


# Innovation and Development in Sub-Sahara Africa: The Role of Institutional Development and Inter Alia

Sadia Lukman<sup>1</sup>, Mohammed Abubakari Sadiq<sup>2\*</sup> , Mohammed Bawah<sup>3</sup>

<sup>1</sup>Department of Management Science and Engineering, School of Management, Beijing Institute of Technology, Beijing, China

<sup>2</sup>Department of Public and Health Services Administration, School of Business, University for Development Studies, P.O. Box 1350, Tamale, Ghana

<sup>3</sup>Department of Human Resource & Organizational Development, School of Business, University for Development Studies, P.O. Box 1350, Tamale, Ghana

DOI: [10.36348/sb.2023.v09i05.001](https://doi.org/10.36348/sb.2023.v09i05.001)

| Received: 03.05.2023 | Accepted: 08.06.2023 | Published: 14.06.2023

\*Corresponding author: Mohammed Abubakari Sadiq

Department of Public and Health Services Administration, School of Business, University for Development Studies, P.O. Box 1350, Tamale, Ghana

## Abstract

Science, Technology and Innovation (STI) is gradually seen by countries in Sub-Sahara African as the engine for economic growth and general uplifting of the standard of living. As a result, Innovation is embraced but institutional weaknesses hinder the required outcome. This paper's aim is to examine the connection between innovation and development in sub-Saharan Africa while considering the function of institutes and other elements. This is in light of the fact that institutions act as the lubricant for progress. The Middle East and North Africa are not included in the scope of the paper, which largely focuses on sub-Saharan African nations. Some western nations and developing economies are, nonetheless, occasionally used as comparison points. We analyze data from reputable organizations like the World Bank, Polity IV, and considering a gauge of innovation and GDP per capita, the quantity of scientific publications published as a proxy for development, the Economic Freedom of the World Project will evaluate a panel of 22 economies in sub-Saharan Africa (EFW). Our results from the POLS and GMM IV regression show, among other things, that innovation has a favorable impact on the development of Africa, even though the impact looks insignificant. Although the majority of the nations in the county have established institutional frameworks for science, technology, and innovation (STI), evidence suggests that the slow rate at which innovation contributes to national development is due to obstacles in the design and implementation of STI policies. The outcome highlights the region's little advancement in the technology-capability indicators. To establish and execute STI policies in the region, a lot more has to be done in the area of collaboration between public entities and parastatals.

**Keywords:** Innovation, Sub-Sahara Africa, Public Policy, Science, Technology and Innovation (STI).

**Copyright © 2023 The Author(s):** This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

## 1. INTRODUCTION

Due to the unstable state of its economy, Sub-Saharan Africa has had to experience some kind of recession over the previous 40 years. The reason for the region's current crisis has been discussed by policymakers and development theorists on several occasions. Among the issues taken into account stand out are corruption, poor governance, and political instability (see Forson *et al.*, 2016; Forson 2016; Forson *et al.*, 2015; Forson *et al.*, 2017; Pellegrini 2011). Nonetheless, neither political nor scholarly discourses

have fully addressed health ledges of diversity that may cause structural transformation.

Thus, the structure of Africa's economy has been impacted by the continent's resistance to innovation and change. Sub-Saharan Africa has been labeled a "latecomer" by researchers like Oyelaran-Oyeyinka (2012) and others to highlight how hesitant the area has been to adopt technological advances. Making any significant progress would need a fundamental adjustment. The structural change of the economy is assessed by verifiable structural shift, per

Oyelaran Oyeyinka (2014). (GDP or Sector employment share described by level of development). In this condition, there is a visible economic change that is followed by notable adjustments in the relative output and factor use contributions of various sectors. That has not been done comprehensively.

It has been suggested in some areas that the problems facing the sub-Sahara might be caused by the inconsistent application of industrial strategy, which is driven by a dearth of innovation throughout the continuum. According to UNCTAD research from 2006, a transformation of the economy is only conceivable if the crucially important enabling policy is implemented, which would guarantee the procedure of accrual of capital, structural change, and technical advancement. However, this cannot be accomplished on a silver platter unless there is a regional government-wide consensus to develop the capacity of its citizens to empower them to effect structural change.

East Asia and possibly Latin America once struggled with the same issue of "weak policy" that currently afflicts Africa, but through concentrated, practical efforts, they were able to resolve these issues using what is now known as "dynamic capability development" (Oyelaran-Oyeyinka, 2014; Sen, 2000) and are now the recipients of all praise. The East Asian phenomena had been extensively discussed in the literature as an example of how important it was for the state to have strong institutions and resources. These foundations have all underlined the need of drawing lessons from instances when capital creation and the development of technological accumulation capabilities were effective (see Forson, 2016; Mcmillan & Rodrik, 2011; Oyelaran-Oyeyinka, 2014). Contrarily, many studies have also said that government involvement is always vulnerable to the threat of misuses like corruption and ineptitude and might have explained its disappointment, which is harmful to growth as a failure of the market (Amsden, 1989).

The study makes two contributions: (1) it looks at how innovation is being affected by institutional development, and (2) it evaluates the influence of innovation on national development. It must be stressed that the more industrialized nations of East Asia and Latin America, adopting broad yet context-based industrial regulations to promote the procedure for growth through transformational structures, have discovered a long-lasting solution to market defects (Oyelaran-Oyeyinka, 2012). Africa has not experienced this. Adeyinka *et al.*, (2013) and Mcmillan & Rodrik (2011) are two research that offers narratives of the change in dynamic growth within the sub-regions of African, but there are still few types of research that investigate the interactions between institutional development and innovation on the one side and innovation and development on the other while

considering a systematic review of national innovation policy (NIP) and its difficulties within a specific framework. This has significant implications for gaining a deeper knowledge of how innovation and the entrepreneurial spirit have influenced the growth dynamics in the area. Is there a county framework for innovation to flourish? is the main concern with relation to sub-Saharan African innovation policy. If so, which portions and components are there? What part did institutional development play in innovation? What effects has innovation had on local development? As the study goes on, these and other questions will be answered. The structure of the paper is as follows. The literature on innovation and development, in general, is reviewed in Section 2. The part focuses on institutions and innovation, innovation policy and national development, and an exploratory analysis of the challenges faced in the creation and application of STI policies in sub-Saharan Africa. The data antequiesue are in Section 3. In Section 4, both empirical analysis and debate are concomitantly handled. In its final paragraph, Section 5 offers policymakers in the area recommendations.

## 2. Innovation and Development Perspectives

### 2.2 *Institute and Innovation*

Evans and Reuschmeyer (1985) defined the state as a collection of institutions with the power to impose laws on individuals and organizations residing within a certain region and to carry out these laws, if necessary, by the use of force. This notion aligns well with the tenets of institutional theory.

In essence, the novel institutional theory builds on the flaws of earlier economic theories. According to Douglass North's (1993) explanation, the novel institutional economics "builds on, adapts, and extends the neoclassical theory to enabling it to come to grips and deal with an entire spectrum of challenges previously outside its understanding" as opposed to numerous attempts to do so. The basic premise of scarcity is still retained, but the supposed assumption of instrumental rationality is dropped. His argument that instrumental rationality has taken control of the world and that institutions are unneeded in addition to beliefs and ideologies not mattering is supported by showing the shortcomings of the previous institutional structure. Due to cognitive limitations, human engagement must be constrained to arrange trade. In a conclusion, a breakthrough in cognitive science is still needed given our cognitive limitations. According to him and others, the new additions are part of the generational transmission of norms, values, and information that greatly varies between various ethnic groups and cultures (Forson *et al.*, 2013; North, 1993).

Furthermore, "it recognizes the great prevalence of market inefficiencies in the economy, particularly in the early phases of growth" (Yanagihara

& Sambommatsu, 1997). This understanding prompts the government to implement policies that enhance the market and help the private sector overcome coordination issues and other market flaws (*ibid*). The way the new institutional theory views the company as an organization with internal coordinating mechanisms is another important aspect that sets it apart from the neoclassical approach. The new institutional theory makes it possible to relate the characteristics of each economic agent to their conduct in this way (Yanagihara & Sambommatsu, 1997).

As is common knowledge, institutes (local, national, and international) are much more than just agencies. Institutes are intricate social structures. According to de la Mothe (2004), innovation results from a complex interplay of administrative skill, technological prowess, and research within the framework of societal need and human creativity. Successful institutions are learning organizations that can network and adapt to new information (Mothe 2004).

According to Mothe (2004), institutions serve as a channel for the flow of ideas from government agencies, small and big businesses, colleges, and labs as well as from organizations that provide community services and work to create what he called "built advantage."

It has been widely studied by Veblen (1915), Lall and Leubal (1998), Lundvall (1992), and most of late Nelson (2008) and Rasiah *et al.*, (2016), the development of an institution is the key to innovation. In their discussions of the industrialization of East Asian countries, Lall and Teubal (1998) and Lall (1994) aimed to highlight the significance of collaboration among research and development (R&D), training, investment, and development of products for better performance. Nelson however, asserts that the set-in institutions and organizations actively develop how technologies used in each business. In support of this claim, Rasiah *et al.*, (2016) found that innovation capabilities were positively connected with institutional support and had a positive association with export when examining the connection between institutional host-site support, competencies of innovation, and exports.

According to Barasa *et al.*, (2017), firm-level resources vary contingent on the environment of an institution, and the influence of firm-level resources is favorably modified by regional institutional quality.

According to Dollar and Kraay (2003), strong institutions frequently result in unproductive behaviors whereas well-built institutions can encourage productive behaviors (Greif, 2006). Institutes may lessen transaction costs, and uncertainty, and make it easier for economic players to coordinate (Alonso &

Garcimartin, 2013). The selection, monitoring, and replacement of a government; the ability of a government to create and carry out appropriate policies; and the regulation of the economic and social relations between citizens and the state are all included in institutional quality (Kaufmann & Mastruzzi, 2013). As a result, the environment of an institution can have several effects on how likely businesses are to innovate (North, 1993). Innovation may be hampered, for instance, by lax regulatory enforcement and a lack of intellectual property rights. Countries in sub-Saharan Africa do badly when compared to those in Latin America, Southeast Asia, the Middle East, and North Africa in terms of respecting the rule of law, regulatory quality, corruption control, and effectiveness of government (Alence, 2004).

Institutions do not generate physical commodities and services, therefore their influence on development (growth) is indirect. Nevertheless, the institutional approach contends that the institutional context determines both the availability and productivity of resources. According to Seputiene (2009), a clearly defined institution will always encourage investments and innovation while lowering macroeconomic instability, promoting specialization, and stimulating specialization.

Numerous studies have been done on empirical evidence of how institutes affect the growth of an economy, but the conclusions have been inconsistent. A thesis from the Knack and Keefer (1995) study, which supports the claim that institutions lead to growth, is acknowledged as one of the early contributions to this debate. The link between institutions, investment, and growth is attempted to be quantified in the aforementioned study utilizing different metrics. The results of the study clearest that property rights protection institutions are essential for investment and economic growth. Even when accounted for in a regression model for investment, this institutional influence on growth still exists. This supports the idea that property rights' security influences not just the size of investment but also how effectively inputs are distributed. This empirical claim is backed up by research by DeLong and Shleifer (1993) that found a correlation between excellent institutions, such as predictable and stable legal systems, effective bureaucracies, and protection of property rights, and economic development.

Incomparable research, Acemoglu *et al.*, (2001) confirmed how institutions affect growth in the European environment. The researchers in the aforementioned paper consider European colonialism as a natural experiment and proposed that, contingent on whether their former colonies were appropriate for European settlement; European colonizers imposed various forms of institutes on them. But they conclude

that institutes have a significant impact on economic expansion.

According to research by Kaufmann *et al.*, (1999, 2002), institutions are crucial for growth in terms of per capita income, mortality of infants, and literacy of adults. Seputiene (2009) has researched to explore and quantify the connections between nations' income levels and regional differences, institutional environments, and trade openness within the European Union. According to his analysis, there was a significant and advantageous relationship between economic development and several institutional factors. The results likewise confirmed the preference for institutions above commerce and geographic openness. In recent research, institutional elements were added to standard Solow and Mankiw *et al.*, models to include 153 nations (1994-2009). A regression study was performed using particular variations of institutional variables including democracy, economic freedom, and business easiness. The empirical results revealed that the degree of economic growth, as determined by the GDP per capita at PPP for the years 2005 to 2009, had a significant beneficial influence on the institutional environment's quality (Próchniak, 2013).

The most thorough cross-sectional study, however, was recently carried out by Barro and Sala-i-Martin (2003) and Pellegrini (2011b). About 100 and 106 nations, respectively, have been sampled in both investigations (1965-1995 and 1996-2005 respectively). Their findings revealed a nonlinear link between democracy, as determined by electoral rights from Freedom House, and GDP growth. Additionally, nonlinearities were seen in other inputs of institutions including civil freedoms. However, other institutional factors, such as the effectiveness of the bureaucracy, showed a positive linear association with economic progress. Using dummy variables that epitomized colony (e.g., Portuguese, Spanish or French, etc.), landlocked, and legal structure, other institutional aspects were also evaluated (British and French). In 59 nations between 1960 and 1990, Rivera-Batiz (2002) examined the Freedom House's measure of political rights and Hall and Jones' indicator of the effectiveness of government. According to this study, good governance has a favorable and considerable impact on economic growth. Both Leblang (1997) and Feng (1997) examined the Gurr and Bollen democracy index for 91 and 96 nations between 1960 and 1989 and 1960 and 1980, respectively. Institutional variables like democracy and the likelihood of political change have not received enough attention. Both researchers agreed that the initial degree of democracy considerably and favorably affects GDP trends. Feng's study, however, had a dual effect: the direct effect was adversely related to development, although the indirect influence was favorable due to the influence of the likelihood of political changes.

Additionally, significant systematic vicissitudes to the government have a positive impact on the performance of macroeconomics, but asymmetrical changes have a differing impact. Próchniak and Witkowski (2012; 2013) used a new approach of Bayesian model averaging to examine a wide range of institutional elements affecting GDP growth, including economic freedom and the degree of democracy. They coconclude that one of the key factors promoting growth in the EU is economic freedom. According to Próchniak (2013), variations in institutional the environment (measured by governance indicators), human capital, and physical capital (measured by GDP per capita) accounted roughly 75% of the disparities in economic performance among 153 countries between 1994 and 2009.

Other research, however, has presented conflicting conclusions about the link a between institutes and economic expansion. Glaeser *et al.*, (2004) for instance, point out that evolution rather enhances institutions and that there is no evidence to support the idea that institutions cause growth. The alleged assertion that institutions cause growth was not supported by the OLS cross-country evidence utilized for the period 1960–2000. In 83 nations between 1975 and 1997, Plumper and Martin (2003) examined the link between development and the degree of democracy. The researchers discovered a nonlinear connection between democracy and economic expansion. They as well came to the conclusion that nations with relatively modest levels of democracy had the greatest GDP dynamics.

### 2.3 Innovation Policy and National Development

According to scholars like Sundbo (2003), innovation is the combining of knowledge to create novel products, processes, input and output markets, or organizations. This definition of innovation includes not only technical innovation but then again managerial and organizational innovation, fresh markets, novel supply sources, new combinations, and novel financial innovations (Perlman and Heertje, 1991). According to Padilla-Perez and Gaudin (2014), innovation is a progressive and participatory procedure built on sharing of information. According to Carayannis *et al.*, (2006), innovation in a knowledge-based economy has turned into a catalyst for economic growth through the creation, dissemination, and application of information. Innovation policy, according to Rycroft and Kash (1999), is a complicated process that results from several organizations, initiatives, and policies.

Innovation, though, may take many various shapes and guises. For instance, manufacturing, technical design, management, and business activities utilized in the marketing of a novel product or the first commercial usage of a novel procedure or piece of equipment are examples of industrial innovation (Freeman, 1982). According to Huang *et al.*, (2007),

there are several components needed for industrial innovation, including technical expertise, human capital, market knowledge, financial resources, R&D environments, a home market, and an international market (Rothwell and Zegveld, 1982). It has been demonstrated and argued by several studies (e.g., Barro, 1990; Mcmillan & Rodrik, 2011; Rothwell & Zegveld, 1982) that industrial innovation may genuinely boost general economic development. The intellectual debate has developed around determining the proper innovation measurement. In a brief response, Huang *et al.*, (2007) noted that macro measures like the R&D tax credit are ineffective and useless and that policies should be created to have an impact on specific sectors of the economy. Product innovation is different from the general idea since it essentially involves the introduction of fresh goods or services or the major enhancement of an already-existing product to its features and envisioned usage (Ayyagari *et al.*, 2012; Barasa *et al.*, 2017). Salmenkaita and Salo (2017), however, dissented and stressed that there are no simple solutions to the issue of what should be an innovation strategy.

#### **2.4 Barriers to Design and Implement STI Policies in sub-Saharan Africa**

The research had previously discussed STI regulations in effect in sub-Saharan Africa. However, technical indications have shown that the area still lags behind its neighbors. The obstacles that have contributed to the current status quo are identified and briefly discussed in this section. Governments must overcome these obstacles to plan and execute STIs in Africa.

First off, despite what could seem to be some political support for the creation of STI policies, the outcomes of the technological-capability indicators have shown that this is not the case. Therefore, high-level political support for STI policy is flimsy at best and continues to be lacking. Ministries, national councils, secretariats, and parastatals are examples of public entities tasked with implementing science and technology innovation policies; nevertheless, they lack the resources and power necessary to proactively advance their agenda. Additionally, there is still uncertainty about how innovation may spur growth, which contributes to relatively modest levels of commitment. As previously stated, despite an increase in commitment levels from 0.24% to 0.61%, 0.36% to 0.79%, 0.25% to 0.66%, 0.37% to 0.54%, and 0.37% to 0.48% of GDP, countries like Ethiopia, Kenya, Mali, Senegal, and Uganda are still far from considerable levels when compared to what is being done somewhere else (such as the US at 3.1% of GDP and Sweden at 3.4% of GDP).

Tax incentives appear to be the greatest choice when looking into alternative funding sources for STI in the area, however, nations in the region are already

struggling with the issue of low tax income, which makes it challenging to execute the policy on tax stimuli. This is a significant obstacle to more public investment in STI. The World Bank said in 2009 that the region's tax receipts as a proportion of GDP were low. Just 14.87% of Ghana's GDP in 2012, 5.46% of Nigeria's GDP in 2008, 26.50% of South Africa's GDP in 2012, 19.88% of Kenya's GDP in 2012, 13.8% of Tanzania's GDP in 2012, 11.2% of Cameroon's GDP in 1999, and 12.46% of Angola's GDP in 2015 were all tax revenues (World Bank, 2013). Therefore, it follows that financing for STIsI would not be available as governments deal with other social crises that require immediate attention.

The region's ongoing political unrest continues to prevent the implementation of STI measures. STI programs don't always last once a new administration takes office. In Africa, this is a typical practice. Regardless of the program's effects on societal well-being, new governments frequently ignore the initiatives started by their predecessors.

Universities in the area are mostly concerned with fundamental science research or teaching, which has a lesser connection to private businesses. Science and technology institutes that were designed from the beginning to be the breeding grounds for businesspersons and innovators have started to offer business administration and social science courses. Universities like the Central University of Technology (CUT) in South Africa, Federal University of Technology (FUT) in Nigeria, and Kwame Nkrumah University Science and Technology (KNUST) in Ghana, for instance, have all watered down their programs by providing more courses in the humanities and social sciences than the pure and applied sciences, which are the foundation of their missions.

In the development and application of STI policies, there is insufficient coordination across governmental entities and parastatals. Departments and parastatals frequently intricate their strategies but lack proper integration and coordination, which makes them compete with one another. This is a roadblock to increasing the effectiveness of STI policy and creating a productive use of the few resources available.

Sub-Saharan financial systems lack sufficient incentives to encourage innovation in the area. New business owners and established companies rarely have access to the banking sector to fund innovative efforts. Additionally, venture money is seldom ever used. Because it frequently takes time to realize a new invention's full potential, established financial institutes that are by now burdened with liquidity and creditworthiness problems are less likely to adopt new technologies.

In conclusion, sub-Saharan African countries are lagging in terms of science, technology, and innovation due to the aforementioned barricades, which have similarities to those that apply elsewhere. These barriers include design and implementation failure, political unpredictability (see Woolthuis *et al.*, 2005), underdeveloped educational structures (Aubert, 2004; Segarra-Blasco *et al.*, 2008), inadequate resources (Aubert, 2004), a lack of financing mix (Seg Hadjimanolis & Dickson, 2001; Willie *et al.*, 2016)).

### 3. DATA AND METHODOLOGY

#### 3.1 Data

This study uses the most latest information (1996-2016) from the World Bank and other credible organizations to analyze a panel of 22 economies in sub-Saharan Africa. The sole basis for choosing these nations was the availability of data. There are two dependent variables: national development as defined by GDP per capita and innovation as assessed by the number of scholarly journals produced. Innovation is the primary research variable for us.

The study relies on institutional and growth-promoting variables like the effectiveness of government, government size, the quality of bureaucratic, regulatory quality, rule of law, freedom of press, growth of population, openness (economic freedom), the prosperity of the economy, inflows of foreign aid, natural resources, and human capital endowments using basic, secondary, and tertiary enrollment. In the growth literature, the majority of these factors are categorized generally as policy variables.

$$Y_{it} = \alpha_0 + \beta_1 NIP_{it} + \sum_{k=1}^k \beta_{2k} INST_{it}^k + \sum_{i=1}^i \beta_{3i} STOCKS_{it}^i + \sum_{s=1}^s \beta_{4i} SHA_{-it}^i + \mu_i + \gamma_t + \varepsilon_{it} \quad (3)$$

Where  $i$  is a country index,  $t$  is the time dimension and  $Y_{it}$  represents national development measured by growth in per capita GDP. The model shows an error term with three subcomponents:  $\mu_{it}$  stands for stationary unobserved country-specific determinants;  $\gamma_t$  stands for common time-specific shocks; and  $\varepsilon_{it}$  is the stationary unobserved country-specific determinants that fluctuate across time. The quantity of scholarly journal papers in the area serves as a benchmark for the National Innovation Policy (NIP). The categories of control variables suggested by theory in the literature are the variables INSTITUTIONS, STOCKS, and SHADOW (i.e., proxies for political, economic and legal institutes, capital stocks and for the accounting).

Econometric tool such as pooled OLS (POLS) and GMM IV are used to understand relation and how these variables have impacted on national development based on the specifications above. The GMM IV regression for instance was chosen due to its ability to

The institution and development literature has extensively studied these factors (see Earle & Scott, 2010; Prasad, 2003; Próchniak, 2013). This allows us to explain why we chose the variables for this study. The appendices include information on the final summary statistics, variable descriptions and country presentations (Table A1), and correlation matrix (Table A2).

#### 3.2 Model Specification

The study expands on the Tebaldi and Elmslie (2008) model, which is provided in equation (1) below, to explore the link between institutional growth and innovation

$$A = \delta A^{1-\alpha} H_A I^\alpha \quad (1)$$

Where,  $A$  measures technical innovation, and  $\delta A^{1-\alpha} H_A$  is the proportion of human capital involved in R&D, which breeds innovation. The  $I^\alpha$  is the level of institutional development, and the model is predicated on a constant return to scale. This implies innovation output is affected by the activities of institutions.

Therefore, the proposed research will complement Tebaldi and Elmslie's (2008) model and have it presented as follows in equations (2) and (3), correspondingly, to address the question of how institutional development affects innovation in sub-Saharan Africa and, ultimately, the relationship among innovation and national development;

$$NIP_{it} = \alpha_0 + \beta_1 Human\ capital + \sum_{k=1}^k \beta_{2k} INST_{it}^k + \mu_i + \gamma_t + \varepsilon_{it} \quad (2)$$

resolve issues on endogeneity considering the fact that we are dealing with institutional factors, known to be externally determined and always correlates with the error term (see Forson *et al.*, 2017; Han & Phillips, 2010). The number of variables deployed deals with omitted variable bias given the extensive literature survey undertaken.

### 4. ESTIMATION RESULTS AND DISCUSSION

As indicated, the study makes use of pooled OLS (POLS) and GMM IV estimates to address the research objectives. This guarantees that the outcomes will be consistent. Institutional development produces innovation as a byproduct. Implementing and developing a national innovation plan requires a strong institutional framework. Therefore, utilizing equation (2) in chapter three, the analysis regresses the various forms of institutional quality and human capital on national innovation policy, herewith referred to as innovation. This is an effort to address the question of

what function new and preexisting institutional frameworks have had in the application of knowledge for the region's overall growth. This is done systematically while improving on the controls as the pooled OLS regression progresses (see Table 1).

According to Kaufmann *et al.*, (2013), institutional quality includes the selection, monitoring, and replacement of a government as well as the ability of a government to formulate and carry out sound policies as well as the regulation of the social and economic interactions between citizens and the state. According to the POLS regression, these issues are addressed through the application of democracy and governance metrics. According to the study, press freedom, which is an aspect of democracy, is important for stimulating innovation in sub-Saharan Africa. The following might be some advantages of press freedom, even though the influence on a broader scale could appear to be indirect: (1) it assures a fair playing field for enterprises, notably in the area of exposing corruption; and (2) it promotes steady business operation. Freedom of the press fosters creativity. However, innovation calls for a high degree of trust as well as a variety of thinking and behavior. Therefore, nations that forbid and punish free speech undermine communal trust and promote more uniform, rigid, and constrained ways of thinking.

However, the region's innovation policy was negatively impacted by government efficiency in terms of policy development and regulatory quality. There is a consensus to imply that the different institutional frameworks established to support the innovation push are definitely on target as provided it being considerably beneficial, despite the regulatory quality which highlights the strength of policy briefs about innovation in the area. The coefficients were consistently positively significant across the four models. Protection of property rights despite the fact that the coefficient is quite small, it is nevertheless substantial to show that protecting property rights increases businesses' incentives to innovate in the region. Human capital measured by both primary and secondary enrollments provides a contrasting account to suggest while at a certain point, human capital in the region has a positive impact on innovation, and in other circumstance its impact is negative. These mixed results are possible due to contextual differences in the region given that knowledge increases the probability to innovation, but a monotonous learning system devoid of the right environment might be affront to inspire novelty. Generally, the cross variable explanation of the four models are appreciably high (i.e. 71% to 80%) and are jointly significant considering the F-statistics of 16.7, 24.21, 21.04 and 18.43 respectively.

**Table 1: Institutions and innovation development in sub-Sahara Africa: POLS estimation**

<i>Variables</i>	<i>Innovation (1)</i>	<i>Innovation (2)</i>	<i>Innovation (3)</i>	<i>Innovation (4)</i>
Corruption	21.689 (43.691)	29.052 (34.064)	32.34482 (35.695)	33.187 (36.856)
Press freedom	6.343** (2.124)	2.656** (1.887)	2.582 (1.920)	2.474 (2.145)
Gov't Effectiveness	-139.931 (87.495)	-60.561 (75.323)	-74.006 (85.138)	-75.749 (87.511)
Reg. Quality	239.643*** (56.823)	152.153*** (54.615)	158.711** (58.275)	157.657** (59.716)
Property Right	1.887** (0.839)	1.774** (0.664)	1.702** (0.702)	1.708** (0.712)
Bureaucracy	12.790 (11.267)	9.247 (9.849)	9.105 (9.973)	9.048 (10.119)
Primary Enrol.		7.699*** (1.575)	7.773*** (1.607)	7.781** (1.630)
Secondary Enrol.		-1.083** (1.671)	-1.121** (1.694)	-1.117** (1.717)
Economic Progress			-0.754 (2.128)	-0.873 (2.375)
Savings				0.337 (2.813)
Constant	-275.632 (177.289)	-761.976*** (165.620)	-771.190 (169.572)	-774.297*** (173.807)
Year Dummy	Yes	Yes	Yes	Yes
Country Dummy	Yes	Yes	Yes	Yes
Observation	125	225	238	320
Adj. R <sup>2</sup>	0.71	0.80	0.7910	0.7912
F-stats	16.70	24.21	21.04	18.43

**Note:** Robust Standard Errors in Parentheses, \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

The study further investigates the strides made by innovation in the dominant sector of the region which is agriculture through value addition. The results are quite interesting and worth discussing. In model (3) and (4), the value addition to agriculture produces and the adoption of mechanized agriculture is significantly positive with development. In fact, in model (1), the contribution of innovation to the region's development

was just 0.008 and was upwardly augmented to 0.009 and 0.013 in models (3) and (4) respectively. It is also crucial to remember that population expansion and a rising consciousness of saving are also responsible for the notable increase in the coefficient of innovation in model (4). The use of knowledge and technologies relies on financial resources, and saving is a way to make this reality.

**Table 2: Sub-Saharan Africa's Innovation and Development: GMM estimation**

	National Development			
	(1)	(2)	(3)	(4)
	<i>Coefficient of corresponding instrumental variable</i>			
<b>Variable Instrumented</b>				
Size of Gov't	2.848**	0.272	2.279	2.344***
	(0.963)	(0.495)	(2.340)	(0.478)
<b>Instruments</b>				
Innovation	0.008*	-0.008***	0.009*	0.013***
	(0.004)	(0.002)	(0.005)	(0.003)
Natural Resources	0.005	0.402**	-0.390	-0.396***
	(0.206)	(0.150)	(0.269)	(0.124)
Foreign Aid	1.538	-0.519	2.385***	2.372***
	(1.538)	(0.910)	(0.559)	(0.655)
Economic Prosperity	4.069	-17.794***	-0.923	-27.254***
	(7.286)	(4.583)	(27.171)	(6.492)
Investment in Edu.	1.479**	-0.277	-2.806***	-2.642***
	(0.655)	(0.347)	(0.725)	(0.507)
Tertiary Enrollment		0.211***	0.255	0.296***
		(0.021)	(0.184)	(0.054)
Agric ( <i>Value Added</i> )			0.332*	0.379***
			(0.236)	(0.154)
Population Growth				8.006**
				(3.361)
Savings				0.046**
				(0.079)
Constant	-46.069*	34.293*	-49.818	-38.06*
	(26.255)	(19.106)	(107.914)	(18.97)
Hausman Test				16.23
				[0.68]
Anderson canon	18.06	10.05	8.07	11.15
Correlation LM statistics	[0.00]	[0.00]	[0.00]	[0.00]
Observation	425	532	645	812

**Note:** Robust Standard Errors in Parentheses, \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

The models shown are further subjected to series of important diagnostic tests and in all there seem to be no violation of the assumptions surrounding its usage.

Innovation and development have in contemporary times become inseparable. Thus, innovation is essential for development. Many technologies that support development tackle social issues. For instance, because poor health lowers workers' potential output, consequences of poverty can significantly affect prospects for engaging in entrepreneurial activity. As a result, tackling social issues can also promote growth.

The relevance of innovation for these economies is occasionally questioned, despite the benefits it has been shown to have in assisting emerging and developing nations in achieving both their short- and long-term developmental goals. In an attempt to answer these and other questions, the study examines the role of innovation on the development trajectory of sub-Sahara Africa. A conscious attempt is made to increase the number of control variables. To deal with the challenges of endogeneity, equation (2) is regressed using GMM within IV regression technique. To that effect the study instrumented with size of government to capture the channels through which corruption originates and which leads to the dysfunctional nature



of existing institutions in performing its role as the oil to facilitate progress. Table 2 shows the relationship between innovation and development in Africa.

Findings from the GMM estimator on the role of innovation on development in sub-Sahara confirm what theory alludes to. Innovation is significantly and positively correlated with development in the region except the coefficients are negligible across the four models. Although there is controversy regarding the role of foreign aid to the region's present situation, evidence provided in this research seem to suggest otherwise. Foreign aid is significantly positive on development. This result has a number of implications: (1) in the long run, aid disbursement affects growth and deals with social discrepancies through poverty reduction, and (2) aid channeled through human capital stimulates growth. Regarding the function of foreign aid, it is worthwhile to reflect on the numerous initiatives and programs run by UNESCO to foster a spirit of technical innovation. The financing for a number of seminars and training courses came from foreign governments providing help. Despite this, certain schools of thought contend that the region has not advanced as a result of help. However, there is no concrete proof that aid causes inflation to rise or even lowers the amount of credit available to support private enterprises.

Whereas investment in education continues to be significantly correlated with development, the human capital base measured by tertiary enrollment is variedly correlated with development. The subsequent circumstance might be explained from the following angles. The first source of innovation is human capital in the sciences and engineering, yet these two areas continue to have the lowest enrollment rates among all other fields of study. Second, the lopsided school enrollment that most nations in the area experienced under colonialism appears to conflict with their current goal of industrialization. It should be obvious that the British, Danish, French, Germans, and Portuguese colonized sub-Saharan Africa.

## 5. CONCLUSION AND POLICY RECOMMENDATION

This paper's aim is to examine the connection between innovation and development in sub-Saharan Africa while taking into account the function of institutions and other elements. This is in light of the fact that institutions act as the lubricant for progress. We evaluate a panel of 22 economies in sub-Saharan Africa using GDP per capita as a proxy for progress and the number of scientific publications published as a proxy for innovation.

The POLS and GMM IV regression results show, among other things, that innovation has a

favorable impact on Africa's development, even though this impact seems to be very little.

Although the majority of the countries in the region have established institutional frameworks for science, technology, and innovation (STI), evidence suggests that the slow rate at which innovation contributes to national development is due to obstacles in the design and implementation of STI policies. As a result, this has had marginal improvement on the technology - capability indicators. In order to establish and execute STI policies in the region, a lot more has to be done in the area of collaboration between public entities and parastatals.

We recommend nations in the area to make all necessary preparations to create national assessment and STI data stands. The ability of the area to develop a distinct conceptual and methodological instrument for monitoring and evaluating STI policies will be a prerequisite for the success of this strategy. Financing area Policies relating to STIs need to be reviewed. Priority should be given to tax advantages and havens for tech-related enterprises to supplement currently in place instruments like export-led instruments.

### Author Contributions

Mohammed Bawah provided helpful research guidance and revised the manuscript. Sadia Lukman and Mohammed Abubakari Sadiq developed the study, carried out the research, evaluated the data, and produced the report.

### CONFLICT OF INTEREST

There are no conflicts of interest, according to the authors.

### REFERENCES

- Acemoglu, D., Johnson, S., & James, A. (2001). The Colonial Origins of Comparative Development: An Empirical Investigation. *America Economic Review*, 91(5), 1369–1401. <https://doi.org/10.1257/aer.91.5.1369>
- Adeyinka, A., Salau, S., & Vollrath, D. (2013). *Structural change in the economy of Nigeria* (No. 24). Lagos.
- Alence, R. (2004). Political institutions and developmental governance in sub-Saharan Africa. *The Journal of Modern African Studies*, 42(2), 163–187. <https://doi.org/10.1017/S0022278X04000084>
- Alonso, J.A., & Garcimartin, C. (2013). The determinants of institutional quality. More on the debate. *Journal of International Development*, 25(2), 206–476.
- Amsden, A. H. (1989). *Asia's next giant: South Korea and late industrialisation*. New York: Oxford University Press.
- Aubert, J. E. (2004). *Promoting Innovation in*

*Developing Countries: A Conceptual Framework* (No. 3554). Washington. Retrieved from <https://openknowledge.worldbank.org/handle/10986/8965>

- Ayyagari, M., Demirguc-Kunt, A., Maksimovic, V. (2012). Firm innovation in emerging markets: the role of finance, governance, and competition. *Journal of Financial Quantitative Analysis*, 46(6), 1545–1580.
- Barasa, L., Knoben, J., Vermeulen, P., Kimuyu, P., & Kinyanjui, B. (2017). Institutions, resources and innovation in East Africa: A firm level approach. *Research Policy*, 46(1), 280–291. <https://doi.org/10.1016/j.respol.2016.11.008>
- Barro, R. J., & Sala-i-Martin, X. (2003). *Economic Growth* (2nd ed.). Cambridge: MA: The MIT Press.
- Barro, R. J. (1990). Government spending in a simple model of endogenous Growth. *Journal of Political Economy*, 98(5). Retrieved from <http://www1.worldbank.org/publicsector/pe/pfma06/BarroEndogGrowthJPE88.pdf>
- Carayannis, E. G., Popescu, D., Sipp, C., & Stewart, M. (2006). Technological learning for entrepreneurial development (TL4ED) in the knowledge economy (KE): case studies and lessons learned. *Technovation*, 26(1), 419–443.
- de la Mothe, J. (2004). The institutional governance of technology, society, and innovation. *Technology in Society*, 26(2–3), 523–536. <https://doi.org/10.1016/j.techsoc.2004.01.009>
- DeLong, B. & Shleifer, A. (1993). Princes and Merchants: European City Growth before the Industrial Revolution. *Journal of Law and Economics*, 36(5), 671–703. <https://doi.org/10.3386/w4274>
- Dollar, D., & Kraay, A. (2003). Institutions, trade, and growth. *Journal of Monetary Economics*, 50(1), 133–162. [https://doi.org/10.1016/S0304-3932\(02\)00206-4](https://doi.org/10.1016/S0304-3932(02)00206-4)
- Earle, L., & Scott, Z. (2010). *Assessing the Evidence of the Impact of Governance on Development Outcomes and Poverty Reduction*. London. Retrieved from [www.gsdrc.org/docs/open/EIRS9.pdf](http://www.gsdrc.org/docs/open/EIRS9.pdf)
- Evans P., & Reuschmeyer, D. (1985). The State and Economic Transformation: toward an analysis of the conditions underlying effective intervention. In *Evans, P., Rueschemeyer, D., and Schocpol, T. Bringing the state back in*. Cambridge: Cambridge University Press.
- Feng, Y. (1997). Democracy, Political Stability and Economic Growth. *British Journal of Political Science*, 27(3), 391–418. Retrieved from <http://www.jstor.org/stable/194123>
- Forson, J. A., Buracom, P., Baah-Enumuh, T. Y., Chen, G., & Carsamer, E. (2015). Corruption, EU Aid Inflows and Economic Growth in Ghana: Cointegration and Causality Analysis. *Contemporary Economics*, 9(3), 299–318. <https://doi.org/10.5709/ce.1897-9254.171>
- Forson, J. A., Buracom, P., Chen, G., & Baah-Enumuh, T. Y. (2017). Genuine Wealth Per Capita as a Measure of Sustainability and the Negative Impact of Corruption on Sustainable Growth in Sub-Saharan Africa. *South African Journal of Economics*, 85, 1–18. <https://doi.org/10.1111/saje.12152>
- Forson, J.A., Ennumh, T.Y., Buracom, P., Chen, G., & Peng, Z. (2016). Causes of corruption: Evidence from sub-Saharan Africa. *South African Journal of Economic and Management Sciences*, 19(4), 562–578. <https://doi.org/10.17159/2222-3436/2016/v19n4a7>
- Forson, J. A., Janrattanagul, J., & Carsamer, E. (2013). Culture Matters: A Test of Rationality on Economic Growth. *Asian Social Science*, 9(9), 287–300. <https://doi.org/10.5539/ass.v9n9p287>
- Forson, J. A. (2016a). A “recursive framework” of corruption and development: comparison between economic and sustainable outcomes. *World Journal of Entrepreneurship, Management and Sustainable Development*, 12(4), 282–298. <https://doi.org/10.1108/WJEMSD-05-2016-0027>
- Forson, J. A. (2016b). *Corruption and Sustainable Growth: Comparative Analysis of Sub-Sahara Africa and East Asia*. National Institute of Development Administration (NIDA).
- Freeman, C. (1982). *The Economics of Industrial Innovation*. Cambridge: MIT Press.
- Glaeser, E. L., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2004). Do Institutions Cause Growth? *Journal of Economic Growth*, 9(3), 271–303. <https://doi.org/10.3386/w10568>
- Greif, A. (2006). *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade*. *Journal of Political Economy*. New York: Cambridge. Retrieved from [http://www.stanford.edu/~avner/Greif\\_Institutions/01Chapter1Introduction.pdf](http://www.stanford.edu/~avner/Greif_Institutions/01Chapter1Introduction.pdf)
- Hadjimanolis, A., & Dickson, K. (2001). Development of national innovation policy in small developing countries: the case of Cyprus. *Research Policy*, 30(1), 805–817. [https://doi.org/10.1016/S0048-7333\(00\)00123-2](https://doi.org/10.1016/S0048-7333(00)00123-2)
- Han, C., & Phillips, P. C. B. (2010). GMM Estimation for Dynamic Panels with Fixed Effects and Strong Instruments at Unity. *Econometric Theory*, 26(1), 119–151. <https://doi.org/10.1017/S026646660909063X>
- Huang, C. Y., Shyu, J. Z., & Tzeng, G. H. (2007). Reconfiguring the innovation policy portfolios. *Technovation*, 27(1), 744–765. <https://doi.org/10.1016/j.technovation.2007.04.002>
- Kaufmann, D., Kraay, A., & Zoido-Lobaton, P. (1999). *Governance Matters*.
- Kaufmann, D., Kraay, A., & Zoido-Lobaton, P. (2002). *Governance Matters II: Updated Indicators*

- for 2000/01. (No. 3106). Retrieved from [http://siteresources.worldbank.org/DEC/Resources/WPS2772\\_2002.pdf](http://siteresources.worldbank.org/DEC/Resources/WPS2772_2002.pdf)
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2013). Worldwide Governance Indicators. Retrieved from <http://info.worldbank.org/governance/wgi/index.aspx#home>
  - Knack, S., & Keefer, P. (1995). Institutions and Economic Performance: Cross Country Tests Using Alternative Institutional Measures. *Economics and Politics*, 7(3), 207–227. <https://doi.org/10.1111/j.1468-0343.1995.tb00111.x>
  - Leblang, D. A. (1997). Political Democracy and Economic Growth: Pooled Cross-Sectional and Time Series Evidence. *British Journal of Political Science*, 27(3), 453–466. Retrieved from <http://www.jstor.org/stable/194125>
  - Mcmillan, M. S., & Rodrik, D. (2011). *Globalisation, Structural change and productive growth* (17143).
  - North, D. C. (1993). The New Institutional Economics and Development. Retrieved October 10, 2013, from [http://www.deu.edu.tr/userweb/sedef.akgungor/Current topics in Turkish Economy/north.pdf](http://www.deu.edu.tr/userweb/sedef.akgungor/Current%20topics%20in%20Turkish%20Economy/north.pdf)
  - Oyelaran-Oyeyinka, B. (2012). Institutional capacity and policy for latecomer technology development. *International Journal of Technological Learning Innovation and Development*, 5(1/2).
  - Oyelaran-Oyeyinka, B. (2014). The State and Innovation Policy in Africa. *African Journal of Science, Technology, Innovation and Development*, 6(5), 481–496. <https://doi.org/10.1080/20421338.2014.983731>
  - Padilla-Perez, R., & Gaudin, Y. (2014). Science, technology and innovation policies in small and developing economies: The case of Central America. *Research Policy*, 43(1). <https://doi.org/10.1016/j.respol.2013.10.011>
  - Pellegrini, L. (2011). Causes of Corruption: A Survey of Cross-Country Analysis and Extended Results. In *Corruption, Development and the Environment* (pp. 29–49). Berlin: Springer. <https://doi.org/10.1007/978-94-007-0599-9>
  - Perlman, M., & Heertje, A. (1991). *Evolving Technology and Market Structure: Studies in Schumpeterian Economics*. Michigan.: University of Michigan Press.
  - Plumper, T., & Martin, C. W. (2003). Democracy, Government Spending and Economic Growth: A Political- Economic Explanation of the Barro-Effect. *Public Choice*, 117(1/2), 27–50. Retrieved from <http://www.jstor.org/stable/30025887>
  - Prasad, B. C. (2003). Institutional Economics and Economic Development: The Theory of Property Rights, Economic Development, Good Governance and the Environment. *International Journal of Social Economics*, 30(6), 741–762. <https://doi.org/10.1108/03068290310474120>
  - Prochniak, M., & Witkowski, B. (2012). Bayesian Model Averaging in Modeling GDP Convergence with the use of Panel Data. *Roczniki Kolegium Analiz Ekonomicznych SGH*, 26, 45–60.
  - Próchniak, M., & Witkowski, B. (2013). Time stability of the beta convergence among EU countries : Bayesian model averaging perspective. *Economic Modelling*, 30, 322–333. <https://doi.org/10.1016/j.econmod.2012.08.031>
  - Próchniak, M. (2013). To What Extent Is the Institutional Environment Responsible for Worldwide Differences in Economic Development. *Contemporary Economics*, 7(3), 17. <https://doi.org/10.5709/ce.1897-9254.87>
  - R., M. (1986). The economics of institutions and the sources of growth. *The Economic Journal*, 96(903), 18.
  - Rasiah, R., Shahrivar, R. B., & Yap, X.-S. (2016). Institutional support, innovation capabilities and exports: Evidence from the semiconductor industry in Taiwan. *Technological Forecasting and Social Change*, 109, 69–75. <https://doi.org/10.1016/j.techfore.2016.05.015>
  - Rivera-Batiz, F. L. (2002). Democracy, Governance and Economic Growth. *Review of Development Economics*, 6(2), 225–247. <https://doi.org/10.1111/1467-9361.00151>
  - Rothwell, R., & Zegveld, W. (1982). *Industrial Innovation and Public Policy: Preparing for the 1980s and the 1990s*. London: Printer.
  - Rycroft, R., & Kash, D. (1999). *The complexity challenge*. London: Pinter.
  - Salmenkaita, J. P., & Salo, A. (2002). Rationales for government intervention in the commercialisation of new technologies. *Technology Analysis and Strategic Management*, 14(1), 183–200.
  - Segarra-Blasco, A., García-Quevedo, J., & Teruel-Carrizosa, M. (2008). Barriers to innovation and public policy in Catalonia. *International Entrepreneurship and Management Journal*, 4(4), 431–451. <https://doi.org/10.1007/s11365-008-0086-z>
  - Sen, A. K. (2000). *Development as Freedom*. New York: Anchor Books. Retrieved from <http://blog.lib.umn.edu/ipid/ipid/Dev.asFreedom-Sen-Ch.1.pdf>
  - Seputiene, J. (2009). The Impact of Institutional Environment on Economic Development of the European Union Countries. Retrieved October 10, 2013, from <http://www.icabr.com/fullpapers/SeputieneJanina.pdf>
  - Sundbo, J. (2003). *Innovation as Strategic Reflexivity*. New York: Taylor & Francis.
  - Tebaldi, E., & Elmslie, B. (2008). *Do Institutions*

- Impact Innovation?* Munich.
- UNCTAD. (2006). *Least Developed Report: Developing Productive Capabilities*. New York. Retrieved from [http://unctad.org/en/Docs/lcd2006\\_en.pdf](http://unctad.org/en/Docs/lcd2006_en.pdf)
  - Willie, S., Adedamola, A., Olawale, O., & Hassan, O. (2016). Science, technology and innovation indicators in policy-making: the Nigerian experience. *Palgrave Communications*. <https://doi.org/10.1057/palcomms.2016.15>
  - Woolthuis, R. K., Lankhuizen, M., & Gilsing, V. (2005). A systemic failure framework for innovation policy design. *Technovation*, 25(6), 609–619. <https://doi.org/10.1016/j.technovation.2003.11.002>
  - World Bank. (2009). World Development Indicators. Retrieved May 18, 2010, from [www.data.worldbank.org](http://www.data.worldbank.org)
  - World Bank. (2013). World Development Indicators. Retrieved December 9, 2017, from [www.worldbank.org](http://www.worldbank.org)
  - Yanagihara, T. (1997). Economic System Approach and its Applicability. In *East Asian Development Experience: Economic Systems Approach and its Applicability*. (Eds, pp. 1–35). Tokyo: Institution of Development Economies.

## APPENDIX

**Table A1: Summary Statistics and Presentation of Countries**

Variables	Years	Description	Mean	Std. Dev.	Source
<b>PANEL A: Summary Statistics</b>					
Innovation	1980-2014	The volume of publications published in science and engineering	486.27	1370	World Bank
Corruption Index	1996-2014	Perceived corruption's level. Countries rated from 0 (not at all clean) to 10 (extremely clean) (highly corrupt)	3.181	1.143	Transparency International
GDP per cap	1970-2014	GDP per person's annual percentage growth rate based on constant local currency	1.114	6.776	World Bank
Agric (Value added)	1980-2014	Forestry, hunting, and fishing are all considered forms of agriculture, along with grain and animal production. After summing up all outputs and deducting intermediate inputs, a sector's net output is known as value added.	27.90	16.39	World Bank
Primary ENR	1970-2014	Overall primary enrollment, irrespective of age	82.92	27.93	World Bank
Secondary ENR	1970-2014	Overall secondary enrollment, irrespective of age	25.063	20.398	World Bank
Tertiary ENR	1970-2014	Regardless of age, total enrollment in tertiary education	18.78	15.03	
		Yearly population increase at an exponential pace	2.663	0.852	World Bank
Natural Resources	1970-2014	Total of all rents (forest, mineral, hard and soft coal, and natural gas)	11.967	13.755	World Bank
Foreign Aid	1970-2014	The transfer of money for the benefit of the recipient nation or its people is measured by the logarithm of aid inflow	8.147	0.742	World Bank
Economic Prosperity	1970-2014	An approximate measure of the per-person GDP in a given nation (constant, 2005 US dollars)	2.817	0.381	World Bank
Gov't Effectiveness	1996-2014	Higher values correlate with better governance results in terms of the quality of public services, civil service, and degree of independence from political influences, which runs from -2.5 to 2.5.	-0.290	0.523	WGI
Economic Freedom	1998-2014	A measure of each person's unalienable right to ownership of both labor and property. Countries are rated from 100 (extremely free) to 0 (least free) (less free).	57.826	5.118	Heritage Foundation
Press Freedom	1996-2014	The extent to which a nation allows unrestricted news and information movement. On a scale of 0 (best) to 100 (worst)	45.237	14.780	Freedom House
Size of Gov't	1970-2014	The four factors that show how much a nation relies on political decision-making when allocating resources, products, and services	6.231	1.060	Economic Freedom of the World (EFW)
Institutional quality	1996-2014	Aggregate governance indicators	-0.220	0.480	WGI
<b>PANEL B: Presentation of countries (22)</b>					
Zimbabwe, Ghana, Cameroun, Kenya, Congo, Rep., Nigeria, South Africa, Mali, Gambia, Guinea Bissau, Mozambique, Liberia, Senegal, Togo					
Uganda, Tanzania, Zambia, Malawi, Burkina Faso, Botswana, Côte d'Ivoire, Namibia					

Source: Authors' construct

**Table A2: Correlation matrix**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
innovation (1)	1																			
agric (2)	-0.271*	1																		
gdp growth (3)	0.019	0.056	1																	
primenrol (4)	0.091	-0.473*	0.021	1																
secenrol (5)	0.525*	-0.631*	-0.013	0.558*	1															
tradeopeness (6)	-0.176	-0.319*	-0.007	0.259*	0.194*	1														
tradefreedom (7)	0.228*	-0.149*	0.144*	0.074*	-0.209*	0.084*	1													
popgrowth (8)	-0.244	0.116*	0.264*	0.022	0.318*	0.007	-0.042	1												
grosssavings (9)	0.033	-0.295*	0.105*	0.229*	0.039	0.387*	0.159*	-0.035	1											
natural resou. (10)	-0.024	0.081*	-0.051	0.139*	0.039	0.333*	-0.204*	-0.045	0.115*	1										
logaid (11)	0.147*	-0.002	-0.028	0.111*	0.026	-0.130*	0.075*	-0.004	-0.036	-0.004	1									
logincome (12)	0.353*	-0.761*	0.055	0.379*	0.689*	0.293*	0.235*	-0.110	0.345*	-0.058	-0.327*	1								
corruption (13)	0.275*	-0.452*	0.098*	0.116*	0.496*	0.138*	0.351*	-0.140*	0.362*	-0.357*	0.022	0.528*	1							
														1						

goveff (14)	0.365*	-0.476*	0.108*	0.042	0.432*	-0.159*	0.455*	-0.045	0.155*	-0.486	0.073*	0.474*	0.812*	1					
regqua (15)	0.299*	-0.274*	0.124*	0.031	0.308*	-0.135*	0.533*	0.031	0.161*	-0.447*	0.036	0.356*	0.706*	0.8724*	1				
propyright (16)	0.5947*	0.348*	-0.099	-0.090	-0.316*	-0.127	-0.040	0.051	0.155	-0.203*	-0.050	-0.048	-0.251*	-0.1245	0.0184	1			
econfreedom (17)	0.6698*	0.4528*	-0.041	-0.041	-0.218*	-0.180*	0.086	0.138	0.134	0.025	-0.015	-0.037	-0.092	0.098	0.2528*	0.6677*	1		
democracy (18)	0.1255*	-0.1441*	-0.072	0.093*	0.039	-0.150*	0.100*	0.139*	-0.007	-0.337*	0.004	0.091*	0.190*	0.2458*	0.2364*	-0.035	-0.1061	1	
bureaucost (19)	-0.3048*	0.1609*	-0.051	-0.246*	-0.350*	-0.093*	-0.036	0.044	-0.297*	-0.079*	0.073*	-0.169*	-0.242*	-0.1161*	-0.1683*	0.0069	-0.0076	-0.1762*	1
investment~p (20)	0.2647*	-0.2973*	0.046	0.221*	0.325*	0.164*	-0.108*	-0.043	0.208*	-0.094	0.012	0.265*	0.170*	0.1103	-0.0404	-0.2255	-0.2528*	0.0545	-0.0578
																			1

Note: Significant at \*p < 0.05