_stab | Gvt\_ef | Regul\_qual | Rule\_law | control\_cor |
| CPS | 1.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GCF | 0.13\*\*\* | 1.00 |  |  |  |  |  |  |  |  |  |  |  |  |
|  | (0.00) |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GDPG | -0.11\*\* | 0.04 | 1.00 |  |  |  |  |  |  |  |  |  |  |  |
|  | (0.00) | (0.30) |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Open | 0.31\*\*\* | 0.55\*\*\* | -0.02 | 1.00 |  |  |  |  |  |  |  |  |  |  |
|  | (0.00) | (0.00) | (0.59) |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fin\_D | 0.78\*\*\* | 0.29\*\*\* | -0.07 | 0.43\*\*\* | 1.00 |  |  |  |  |  |  |  |  |  |
|  | (0.00) | (0.00) | (0.06) | (0.00) |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Inf | -0.10\*\* | -0.13\*\* | -0.16\*\*\* | -0.11\*\* | -0.09\* | 1.00 |  |  |  |  |  |  |  |  |
|  | (0.01) | (0.00) | (0.00) | (0.01) | (0.02) |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Remit | 0.04 | -0.08 | -0.02 | -0.11\*\* | -0.15\*\*\* | -0.07 | 1.00 |  |  |  |  |  |  |  |
|  | (0.27) | (0.06) | (0.54) | (0.01) | (0.00) | (0.07) |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Schol\_Prim | 0.09\* | 0.08 | 0.08 | 0.11\*\* | 0.10\* | -0.01 | -0.05 | 1.00 |  |  |  |  |  |  |
|  | (0.04) | (0.06) | (0.06) | (0.01) | (0.02) | (0.86) | (0.29) |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Voic\_acc | 0.44\*\*\* | 0.17\*\*\* | -0.01 | 0.19\*\*\* | 0.46\*\*\* | 0.05 | 0.02 | -0.21\*\*\* | 1.00 |  |  |  |  |  |
|  | (0.00) | (0.00) | (0.83) | (0.00) | (0.00) | (0.33) | (0.70) | (0.00) |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Polit\_stab | 0.33\*\*\* | 0.13\*\* | -0.05 | 0.36\*\*\* | 0.43\*\*\* | 0.03 | -0.00 | -0.11\* | 0.43\*\*\* | 1.00 |  |  |  |  |
|  | (0.00) | (0.01) | (0.25) | (0.00) | (0.00) | (0.54) | (0.94) | (0.03) | (0.00) |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Gvt\_ef | 0.59\*\*\* | 0.21\*\*\* | -0.03 | 0.44\*\*\* | 0.65\*\*\* | 0.06 | -0.01 | 0.21\*\*\* | 0.62\*\*\* | 0.43\*\*\* | 1.00 |  |  |  |
|  | (0.00) | (0.00) | (0.48) | (0.00) | (0.00) | (0.21) | (0.90) | (0.00) | (0.00) | (0.00) |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Regul\_qual | 0.52\*\*\* | 0.25\*\*\* | 0.04 | 0.30\*\*\* | 0.58\*\*\* | 0.03 | -0.04 | -0.08 | 0.54\*\*\* | 0.36\*\*\* | 0.73\*\*\* | 1.00 |  |  |
|  | (0.00) | (0.00) | (0.37) | (0.00) | (0.00) | (0.48) | (0.38) | (0.12) | (0.00) | (0.00) | (0.00) |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Rule\_law | 0.39\*\*\* | 0.29\*\*\* | -0.00 | 0.35\*\*\* | 0.50\*\*\* | -0.06 | -0.01 | -0.15\*\* | 0.46\*\*\* | 0.43\*\*\* | 0.52\*\*\* | 0.59\*\*\* | 1.00 |  |
|  | (0.00) | (0.00) | (0.95) | (0.00) | (0.00) | (0.23) | (0.90) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| control\_cor | 0.47\*\*\* | 0.33\*\*\* | -0.05 | 0.42\*\*\* | 0.59\*\*\* | -0.02 | 0.00 | 0.07 | 0.57\*\*\* | 0.43\*\*\* | 0.65\*\*\* | 0.65\*\*\* | 0.73\*\*\* | 1.00 |
|  | (0.00) | (0.00) | (0.28) | (0.00) | (0.00) | (0.62) | (0.94) | (0.15) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |  |

*p*-values in parentheses

\* *p* < 0.05, \*\* *p* < 0.01, \*\*\* *p* < 0.001

**Source:** Author’s own computation

The correlation matrix in table2 reveals key relationships among the variables, highlighting financial development (Fin\_D) as strongly correlated with credit to the private sector (CPS) (0.78\*\*\*), suggesting that more developed financial systems support private-sector credit access. CPS also shows moderate positive correlations with trade openness (Open) (0.31\*\*\*), government effectiveness (Gvt\_ef) (0.59\*\*\*), and control of corruption (control\_cor) (0.47\*\*\*), indicating that institutional quality and trade integration foster credit expansion. Gross capital formation (GCF) is moderately correlated with Open (0.55\*\*\*) and control\_cor (0.33\*\*\*), suggesting that investment levels benefit from both external trade and governance improvements. GDP growth (GDPG) exhibits weak negative correlations with inflation (Inf) (-0.16\*\*\*), reflecting the adverse effects of macroeconomic instability on growth. Institutional quality indicators are positively interrelated (e.g., regulatory quality and control\_cor: 0.65\*\*\*) and show moderate associations with CPS, Open, and Fin\_D, emphasizing their collective role in supporting financial and economic development. Inflation shows weak negative correlations with CPS (-0.10\*\*) and GCF (-0.13\*\*), further underscoring the destabilizing effects of price volatility. These patterns align with the descriptive statistics by illustrating the interconnectedness of institutional quality, financial development, and economic performance, while also highlighting variability in relationships across countries.

**Table 3: Institution Quality and Growth Dynamics in Sub-Saharan Africa Countries**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Static Panel Model** | | | | |  |  | **Dynamic Panel Model** | | |
|  | **FE-CPS** | **FE-GCF** | **FE-GDPG** | **FE-Open** |  | **BCGMM-CPS** | **BCGMM-GCF** | **BCGMM-GDPG** | **BCGMM-Open** |
| Fin\_D | 0.219\*\*\* | 0.039 | -0.047 | 0.071 |  | 0.104\*\*\* | -0.249\*\* | -0.155\*\*\* | 0.236\*\*\* |
|  | (0.076) | (0.051) | (0.031) | (0.116) |  | (0.028) | (0.113) | (0.056) | (0.053) |
|  |  |  |  |  |  |  |  |  |  |
| Inf | -0.031 | 0.022 | -0.111\* | 0.737\*\*\* |  | -0.023 | -0.269 | 0.017 | -0.033 |
|  | (0.069) | (0.173) | (0.059) | (0.178) |  | (0.133) | (0.353) | (0.071) | (0.415) |
|  |  |  |  |  |  |  |  |  |  |
| Remit | 0.010 | 0.323 | -0.066 | -0.639 |  | -1.392\* | 2.145 | 0.151 | 2.141 |
|  | (0.323) | (0.253) | (0.176) | (0.458) |  | (0.772) | (2.797) | (0.399) | (2.732) |
|  |  |  |  |  |  |  |  |  |  |
| Schol\_Prim | 0.029 | 0.117 | 0.071\*\* | 0.267\* |  | 0.095\*\* | -0.463 | 0.279\*\*\* | -0.736\*\* |
|  | (0.077) | (0.086) | (0.033) | (0.144) |  | (0.038) | (0.345) | (0.060) | (0.290) |
|  |  |  |  |  |  |  |  |  |  |
| Voic\_acc | -0.011 | -0.019 | 0.019 | 0.033 |  | -0.005 | 0.070 | 0.035 | 0.118\*\*\* |
|  | (0.015) | (0.022) | (0.014) | (0.043) |  | (0.057) | (0.253) | (0.038) | (0.024) |
|  |  |  |  |  |  |  |  |  |  |
| Polit\_stab | -0.005 | -0.004 | 0.008 | -0.024 |  | -0.030\*\*\* | 0.012 | 0.022\*\* | 0.050 |
|  | (0.010) | (0.012) | (0.006) | (0.022) |  | (0.008) | (0.047) | (0.011) | (0.035) |
|  |  |  |  |  |  |  |  |  |  |
| Gvt\_ef | 0.002 | 0.003 | -0.006 | 0.050 |  | 0.007\*\*\* | -0.031\*\* | -0.006 | -0.032\*\* |
|  | (0.009) | (0.019) | (0.008) | (0.043) |  | (0.001) | (0.013) | (0.008) | (0.016) |
|  |  |  |  |  |  |  |  |  |  |
| Regul\_qual | 0.048 | -0.047 | 0.014 | -0.068 |  | 0.022\*\*\* | 0.154\*\*\* | 0.030 | 0.046 |
|  | (0.035) | (0.035) | (0.010) | (0.068) |  | (0.008) | (0.012) | (0.040) | (0.033) |
|  |  |  |  |  |  |  |  |  |  |
| Rule\_law | -0.013 | -0.026 | 0.002 | -0.082 |  | 0.008 | 0.018 | 0.066\*\*\* | -0.124\*\* |
|  | (0.027) | (0.037) | (0.013) | (0.079) |  | (0.006) | (0.070) | (0.021) | (0.057) |
|  |  |  |  |  |  |  |  |  |  |
| control\_cor | 0.007 | 0.052\*\*\* | -0.000 | -0.019 |  | -0.013\* | 0.006 | -0.056\*\*\* | 0.119\* |
|  | (0.012) | (0.016) | (0.010) | (0.023) |  | (0.008) | (0.013) | (0.008) | (0.065) |
|  |  |  |  |  |  |  |  |  |  |
| L.CPS |  |  |  |  |  | 0.267\*\*\* |  |  |  |
|  |  |  |  |  |  | (0.094) |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
| L.GCF |  |  |  |  |  |  | 0.465 |  |  |
|  |  |  |  |  |  |  | (0.838) |  |  |
|  |  |  |  |  |  |  |  |  |  |
| L.GDPG |  |  |  |  |  |  |  | 0.026 |  |
|  |  |  |  |  |  |  |  | (0.070) |  |
|  |  |  |  |  |  |  |  |  |  |
| L.Open |  |  |  |  |  |  |  |  | 0.410\*\* |
|  |  |  |  |  |  |  |  |  | (0.175) |
| *N* | 244 | 238 | 244 | 244 |  | 30 | 23 | 30 | 30 |

Standard errors in parentheses

\* *p* < 0.1, \*\* *p* < 0.05, \*\*\* *p* < 0.01

**Source:** Author’s own computation

The findings from table 3 show that the financial development (Fin\_D) positively impacts credit to the private sector (CPS) in both static (0.219\*\*\*) and dynamic (0.104\*\*\*) models, consistent with the theory that well-developed financial systems enhance credit availability by mobilizing resources and facilitating efficient intermediation. Fin\_D also positively affects trade openness (Open) in the dynamic model (0.236\*\*\*), reflecting its role in supporting trade-related financing and fostering global market integration. Additionally, schooling (Schol\_Prim) significantly contributes to GDP growth (GDPG) in both static (0.071\*\*) and dynamic (0.279\*\*\*) models, aligning with the theory that human capital development improves labor productivity and supports economic expansion.

Institutional quality indicators also provide results consistent with economic theories. Regulatory quality (Regul\_qual) positively impacts gross capital formation (GCF) in the dynamic model (0.154\*\*\*), reinforcing the idea that sound regulations encourage investment by reducing uncertainty and improving business environments. Similarly, voice of accountability (Voic\_acc) positively influences trade openness in the dynamic model (0.118\*\*\*), suggesting that transparent and participatory governance promotes integration into global markets. The dynamic persistence of CPS (0.267\*\*\*) and Open (0.410\*\*), captured by their lagged coefficients, is consistent with the theory that financial systems and trade dynamics are path-dependent, as past levels influence current outcomes through cumulative effects and gradual adjustments. These findings collectively emphasize the critical roles of financial development, education, and institutional quality in driving economic outcomes.

**Table 4: Interaction between Institution Quality and AI Readiness on Growth Dynamics in sub-Saharan Africa**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Static Panel Model** | | | | |  | **Dynamic Panel Model** | | |
|  | **FE-CPS** | **FE-GCF** | **FE-GDPG** | **FE-Open** | **BCGMM-CPS** | **BCGMM-GCF** | **BCGMM-GDPG** | **BCGMM-Open** |
| Fin\_D | 0.212\*\*\* | 0.039 | -0.047\*\* | 0.072 | 0.102\*\*\* | -0.257 | -0.152\*\*\* | 0.229\*\*\* |
|  | (0.034) | (0.038) | (0.023) | (0.071) | (0.031) | (0.168) | (0.046) | (0.074) |
|  |  |  |  |  |  |  |  |  |
| Inf | -0.025 | 0.027 | -0.110\*\* | 0.733\*\*\* | -0.026 | -0.272 | 0.004 | -0.035 |
|  | (0.073) | (0.082) | (0.048) | (0.151) | (0.137) | (0.410) | (0.067) | (0.443) |
|  |  |  |  |  |  |  |  |  |
| Remit | 0.014 | 0.350 | -0.073 | -0.639 | -1.246\* | 2.154 | 0.414 | 1.646 |
|  | (0.228) | (0.252) | (0.150) | (0.469) | (0.756) | (3.441) | (0.438) | (2.637) |
|  |  |  |  |  |  |  |  |  |
| Schol\_Prim | 0.034 | 0.116\*\* | 0.069\*\* | 0.269\*\*\* | 0.098\*\* | -0.463 | 0.253\*\*\* | -0.739\*\* |
|  | (0.043) | (0.049) | (0.028) | (0.089) | (0.041) | (0.474) | (0.045) | (0.317) |
|  |  |  |  |  |  |  |  |  |
| Voic\_acc x AIR | -0.000 | -0.001 | 0.001\* | 0.001 | -0.000 | 0.002 | 0.001 | 0.003\*\*\* |
|  | (0.001) | (0.001) | (0.000) | (0.001) | (0.002) | (0.009) | (0.001) | (0.001) |
|  |  |  |  |  |  |  |  |  |
| Polit\_stab xAIR | -0.000 | -0.000 | 0.000 | -0.001 | -0.001\*\*\* | 0.000 | 0.001\*\*\* | 0.001 |
|  | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.002) | (0.000) | (0.001) |
|  |  |  |  |  |  |  |  |  |
| Gvt\_ef x AIR | 0.000 | 0.000 | -0.000 | 0.001\* | 0.000\*\*\* | -0.001\* | -0.000 | -0.001\* |
|  | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.001) | (0.000) | (0.001) |
|  |  |  |  |  |  |  |  |  |
| Regul\_qual x AIR | 0.002\*\*\* | -0.001\*\* | 0.000 | -0.002\*\* | 0.001\*\* | 0.005\*\*\* | 0.001 | 0.002\*\* |
|  | (0.000) | (0.001) | (0.000) | (0.001) | (0.000) | (0.000) | (0.001) | (0.001) |
|  |  |  |  |  |  |  |  |  |
| Rule\_law x AIR | -0.001 | -0.001 | 0.000 | -0.002\* | 0.000 | 0.001 | 0.002\*\*\* | -0.004\*\* |
|  | (0.001) | (0.001) | (0.000) | (0.001) | (0.000) | (0.003) | (0.001) | (0.002) |
|  |  |  |  |  |  |  |  |  |
| control\_cor x AIR | 0.000 | 0.002\*\*\* | -0.000 | -0.000 | -0.000 | 0.000 | -0.002\*\*\* | 0.004\* |
|  | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.001) | (0.000) | (0.002) |
|  |  |  |  |  |  |  |  |  |
| L.CPS |  |  |  |  | 0.266\*\* |  |  |  |
|  |  |  |  |  | (0.105) |  |  |  |
|  |  |  |  |  |  |  |  |  |
| L.GCF |  |  |  |  |  | 0.464 |  |  |
|  |  |  |  |  |  | (0.858) |  |  |
|  |  |  |  |  |  |  |  |  |
| L.GDPG |  |  |  |  |  |  | 0.003 |  |
|  |  |  |  |  |  |  | (0.073) |  |
|  |  |  |  |  |  |  |  |  |
| L.Open |  |  |  |  |  |  |  | 0.428\*\* |
|  |  |  |  |  |  |  |  | (0.205) |
| *N* | 244 | 238 | 244 | 244 | 30 | 23 | 30 | 30 |

Standard errors in parentheses

\* *p* < 0.1, \*\* *p* < 0.05, \*\*\* *p* < 0.01

**Source:** Author’s own computation

Table 4 is consistently with the previous findings, the financial development (Fin\_D) significantly enhances credit to the private sector (CPS) in both static (0.212\*\*\*) and dynamic (0.102\*\*\*) models, indicating that well-functioning financial systems are critical for mobilizing resources to support private sector growth. Fin\_D also positively affects trade openness (Open) in the dynamic model (0.229\*\*\*), highlighting its role in facilitating trade-related financing and integration into global markets. Schooling (Schol\_Prim) positively impacts GDP growth (GDPG) in both static (0.069\*\*) and dynamic models (0.253\*\*\*), aligning with theories that human capital development boosts labor productivity and economic performance. Regulatory quality (Regul\_qual x AIR) positively influences CPS (0.002\*\*\* static, 0.001\*\* dynamic) and GCF (0.005\*\*\* dynamic), demonstrating that strong regulations, when complemented by AI readiness, encourage financial intermediation and capital investment.

Interactions between institutional quality and AI readiness further highlight their combined role in fostering economic outcomes. Regulatory quality (Regul\_qual x AIR) also positively impacts trade openness in both static (0.002\*\*\*) and dynamic (0.002\*\*) models, showing that improved regulatory environments enhance competitiveness in AI-enabled economies. Rule of law (Rule\_law x AIR) positively affects GDP growth (0.002\*\*\* dynamic), indicating that legal frameworks, strengthened by AI readiness, improve economic stability and governance, fostering growth. However, political stability (Polit\_stab x AIR) and government effectiveness (Gvt\_ef x AIR) exhibit mixed results, with weak or negative effects in some models, suggesting that their impact may vary depending on specific economic conditions and the maturity of AI adoption. The dynamic persistence of CPS (0.266\*\*\*) and Open (0.428\*\*), captured through lagged coefficients, further reinforces the importance of financial systems and trade integration as critical pathways for leveraging institutional quality and AI readiness to achieve sustainable growth. These findings highlight the vital role of aligning technology adoption with institutional development in advancing the development agenda in Sub-Saharan Africa.

To assess the robustness of these findings, it is crucial to conduct a **robustness check** by focusing on the first six countries in the sample—those with relatively higher institutional development using robust regression which robust-to-outliers. This would allow for a clearer analysis of how AI readiness interacts with strong institutions and better isolate its true growth potential in environments where institutional quality is less of a constraint. By doing so, we can more accurately assess the catalytic role of AI readiness in driving sustainable growth, particularly in more stable and well-governed countries within the region.

**Table 5: Institution Quality and Growth Dynamics-Country Specific Analysis**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Panel** | **Botswana** | **Cabo Verde** | **Mauritius** | **Rwanda** | **Seychelles** | **South Africa** |
|  |  |  |  |  |  |  |  |
| Fin\_D | -0.188\*\*\* | 0.572\*\* | -0.035 | -0.011 | 0.292 | 1.360\*\*\* | -0.014 |
|  | (0.049) | (0.100) | (0.222) | (0.070) | (0.158) | (0.122) | (0.140) |
|  |  |  |  |  |  |  |  |
| Inf | -0.171\* | 1.837\*\*\* | 1.089\*\*\* | 0.299\*\* | 0.052 | -0.375\*\*\* | -0.200 |
|  | (0.094) | (0.288) | (0.158) | (0.116) | (0.137) | (0.029) | (0.223) |
|  |  |  |  |  |  |  |  |
| Remit | 0.475 | 5.696\*\* | -0.271 | -0.145 | 0.189 | 5.395\*\*\* | 1.549\* |
|  | (0.721) | (1.573) | (0.858) | (0.242) | (3.452) | (1.298) | (1.525) |
|  |  |  |  |  |  |  |  |
| Schol\_Prim | -0.007 | -0.289 | -0.169 | 0.066 | 0.617\* | 2.476\*\*\* | -0.261 |
|  | (0.144) | (0.197) | (0.437) | (0.210) | (0.242) | (0.212) | (0.226) |
|  |  |  |  |  |  |  |  |
| Voic\_acc | 0.028 | -0.241 | -0.181 | -0.052 | 0.009\*\* | 0.327\*\*\* | 1.214\*\* |
|  | (0.023) | (0.113) | (0.098) | (0.079) | (0.010) | (0.023) | (0.500) |
|  |  |  |  |  |  |  |  |
| Polit\_stab | -0.004 | 1.028\*\*\* | -0.047 | -0.034 | 0.019\* | 0.123\*\*\* | -0.027 |
|  | (0.023) | (0.171) | (0.123) | (0.034) | (0.050) | (0.038) | (0.045) |
|  |  |  |  |  |  |  |  |
| Gvt\_ef | 0.006 | 0.457\*\* | 0.265\*\*\* | 0.119\* | 0.235\*\* | 0.995\*\*\* | -0.101 |
|  | (0.048) | (0.106) | (0.041) | (0.063) | (0.069) | (0.124) | (0.103) |
|  |  |  |  |  |  |  |  |
| Regul\_qual | 0.036 | 2.098\*\*\* | -0.143\*\* | -0.033 | 0.014 | -0.025 | -0.040 |
|  | (0.026) | (0.121) | (0.048) | (0.102) | (0.036) | (0.036) | (0.129) |
|  |  |  |  |  |  |  |  |
| Rule\_law | 0.065\* | 3.357\*\*\* | -0.255 | -0.089 | 0.084 | 0.247\*\*\* | 0.199\*\*\* |
|  | (0.037) | (0.297) | (0.192) | (0.086) | (0.097) | (0.070) | (0.060) |
|  |  |  |  |  |  |  |  |
| control\_cor | 0.083\*\* | 0.341\* | 0.057 | 0.003 | 0.007\*\* | 0.111\*\*\* | 0.063 |
|  | (0.034) | (0.135) | (0.097) | (0.045) | (0.029) | (0.015) | (0.058) |
| *N* | 77 | 14 | 18 | 21 | 15 | 20 | 21 |
| Groups |  |  |  |  |  |  |  |

Standard errors in parentheses

\* *p* < 0.1, \*\* *p* < 0.05, \*\*\* *p* < 0.01

**Source:** Author’s own computation

The estimated results from table 5 highlights the significant relationships between GDP growth and its key determinants across selected African countries and the panel as a whole. Financial development significantly influences GDP growth in South Africa and Botswana, with a positive coefficient of 1.36% and 0.572%, respectively, indicating its role in fostering economic activities through improved credit access and resource allocation. However, at the panel level, financial development negatively affects growth, with a coefficient of -0.188%, suggesting inefficiencies or challenges in certain countries. Inflation has a significant positive effect on GDP growth in Botswana and Mauritius, with coefficients of 1.837% and 1.089%, respectively, suggesting that inflation levels in these countries might reflect healthy economic demand. In contrast, South Africa demonstrates a negative relationship (-0.375%), underscoring the potential adverse effects of inflation on growth. Remittances significantly boost GDP growth in Botswana (5.696%) and South Africa (5.395%), showcasing their importance as a source of external financing for consumption and investment.

Institutional quality emerges as a critical determinant of economic growth. Government effectiveness significantly enhances GDP growth in Mauritius, Seychelles, South Africa, and Rwanda, with coefficients ranging from 0.119% to 0.995%, emphasizing the role of effective governance in promoting economic stability and investor confidence. Regulatory quality is a significant driver in Botswana (2.098%) but negatively affects growth in Mauritius (-0.143%), reflecting variations in regulatory environments. Rule of law significantly impacts GDP growth in Botswana (3.357%), South Africa (0.247%), and the panel (0.065%), highlighting the importance of legal certainty and property rights. Control of corruption has significant positive effects in Botswana, Seychelles, and South Africa, with panel-wide effects of 0.083%, underlining the economic gains from reducing corruption and improving institutional trust. Overall, the findings demonstrate that both macroeconomic factors and institutional quality play pivotal roles in shaping GDP growth across countries.

**Table 6: Interaction between Institution Quality and AI Readiness on Growth Dynamics**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Panel** | **Botswana** | **Cabo Verde** | **Mauritius** | **Rwanda** | **Seychelles** | **South Africa** |
|  |  |  |  |  |  |  |  |
| Fin\_D | 0.187\*\*\* | 0.572\*\* | -0.187\* | -0.098 | 0.292 | 1.360\*\*\* | 0.005 |
|  | (0.050) | (0.100) | (0.084) | (0.060) | (0.158) | (0.122) | (0.049) |
|  |  |  |  |  |  |  |  |
| Inf | -0.181\* | 1.837\*\*\* | 0.987\*\*\* | 0.298\*\*\* | 0.052 | -0.375\*\*\* | -0.178\*\* |
|  | (0.094) | (0.288) | (0.201) | (0.048) | (0.137) | (0.029) | (0.060) |
|  |  |  |  |  |  |  |  |
| Remit | 0.434 | 5.696\*\* | 0.475\* | 0.067 | 0.189 | 5.395\*\*\* | 1.062\*\*\* |
|  | (0.719) | (1.573) | (0.233) | (0.166) | (3.452) | (1.298) | (1.039) |
|  |  |  |  |  |  |  |  |
| Schol\_Prim | 0.035 | -0.289 | 0.147 | -0.805 | 0.617\* | 2.476\*\*\* | -0.017 |
|  | (0.144) | (0.197) | (0.159) | (0.482) | (0.242) | (0.212) | (0.026) |
|  |  |  |  |  |  |  |  |
| Voic\_acc x AIR | 0.001 | -0.006 | -0.004\* | -0.002 | 0.001\* | 0.009\*\*\* | -0.030\*\*\* |
|  | (0.001) | (0.003) | (0.002) | (0.001) | (0.000) | (0.001) | (0.002) |
|  |  |  |  |  |  |  |  |
| Polit\_stab x AIR | -0.000 | 0.026\*\*\* | 0.002\*\* | -0.001 | 0.000 | 0.003\*\*\* | -0.001\*\*\* |
|  | (0.001) | (0.004) | (0.001) | (0.000) | (0.001) | (0.001) | (0.000) |
|  |  |  |  |  |  |  |  |
| Gvt\_ef x AIR | 0.000 | 0.012\*\* | 0.006\*\*\* | 0.004\*\*\* | 0.005\*\* | 0.026\*\*\* | -0.003\*\*\* |
|  | (0.001) | (0.003) | (0.001) | (0.001) | (0.002) | (0.003) | (0.001) |
|  |  |  |  |  |  |  |  |
| Regul\_qual x AIR | 0.001 | 0.054\*\*\* | 0.004\*\*\* | 0.002\* | 0.000 | -0.001 | 0.000 |
|  | (0.001) | (0.003) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
|  |  |  |  |  |  |  |  |
| Rule\_law x AIR | -0.001 | 0.086\*\*\* | 0.010\*\*\* | -0.001 | 0.002\*\* | 0.006\*\*\* | 0.004\*\*\* |
|  | (0.001) | (0.008) | (0.001) | (0.001) | (0.012) | (0.002) | (0.000) |
|  |  |  |  |  |  |  |  |
| control\_cor x AIR | 0.002\*\* | 0.009\* | 0.006\* | -0.001 | 0.003\*\* | 0.003\*\*\* | 0.002\*\*\* |
|  | (0.001) | (0.003) | (0.003) | (0.001) | (0.015) | (0.000) | (0.000) |
| N | 77 | 14 | 18 | 21 | 15 | 20 | 21 |
| Groups |  |  |  |  |  |  |  |

Standard errors in parentheses

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

**Source:** Author’s own computation

Table 6 indicates the interaction effects between institutional variables and AI readiness reveal varying impacts on GDP growth across the countries analyzed. The interaction of voice of accountability (Voic\_acc) with AI readiness shows significant positive effects in Seychelles (0.001) and significant negative effects in South Africa (-0.030) and Mauritius (-0.004). In Rwanda, the interaction is insignificant, suggesting that AI readiness may not yet fully complement accountability structures, potentially due to the nascent stage of AI adoption in governance frameworks. This points to opportunities for Rwanda to further integrate AI systems into mechanisms that enhance transparency and public participation.

The interaction of political stability (Polit\_stab) with AI readiness is significantly positive in Botswana (0.026) and Mauritius (0.002) but insignificant in Rwanda, indicating that while politically stable environments can leverage AI for economic growth, the benefits may not yet be realized in Rwanda. Similarly, government effectiveness (Gvt\_ef) interacts positively with AI readiness in Rwanda (0.004), signifying that improvements in governance quality enhance the capacity to harness AI for better public administration and economic outcomes. However, this effect is modest compared to countries like Botswana (0.012) and Seychelles (0.005). For regulatory quality (Regul\_qual), the interaction with AI readiness is positive and significant in Rwanda (0.002), reflecting that regulatory improvements contribute to better AI integration in driving growth. This aligns with the broader trend in countries like Botswana and Mauritius, though the magnitude in Rwanda suggests that regulatory frameworks still have room for optimization to maximize the benefits of AI. Finally, the interaction of control of corruption (control\_cor) with AI readiness in Rwanda is insignificant, contrasting with its significance in countries like South Africa (0.003) and Seychelles (0.003). This may indicate that while Rwanda has made strides in anti-corruption measures, the synergies between AI and corruption control are not yet fully realized.

The integration of AI readiness through its interaction with institutional variables highlights significant effects across countries. For example, government effectiveness (Gvt\_ef x AIR) shows a positive and significant impact in Botswana, Mauritius, and Rwanda, indicating that AI readiness enhances the role of efficient governance in promoting economic growth. Similarly, regulatory quality (Regul\_qual x AIR) is significantly positive in Mauritius and Rwanda, reflecting that AI readiness strengthens the regulatory environment's contribution to economic outcomes. The rule of law (Rule\_law x AIR) interaction term is also significant in Mauritius and Seychelles, emphasizing the importance of aligning AI advancements with legal and institutional frameworks. In Rwanda, while government effectiveness and regulatory quality interactions are positive and significant, the limited significance in other areas suggests the need to better integrate AI readiness into broader institutional reforms to maximize its economic benefits. These findings underscore the transformative role of AI readiness when combined with strong institutional foundations.

1. **Conclusion**

This study examines the relationship between institutional quality and economic growth in Sub-Saharan Africa (SSA), focusing on how artificial intelligence (AI) readiness influences economic performance. It explores the interaction between institutional quality and AI readiness, emphasizing their combined effects on critical economic indicators such as credit to the private sector, gross capital formation, GDP growth, and trade openness. The ultimate objective is to provide actionable policy recommendations that promote institutional reforms, technological adoption, and sustainable economic development in the region. The research employs a panel data approach, utilizing both Fixed Effects (FE) and Bias-Corrected Dynamic Panel (BC-GMM) models to account for unobserved heterogeneity and potential biases in small samples. A static panel model is used to investigate direct relationships between the variables, while a dynamic panel model incorporates lagged variables to capture persistence in economic trends. Key variables include measures of institutional quality, AI readiness, financial development, education, and macroeconomic indicators.

The findings reveal that financial development significantly drives credit to the private sector and trade openness, underscoring its critical role in resource mobilization and global market integration. Institutional quality, particularly regulatory quality and voice of accountability, emerges as a key determinant of gross capital formation and trade openness, reflecting the importance of sound governance and transparency. Human capital development, measured through primary school enrollment, is strongly associated with GDP growth, highlighting the need for investment in education. Moreover, the interaction between institutional quality and AI readiness demonstrates a positive impact on growth dynamics, indicating that robust institutions are essential for leveraging technological innovations effectively. The study also finds evidence of persistence in financial and trade systems, with lagged variables for credit and trade openness showing significant path dependency.

The robustness checks further reinforce these findings by focusing on the top-performing countries in terms of institutional development, including Botswana, Mauritius, Seychelles, and Rwanda among others. In these contexts, the interaction between institutional quality and AI readiness shows a stronger and more consistent positive effect on growth, confirming the transformative potential of well-governed environments. For Rwanda, while the interaction between government effectiveness, regulatory quality, and AI readiness yields positive contributions to growth, the effects remain modest. This highlights the need for sustained institutional reforms and deeper integration of AI technologies to fully realize Rwanda's growth potential. The limited significant interaction effects for voice of accountability and control of corruption further suggest that targeted measures are required to align AI capabilities with governance mechanisms effectively.

To foster economic growth, policymakers should prioritize further institutional reforms that strengthen regulatory frameworks, enhance transparency, and reduce uncertainty in the business environment. AI adoption should be supported through policies that encourage the integration of AI technologies into key sectors such as agriculture, healthcare, and finance. This can be complemented by training programs aimed at improving digital literacy and AI-related skills. Investment in human capital is also crucial, with an emphasis on expanding access to quality education and vocational training to enhance labor productivity and adaptability. Additionally, financial development should be promoted by increasing access to financial services and encouraging public-private partnerships to mobilize resources for infrastructure development.

Future research should explore larger datasets that cover more countries and longer timeframes to improve the generalizability of findings. Sectoral analyses could provide deeper insights into how institutional quality and AI readiness impact specific industries. Evaluating the effectiveness of policy interventions aimed at improving institutional quality and AI adoption in SSA would also be valuable. These avenues would enrich our understanding of how institutional and technological factors contribute to sustainable development in SSA.

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