UNIVERSITÀ DEGLI STUDI DI MILANO

Essays on Political Economy of Institutions and Innovation: Evidence from sub-Saharan African Economies

---

Bekana Dejene Mamo

Submitted to University of Milan

Department of Social and Political Sciences

In partial fulfillment of the requirements for the degree of Doctor of Philosophy in Political Studies

Supervisor: Prof. Dr. Giovanni M. Carbone

Milano, Italy

February, 2020

Table of Contents

Abstract

This thesis considers the question of how institutions (i.e. political and governance), and innovation affect economic performance in sub-Saharan African economies– a context in which democratic and governance institutions are underdeveloped. To address this fundamental question this dissertation draws on the theories of institutions by North, D. C.(1990), and Acemoglu, D., & Johnson, S.(2005), and the indigenous growth theories by Romer(1986), Lucas(1988), and Schumpeter(1934). To this effect, three different but related in depth investigations are conducted using a panel of sub-Saharan African economies.

Using data for a sample of 35 sub-Saharan African economies for 1995–2015 the first article, examines the extent to which political institutions identified as belonging to democratic or autocratic regimes explains the existing differences in innovation across sub-Saharan Africa. While the very few existing studies focus only on the direct effect of institutions, this article examines the impact of the interaction between different regime types and human capital development on innovation in developing countries. The evidence provides very strong support for the direct effect of democratic development on innovation as well as for its indirect effect via its impact on human capital development. However, the results do not support theories that argue in favour of interaction between democracy and human capital, thereby pointing to the need for better calibration of the numerous existing theories and related empirical measures.

The second article examines the effect of quality of governance institutions on innovation in 37 sub-Saharan African countries for the period 1996–2016. The empirical analysis followed the ordinary least square and general methods of moment's regression technique. The motivation for using general methods of moment's estimation technique is to provide special focus to the issue of endogeneity by estimating general methods of moment's model. The following general findings are presented. First, governance quality does, in fact, appear to promote innovativeness. Second, for all governance indicators, the effect of the quality of governance institutions follows two channels: directly and indirectly through its positive impact on human capital development. The empirical findings suggest that countries with better quality of governance infrastructure are able to promote innovation in better ways. That is, the results do support theories that argue in favour of the development of governance quality

and the improvement of human capital infrastructure to foster national innovation system. These results are found to be robust across alternative empirical specifications tested.

Based on empirical panel data for a sample of 37 sub-Saharan African economies for 1996–2016 the third article, investigates the extent to which institutional quality explains the existing cross-country difference in economic performance in sub-Saharan Africa. While most of the existing studies focus only on the direct effect of institutional quality, this article investigates the direct and indirect effects of institutions. It also reflects on impact of the interaction between institutional quality and innovation on economic growth in developing countries. The evidence provides very strong support for the direct effect of institutional quality development on economic performance as well as for its indirect effect via its impact on innovation. However, the results do not support theories that argue in favour of interaction between institutional quality such as democracy, governance quality and innovation, thereby pointing to the need for better calibration of the numerous existing theoretical postulations and related empirical measures. A final epilogue provides explanation on how some of the key trends emerging from the three empirical studies are contributing to both continuity and change in institutional development as well as economic growth in sub-Saharan Africa and what this might mean for African states into the future.

Keywords: *Institutions, Democracy, Governance, Innovation, economic growth, Africa*

Declaration statements

I hereby declare that this thesis contains no materials accepted for any other degrees in any other institutions.

I hereby certify that this thesis contains no material(s) written and/or published before admission to the PhD program by myself for another person, except where appropriate acknowledgment is made in the form of bibliographical reference, etc.

Bekana Dejene Mamo
February, 2020

List of Tables

List of Figures

Acknowledgements

First and foremost, I would like to gratefully acknowledge the University of Milan for providing me with the necessary financial and intellectual resources to pursue a PhD in political studies. Moreover, I would like to appreciate the university, and the staff and colleagues who were part of my experience at the University of Milan. Specifically, I would like to acknowledge the supervisor of my research Professor Dr. Giovanni Carbone. He has been very helpful and inspiring guide throughout this project work. The suggestions and advices from Andrea Cassani concerning methodological approaches and relevant literature are also appreciable.

I am grateful to the two referees of this dissertation: Professor Silvia Marchesi and Professor Marco Sanfilippo. Thank you very much for your critical and helpful comments on the final draft of the thesis. Your comments were invaluable to improve the thesis to where it stands in its current format.

My profound gratitude goes to my immediate family; to my life partner, Sintayehu Gofe – who has been caring, and supportive throughout the study period. Special thanks to you for rearing our baby boy, Nimona when I have to work day and night on the PhD thesis. I am enormously grateful. I could not have gone far without your support and encouragement.

Thanks to my friends: Lemessa Bayissa, Lemma Gudissa, and Jovan Bliznakovsk for commenting and/or proof reading the chapters of the thesis. I am deeply grateful.

Chapter One
Introduction and Background

1.1. Introduction to the research

In development discourse the sources of growth and development have been one of the most controversial issues. The non-state interventionist policy framework from its early root of Classical Economic Model (Harrod, 1939; Domar, 1946) to the present neo-liberal theory (Williamson J., 1990) suggests market liberalization with focus on capital formation as a rule for economic growth and development. The classical growth model focuses on formation of capital that is needed for financing productive investments in local businesses. The growth models documented by Harrod and Domar note that capital formation raises the standard of living, which in turn results in higher growth. Criticizing the growth models proposed by Harrod and Domar on the account of the fixed proportion of factors of production and substitutability between labor and capital, Solow (1956) argued that capital formation increases labor productivity in a dynamic process of investment growth.

Indigenous growth theories (Romer, 1986; Lucas, 1988; Schumpeter, 1934) explain growth in terms of government policy to foster the right kinds of investment in physical and human capital formation for economic expansion, growth and development. Similarly, Romer (1990); Helpman and Grossman (1991) incorporate knowledge capital gained through research and development to explain growth along with other variables. Overall theoretical growth literature demonstrates the role of capital or changes in the definition in capital (knowledge capital or human capital) in enhancing economic growth. Developing economies are poor in innovation capacity partly because institutions (i.e. economic, political and legal) are poorly developed to promote the right form of investment into human capital development through education and training. For economic development, human and physical capital formation is essential for the efficient utilization of natural resources (Schumpeter, 1934).

Institutional theory suggests the improvement of the quality of institutions for long-run economic growth and development (North, D. C., 1990; Acemoglu, D., & Johnson, S., 2005; Frunza, R., 2011; Yao and Yueh, 2008; Hasan et al., 2009; Casson et al., 2010; Huang, 2010; Angelopoulos et al., 2010; Blackburn and Forgues-Puccio, 2010). The institutions represent a

network of formal and informal rules meant to introduce order in the economic and social life and to improve a mechanism of applying and monitoring these rules in view of efficiently using the available national resources (North, 1990). The institutions form the environment that can influence the itinerary of economic and social activities of a country favorably or unfavorably (Frunza, R., 2011). Strong legal, political and economic institutions are essential to promote development directly and by influencing policies including innovation policy. According to North (1990: pp.3), institutions are defined as the "rules of the game in a society, or more formally, humanly devised constraints that shape human intervention." Among the institutions that are the most crucial to economic growth are those that enable a country to allocate capital to its most productive uses. Such institutions establish and maintain strong property rights, an effective legal system, and a sound and efficient innovation system. In recent years, the field of economic development has come to the conclusion that institutional rules are critical to economic growth (North, 1990; Rodrik et al., 2004). According to Ramona Frunza (2011), institutions represent a network of formal and informal rules meant to introduce order in economic and social life and to provide a mechanism for applying and monitoring these rules with a view to efficiently using the available national resources. However, empirical literature proved that the effect of institutions on economic development is also indirect through its effect on policies. Accordingly, institutions help install policies targeting institutional reforms that aim at promoting growth-driven innovation systems (Drezner, 2002). It is clear from work in institutional economics that the levels and modes of innovative and entrepreneurial activities are affected by the surrounding institutions (Licht and Siegel, 2006; Busenitz et al., 2000). Institutions can help alter the constraints and structure of incentives in a society to direct self-interested behavior towards either more or less economically productive activity (Baumol, 1990; Nee, 1996). New opportunities open up as emerging economics undertake the shift from redistributive bureaucracy to open markets (Nee, 1996), but we still lack an understanding of which shifts are more important for increasing technological innovation.

Innovation capacity determines the level of capital formation (Schumpeter, 1934). In the economies of the sub Saharan African region innovation capacity development demands institutional and economic reforms to improve the performance of formal institutions and thereby enhance economic growth. The theoretical argument for linking innovation capacity to

economic development is that a well-developed innovation system improves the efficiency of capital allocation (Schumpeter, 1912; Helpman and Grossman, 1991). A modern innovation system promotes investment by identifying and funding good business opportunities, mobilizes savings, monitors the performance of managers, enables the trading, diversification of risk, and facilitates the exchange of goods and services. These functions result in a more efficient allocation of resources, in a more rapid accumulation of physical and human capital, and faster technological progress, which in turn feed economic growth (Bagehot, 1873; Schumpeter, 1934).In the neoclassical framework, the impact of innovation is treated as part of the Solow residual and hence a key contributing factor to economic progress and long-term convergence (Solow, 1957; Fagerberg, 1994). In recent decades, due to the popularity of endogenous growth theories, economists are increasingly of the view that differences in innovation capacity and potential are largely responsible for persistent variations in economic performance and hence wealth among the nations in the world (Grossman and Helpman, 1991).

However, the questions of *what fundamental forces result in a well-developed innovation system?* On the contrary, *what basic factors hinder the development of innovation capacity?* These questions are still debatable in the plethora of economic literature. One thing apparently clear in this regard as a general consensus is that institutions which foster investment in education, training, research and development are critical for nourishing innovation systems. Though there is still significant knowledge gap about the factors that ultimately determine a country's rate of innovation capacity, economists have increasingly become aware that institutional arrangements affect knowledge accumulation (Rodrik, 2000; Sala-i-Martin, 2002; Gradstein, 2004) and as a result, recognize that institutional arrangements affect the long-run growth of output. If one wants not only to diagnose the problem of growth, but also search for ways to stimulate growth, it is very important to understand how institutions and innovation are linked. In spite of these, the existing literature reveals that political economists are still challenged by the daunting task of understanding the nexus between institutional quality and innovation capacity and to integrate institutions into the standard theoretical framework of economic growth (Sala-i-Martin, 2002; Huang & Xu, 1999). Besides, few growth models explicitly address this issue (Huang & Xu, 1999; Fedderke, 2001; Gradstein, 2004; Tebaldi & Elmslie, 2008) and little empirical cross-country analyses directly examine such a link. The existing literature on institutional and economic performance finds a positive association

between institutions and levels of income (Hall and Jones, 1999; Acemoglu et al., 2001; Alcala and Ciccone, 2004; Easterly and Levine, 2003). Also the link between institutions and the transitional growth rates of per capita income has been well explained in previous literature (Barro, 1991; Mauro, 1995; Acemoglu et al., 2001). Nevertheless, an unambiguous empirical association between institutions and technical innovation has not yet been established. In addition, very little has been done in terms of theoretical explanation and empirical evaluation of the influences of institutional quality on technical innovation. This study contributes to the literature by examining empirically the links between technical innovation and the quality of institutional arrangement on the one hand and the link between innovation capacity and economic performance on the other hand. Consequently, the author argues that institutional development is imperative to improve the innovation capacity of a nation and there by the performance of its economy.

1.2. Background to the African social and political issues

The international experience in economic and institutional reform has got the central idea of the role of the state and markets in economic development. The dominant idea of the post second World War period is that the state could be set to do better than the market and should therefore play a critical role in guiding societies that lacked a strong entrepreneurial class towards a sustainable growth path, most states directly concerned themselves with production in an attempt to accelerate capital accumulation and to acquire new technologies. The argument culminates with the conclusion that the society knows little or nothing as to how to move forward from vicious circle of poverty to virtuous cycle of wealth accumulation and therefore should be guided by the state policy makers and planners. According to Fenelli and Popov (2003), Norman v. Louyza and Raimundo Sotto(2003) the state policy makers experimented with tools like manipulation of relative prices, protectionism and intervention in the process of financial intermediation to influence resource allocation in the desired direction.

However,1970s began to show up the drawbacks of the model in the form of increased burden on government finance resulting from inefficient state owned enterprises, inflated bureaucracies, low productivity, and foreign exchange shortages resulting in reducing the role of the state and increasing reliance on markets (Heidhues Franz, 2009). In the late 1980s the

embrace of market oriented development approach became widespread as many reforms were put together when the Washington Consensus (Williamson J., 1990) development policy prescriptions were in place demanding a market liberalization, privatization and deregulation measures as the only way out of poverty for underdeveloped economies. The irony is the policy prescriptions failed in most of the cases because it exports only the sets of policy prescriptions but not the institutional array necessary for implementation of the policies. At the same time many countries moved to political systems that, at least on the surface, were more democratic than their predecessors. The 1990s saw even more dramatic institutional changes, in particular in the former socialist economies of Europe, East Asia and Africa. For Sub-Saharan Africa, economic performance in the 1970s and 1980s was very poor (Acemoglu, et al., 2002; Jerven, 2009; IMF, 2009). Much of the region was unable to break away from paths of negative or low per capita income growth (Ferguson, 2006; Thomson, 2010), high inflation and fiscal deficits(Hodges, 2004), and balance of payments difficulties, which in some countries culminated into political and social turmoil (Chabal, P. & Daloz, J., 1999; Sender and Smith, 1986).

For African economies, the historical experience is quite the same as that observed in many other developing countries. Since independence in 1960s Africa's development scenario was very interesting for about two decades. Sub-Saharan average economic growth was 3.4 percent between 1961 and 1981(World Bank, 1981). Over this period Ivory Coast and Nigeria outperformed Indonesia, while countries such as Congo Democratic Republic, Ghana and Uganda were in par with South Korea's development performance (Klasen, 2003). By the end of 1970s the general development prospect of sub-Saharan African countries was unsatisfactory although some countries had experienced better economic growth (World Bank, 1981). Development motives in the region since the late 1960s have been full of controversies (Gareth Austin, 2010). During the 1970's and 1980's, almost all of the countries implemented policies of self-reliance and protectionism, which entailed state taking the leading role in national development under socialist systems(Heidhues Franz, 2009). These included extensive compulsory villagization, nationalization, and price controls. Among others nationalization of private owned companies and creation and management of state enterprises was based on the infant industry protection and development considerations and the thinking that the state was in a better position to guide the society towards sustainable development.

However, by the 1980's, African economies were among the world's poorest countries in GDP per capita terms and it seems that for the most part, its problems were related to poor policies and structural weaknesses characterized by internal and external political frictions (Heidhues Franz, 2009; Sender and Smith, 1986; Easterly and Levine, 1997; Jerven, 2009; IMF, 2009). Since the demise of the socialist system at the end of 1980's, the countries started to reorient their policies towards free enterprise system. The governments renovated their approach to structural adjustment policies suggested by the World Bank and IMF. Structural reforms carried out by the governments in sub-Saharan Africa have focused on realigning the incentive structure towards efficient use of scarce foreign exchange, liberalizing markets for goods and services, and reducing the involvement of the public sector in the economy and privatization of public enterprises under capitalist economic system. However, little or no success history was reported from the implementation of structural adjustment programs as a result of the weak institutional array in these economies (Acemoglu, et al., 2002; Ferguson, 2006; Thomson, 2010; Hodges, 2004; Williams G., 2007). Those economies like Ethiopia and Rwanda which realized the failure and reoriented their development policy towards the Developmental State Model, mainly imitated from the Asian economies proved to succeed posing critical question on mechanisms of institutional development for improvement of innovation capacity and thus economic and social progress (Oliver Reynolds, 2018; Ben Shepherd and Anna Twum, 2018). Hence, this thesis argues that lack of quality institutions and failure to mobilize support for collective action has limited the ability of African countries to influence the design of innovation policy in particular and economic growth promoting policies in general. Building on this argument this thesis asks: *What is the nexus of institutions, innovation and economic growth in sub-Saharan Africa?* Given this back drop, there is a need to research on the linkages among institutions, innovation capacity and economic performance so as to find answers to questions which remain unanswered with respect to African Economies' experiences. Thus, the research questions are:

1) What is the impact of political institutions on innovation capacity development in sub-Saharan African economies?
2) Does governance quality promote innovation in sub-Saharan African economies?

3) What is the relevance of institutional development for innovation capacity development and thereby economic growth in sub-Saharan African economies?

1.3. Framework to the study

To analyze the linkage from institutions— innovation capacity development— economic development in African economies, it is very important to develop complete picture of the conceptual framework. The researcher has, therefore, constructed a conceptual framework as shown below. The framework begins with the initial economic and institutional conditions relevant to innovation capacity development and considerations of external conditions that affect innovation system development. These initial conditions are mostly determined by domestic developments. These conditions will be taken as given, rather than trying to explain them, but they are crucial in determining both policy choice and response to policies. From the perspective of policy choice, the researcher is particularly interested in several institutional variables (Kaufman, Kraay and Mastruzzi, 2003) including Rule of Law, Voice and Accountability, Control of Corruption, Political Stability and Absence of Violence, Regulatory Quality, Government Effectiveness and Polity IV Project for democracy autocracy.

This empirical research employs a two stage study to scaffold the link among institutions—innovation capacity development—economic development. The dependent variables of the model for the relationship between institutions and innovation capacity development are the proxy indicators for innovation capacity. There are many alternative indicators that were used in various studies related to innovation capacity development. These include among others the Global Innovation Capacity Index (GICI), the number of patent applications (PATENT) filed through the Patent Cooperation Treaty to ask for protection of ideas, the amount of research and development expenditure as a percentage of (RDE) and the number of researchers and scientists in the country (RESEA). The existing literature (Jaffe and Palmer, 1997; Griliches, 1990; Ace et al., 2002; Ulku, 2007) employed the number of patent applications as a proxy for innovation. Rodriguez-pose and Crescenzi (2008) showed how the interaction between research and development spending along with social-economic and institutional conditions shapes regional innovation. Prodan's (2005) also considered the amount of R&D expenditure and the number of patent applications to present a regression model to test the correlation

between to innovation and economic growth. Owing to data availability, this thesis considers Global Innovation Capacity Index (GICI) and the number of scientific and technical publications in a country as proxy for innovation. The number of scientific and technical publications index is an intermediate input measure of innovation and as a result is considered better proxy than research and development spending. This is because of the fact that scientific and technical publications index measures the quality of research and development undertakings unlike the monetary spending data for the same purpose. However, it is less preferred to patent applications or patent registrations (Taylor M, 2004; McMillan, G. Steven, and Robert D. Hamilton, 2000). Unfortunately neither patent data nor research and development spending is available for sub-Saharan African economies, save South Africa and Botswana somehow. Hence, this research uses the aforementioned two indicators of innovation capacity development for empirical investigation to analyze the impact of institutions on innovation capacity and economic performance. Thus, in terms of analyzing the impact of institutions on innovation capacity development in the particular case, the framework will bring together a cogent and thorough analysis of economic and institutional conditions and their impact on innovation deepening.

The second model explains the linkage between innovation and economic development. The independent variable in the model is the proxy for innovation. GDP growth rate is used as proxy indicator for Economic growth. The outcome with respect to this variable depends very much on how the well innovation policies can be implemented in a planned and coordinated manner. These variables which are impacted by innovation are interlinked such that institutions affect innovation directly and indirectly through affecting human capital formation. Innovation affects the allocation of capital in the input and or intermediate goods markets which in turn feeds into improved economic performance. In this model the thesis asks: *Does the interaction of institutions and innovation capacity matter for economic growth?* The schematic design of the conceptual framework, therefore, is as follows:

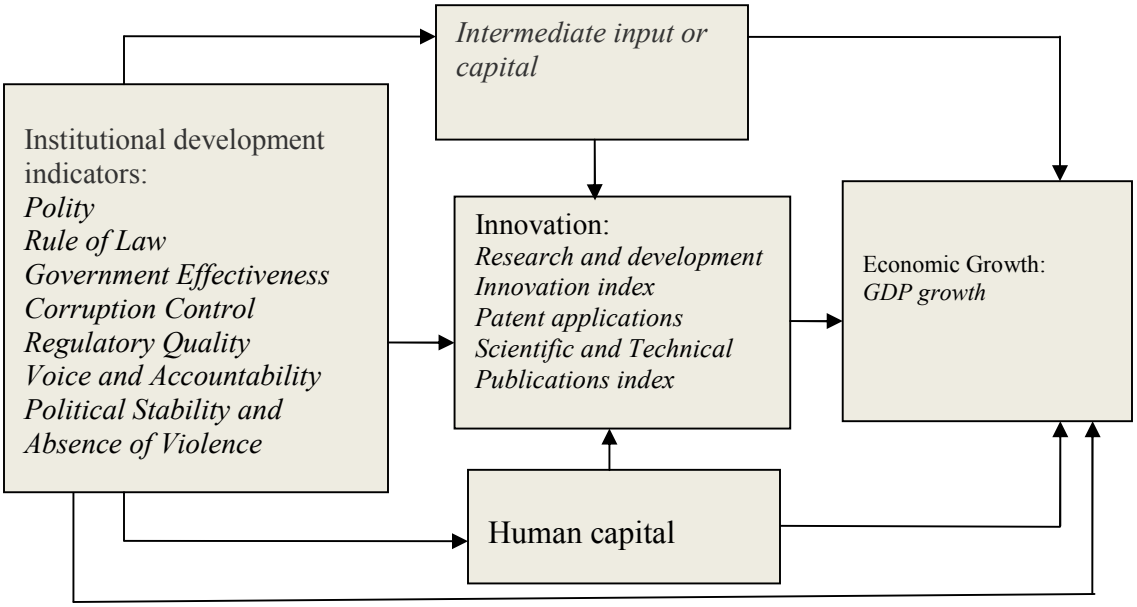

Figure-1: Schematic Design of the Conceptual Framework
Source: Adapted from Edinaldo Tebaldi & Bruce Elmslie (2008), and literature review

The theoretical framework adopted above could generate methodological concerns related to the identification strategy that needs to be employed for empirical analysis. First, the framework presented above is based on the argument that institutions (i.e. both governance and political) influences innovation directly and indirectly through its implication on human capital development. Second, institution affects economic growth directly and indirectly through its impact on innovation capacity. That means the relation between institutions and human capital for example seemingly appears to be a complementary one (i.e. one potentially reinforces the other. But that is a partial effect of institutions when the link from institutions to human capital and the link from human capital to innovation are considered. While the direct effect of institutions theoretically implies that the relationship between human capital and institutions is complementary, the argument for the indirect effect suggests that it is sequential one (i.e. one in which improvements in human capital that affect innovation capacity come from improvements in policy). It might be well counter-argued that countries with more advanced innovative capacities are those who raise incentives to invest in education (and so to accumulate human capital) and have a larger demand for better (whatever type of) institutions. And, this might lead into concern for potential endogeneity. However, given that this project studies effect of institutions in a context in which institutions are underdeveloped the question

is can a country achieve better innovative capacity and accumulate human capital before it achieve institutional development? The classical answer to this question based on the available theoretical and empirical literature is no. Institutions as the rule of the game in a society imply the primacy of institutional development to achieve progress in social and economic development (Rodrik et.al, 2004; North, 1991; Crouch, 2005). Previous empirical research has documented social capabilities of countries are important in the adoption and diffusion of technologies but countries differ in social capabilities (Becker, 1993; Abramowitz, 1986). Hence, to the extent to which human capital contributes to innovative capacities, its effect is conditioned by the country's social capabilities which include factors like quality of institutions (i.e. governance and political institutions). The same line of theoretical argument could be extended to the link from institutions – innovation to – economic growth. That is a country is not expected to achieve economic growth/development and better innovative capacity without prior development of strong polity system and governance institutions.

1.4.Theoretical and empirical contribution

This thesis is one of the few that have investigated effect of institutions in a nondemocratic political environment and poorly developed governance systems (Cheeseman Nic., 2015; Freedom House, 2017; Democracy Index, 2017; Temnin John, 2018) and one of a handful on the nexus of institutions, innovation and economic growth in sub-Saharan African economies. As such, it makes substantial empirical contribution adding to the growing body of knowledge about the nexus of institutions (i.e. both political and governance institutions), innovation and economic growth, specifically for economies in the developing world and/or low income economies – economic and social environments other than industrialized, liberal democracies. More Studies such as this are necessary because of the profound role of institutions and technological innovation for economic growth and development (Acemoglu et.al, 2001; Schumpeter, 1934). This study sheds a light on some of the obscure issues in the existing literature. The findings in this research emphasize the importance of the development of institutions and innovation capacity in line with the theoretical development in previous studies (North, 1990; Schumpeter, 1934; Edinaldo, and Bruce, 2008). The findings in this thesis reveal

that institutions affect economic growth directly by harnessing the policy environment and indirectly by improving innovative capacity of countries.

Three in depth studies (chapters two- four) analyze the nexus of institutions, innovation and economic growth, and how this contributes to our understanding and conceptualization of the impact of institutions on economic growth in the context of developing economies. In chapter five: bringing it all together this thesis discuss more specifically the pitfalls in the existing literature, and the lessons we can draw from these three detailed investigations in order to strengthen theoretical understandings of the role of institutional development. As study of some particular affairs in sub-Saharan African economies, the study also contributes to the growing literature on the contemporary African political and social systems and how it is changing. By focusing on the direct and indirect effect of institutions on economic growth, this study can provide insight into broader view of institutional transformation in developing societies. This thesis does not claim to have any grand theory about sub-Saharan African institutional transformation, or conclusions about the direction or fate of ongoing institutional reforms. Nevertheless, from this study it is possible to have some insights into the wider issue of how the under development of institutions undermined economic growth, and what this might mean for African policy makers in the near future.

1.5. Structure of this thesis

Following from the conceptual framework three related but different essays are developed in this PhD thesis. The first essay is aimed at answering the first basic research question. It is entitled. Political institutions, human capital and innovation: evidence from sub-Saharan African economies[1]. This paper presents documentation of analysis of the past trends which have contributed to the present state of affairs in terms of institutional development, innovation capacity. That is, it deals with the diagnosis of the linkage between political institutions identified as belonging to democracy/autocracy categorization and innovation in sub-Saharan

[1] Published: Dejene Mamo Bekana (2019). "Political institutions, human capital and innovation: evidence from sub-Saharan Africa." *Democratization*, 26(4): 666-708, DOI: 10.1080/13510347.2019.1574296

African economies. To this end, it relies on quantitative and analytical explanation of the association based on panel dataset relevant to institutions and innovation capacity development in Africa. Based on econometric investigation of the impact of political institutions identified as regime types on innovation capacity, this paper corroborates strong evidence that political institutions affect innovation directly and indirectly through their effect on human capital development.

The second paper analyzes the effect of governance quality on innovation aimed at addressing the second basic research question. This paper empirically analyzed impacts of the quality of governance institutions on innovation capacity in sub-Saharan Africa[2]. By examining panel data for 37 sub-Saharan African economies, the paper provides strong evidence the effect of the quality of governance institutions on innovation follows two channels: directly and indirectly through its positive impact on human capital development. The empirical findings suggest that countries with better quality of governance infrastructure are able to promote innovation in better ways. That is, the results do support theories that argue in favour of the development of governance quality and the improvement of human capital infrastructure to foster the national innovation system.

The third paper is committed to extending the investigation to the impact of institutions on economic growth. It analyzed the nexus among institutions (i.e. both political institutions and governance quality), innovation capacity and economic growth[3]. This paper is based on econometric investigation of the impact of innovation capacity on economic performance. To examine possible differences in how innovation capacity affects economic performance, the study considers the role of institutions. The evidence provides very strong support for the direct effect of institutional quality development on economic performance as well as for its indirect effect via its impact on innovation. However, the results do not support theories that argue in favour of interaction between institutional quality such as democracy, governance quality and

[2] Published: Dejene Mamo Bekana (2020). "Does governance quality promote innovation in sub-Saharan Africa? An empirical study across 37 countries." *Innovation and Development*, 10(1): 21-44, DOI: 10.1080/2157930X.2018.1562603

[3]Published: Dejene Mamo Bekana (2020). "Innovation and Economic Growth in Sub-Saharan Africa: Why Institutions Matter? An Empirical Study Aross 37 Countries." *Arthaniti: Journal of Economic Theory and Practice*. https://doi.org/10.1177/0976747920915114

innovation, thereby pointing to the need for better calibration of the numerous existing theoretical postulations and related empirical measures.

The last chapter (i.e. chapter 5) generates concluding remarks grounded on the evaluation of evidence in the previous chapters. The discussion in this chapter culminate with propositions of couples of policy implications related to institutional, innovation and their significance in promoting economic growth.

Chapter Two

Political Institutions, Human Capital and Innovation: Evidence from sub-Saharan Africa

2.1. Introduction

Growth theories predict that innovation is a key factor for economic prosperity and social transformation (Schumpeter, 1934; Solow, 1956). As a result, it is important to explore the cross-country differences in innovation. Understanding the key determinants of innovation at the national level is important to nurture the science and technology policies of countries. Thus, by drawing on the theories of institutions (Acemoglu& Johnson, 2005; North, 1981, 1990), and the Schumpeterian theories on the economics of innovation (Schumpeter, 1934; Romer, 1986, 1990), the current paper argues that political institutions influence innovation both directly and indirectly, through their impact on human capital development.

Studies on institutions underscore the positive impact of institutional development on both innovation and human capital development (Rodrik, 2000; Sala-i-Martin, 2002; Gradstein, 2004). Further, research documents the prominent role of human capital development in improving the innovative and competitive capacities of nation states. Determinants of innovation, for instance, have been studied at both the national and firm levels. Firm-level strands of empirical research prove that knowledge is pivotal in the innovation process (Zahra & George, 2002; Barney, 1991; Kogut & Zander, 1992). In these strands of literature, knowledge is often labelled as human capital (Annelies van Uden et al., 2016). Some cross-country studies also underscore the fact that human capital is a key factor, among others, in fostering the innovative capacity of nations (Bourdieu, 1986; Maskell and Malmberg, 1999; Dakhli & De Clercq, 2004.

The literature in the field of development studies has reached the general conclusion that economic development is primarily the outcome of technological change; however, other factors also play a role. There is still a significant lack of clarity in cross-country studies concerning the determinants of cross-country variations in innovation. For instance, what determines the innovative capacity of countries? What factors contribute most to the cross-

country variation in innovation? To put it differently, why are some countries more innovative than others? These and related questions are yet to be addressed. It is true that economists and political economists have, over the last decade and a half, shed light on the impact of institutions on human capital development, innovation, and economic growth(Rodrik, 2000; Sala-i-Martin, 2002; Gradstein, 2004; Dinopoulos and Syropoulos, 2007; Davis and Sener, 2010; Edinaldo & Bruce, 2013). The focus in these few studies, except the one by Edinaldo & Bruce, is on the linkage from institutions to economic growth via innovation; however, little attention has been paid to the direct analysis of the explanatory role of institutions in cross-country differences in terms of innovation.

There are two reasons why the literature on the analysis of the direct impact of institutions on innovation is limited. The first reason is conceptual or theoretical and the second is methodological; the second is the direct outcome of the first. From the theoretical perspective, there is no consensus on the conceptualisation of institutions. There is an array of different definitions offered by scholars. For example, North (1990:pp.3) defines institutions as the 'rules of the game in a society, or more formally, humanly devised constraints that shape human intervention'. Putting it differently, North conceptualises institutions as rules (both formal and informal) in a society, along with the procedures laid down for enforcement. A similar definition, but puts lightly differently, is by Engerman, S. L. and Sokoloff, K. L. (1997), who claim that institutions should be 'interpreted broadly to encompass not only formal political and legal structures but culture as well' (p. 261). The new institutional economics school offers a more vague and generic definition of institutions. It conceptualises institutions as 'application and extension of concepts such as transaction costs, property rights, public choice, and ideology' Furubotn and Richter, 2005, p. 37). The conceptualisation problem, which provides generic definitions of institutions, has serious repercussions for measurement because of methodological pitfalls related to modelling and econometric specifications.

Taking into account the multidimensionality of institutions, North (1981), Dawson (1998), and Rodrick (2000) suggests indicators that capture the different dimensions of institutions. This has led to the proliferation of indicators by POLITY, World Economic Forum, Global Integrity, Freedom House, Fraser Institute (Gwartney, J., Lawson, 2008), Heritage Foundation (Miller, T.et.al, 2009), World Governance Indicators, and World (Bank Kauffman, D. et.al, 2005). Most of these indicators have been employed in empirical research; however, they

have been criticised for their failure to capture the diverse dimensions of institutions (Knack, 2002; Kaufmann and Kraay, 2008; Van de Walle, 2005). This measurement issue has led to problems of econometric specification. In the effort to capture the different dimensions of institutions, the development and improvement of these indicators has included almost each and every social and economic factor. This has led to endogeneity concerns in econometric specifications (Edinaldo & Bruce, 2013).

In previous research, the relationship between human capital and innovation and between innovation and institutions has scarcely been studied. This paper considers the direct and indirect channels through which political institutions influence cross-country variations in innovation. First, it analyses the direct impact of institutions on the innovative capacity of countries. Second, it deals with the impact of institutions via its interaction with human capital development. The paper analyses how distinct combinations of these cross-country levels of institutions and human capital relate to technological change. This paper examines whether the combination of political institutions, classified according to the type of regime to which they belong (i.e. democracy or autocracy), and human capital have a favourable effect on innovation. The few cross-country studies about the association between institutions, human capital, and innovation that have been conducted used data mainly from the advanced economies of the West (Dakhli & De Clercq, 2004; Edinaldo & Bruce, 2013; Gradstein, 2004). This is rather surprising, given that various firm-level studies have underscored the need for low-income countries to promote innovation (Lee & Kang, 2007; Crespi & Zuniga, 2011). Drawing on a panel data set from sub-Saharan African economies, this paper offers a different perspective on the role of institutions and human capital in fostering innovation. The shortage of human capital is known to be one of the key bottlenecks in stimulating innovation in low-income countries (Georgeet al., 2016). In addition, the underdevelopment of institutions and the sluggish transition to democratic order has limited the innovative capacities of African countries (Ndubuisi Ekekwe, 2015).

2.2. Theory and Empirical Literature

Innovation in Developing Countries

Innovation is a multifaceted economic and social phenomenon. As a result, it has been defined by various authors in different ways. Innovation is conceptualised as a process that takes an invention and develops it all the way to a marketable good or service that has the potential to transform the economy (Schumpeter, 1934). Schumpeter underscores the fact that innovation creates a new product that must lead to an essential change in the economy. Somewhat similarly, Christensen (1997) develops the concept of innovation by separating the attributes of newness and impact. According to "Oslo Manual" (2005), innovation is the implementation of a new or significantly improved product (good or service), process, or marketing and organisational methods in business practice, workplace organisation, and external relationships. It is striking that despite its role being more profound in the developing world than in the developed world, innovation is not given necessary attention in developing countries (Aubert, Jean-Eric, 2005). Several rationales have been proposed about the profound role of innovation in developing countries. First, as argued by Bell and Albu (1999), catch-up in economic development based solely on foreign technology acquisition would end up sub-optimal. However, there is still the possibility that economic agents in developing countries can bolster their catch-up efforts through acquisition and imitation of foreign technology because they operate on the borderline of the technology frontier available to the global economy (Amman & Cantwell, 2012; Bell & Pavitt, 1993; Katz, 1986). Second, innovation provides the dual advantage of generation of knowledge and improvement of national absorptive capacity (Cohen and Levinthal, 1990). Third, innovation is essential for economic diversification towards more value-adding activities, which, in turn, amount to a structural change in the economy (Hausman and Hidalgo, 2011).

2.3. Political Institutions and Innovation

Institutionalism asserts that the nature of a nation, characterised by its political regime, is important for innovation. The argument is rooted in the fact that democracies create a congenial environment for the exercise of political freedom and civil liberties, amongst other things, thereby fostering innovation and economic development (Lopez-Claros and Yasmina, 2009). In contrast, autocracies repress political and civil liberties and, thus, deprive citizens of economic liberties, thereby creating an arrangement that may not be long lasting (Davin Patt,

1988). This is because of the inseparability of economic liberties from political liberties (Albert and Robin, 1991; Drezner, 2002). Moreover, democracies create a decentralised decision-making process that facilitates free flow of information and resource allocation based on local priorities. Siegle, Joseph T., et al.(2004) affirm that 'democracies are open: they spur the flow of information and free flow of ideas, every bit as much as the flow of goods fosters efficient, customised, and effective policies'. As a result, decentralised systems successfully encourage creativity and innovation, something that their centralised counterparts are not capable of doing because of the restrictions they impose on political and civil liberties. The power structure of a country is important in determining the effectiveness of national innovation policies, and a decentralised state structure is a necessary condition to maintain technological leadership (Drezner, 2002; North, 1990). Drezner further claimed that for countries at the technological frontier, a centralized state system would result in policies that impede innovation. Empirical evidence suggests that democracies are much better at creating the conditions in a country that are conducive to the nurturing of creativity and independence of thought; these, in turn, are essential for innovation (Siegleet.al, 2004). However, there exists strong evidence that democracy could generate adverse outcomes at the early stages of social and economic development (Miller et al., 1996; Aslund et al., 2001; Dewatripont and Roland, 1992; Roland, 2001) because of poor institutionalisation (Mansfield and Snyder, 2007).

Institutional theory posits that a country's political, legal, social, and cultural institutions determine and characterise its economy (North, 1990; Acemoglu et al., 2001; Hall and Jones, 1999; Rodrik et al., 2004). In recent literature on growth, the role of institutions in harnessing economic performance is well acknowledged and widely employed in studies on growth and cross-country comparison of income (Acemoglu et al., 2001; Easterly and Levine, 2003; Hall and Jones, 1999; Rodrik et al., 2004). Some empirical studies have found a positive relationship between the innovation capability of a country and the quality of its institutions (Morck& Yeung, 2001; Sala-i-Martin, 2002). For example, Sala-i-Martin (2002:pp.18) underscored that "It is hard to come up with new and better technologies if an economy does not have the right institutions"; this is because quality institutions play a key role in not only the creation of cutting-edge new technologies, but also their diffusion(Freeman, 1987). Lundvall (1992) points out that quality institution also foster cooperation among economic agents and this often leads to the creation of new technologies.

2.4. Human Capital and Innovation

Studies on innovation, both at the firm and national levels, note that human capital is a crucial factor for technological change. Firm-level strands of empirical research prove that human capital is pivotal in the innovation process (Zahra & George, 2002; Barney, 1991; Kogut & Zander, 1992). Some cross-country studies also underscore the role of human capital, among others, as a key factor in fostering the innovative capacity of nations (Bourdieu, 1986; Maskell and Malmberg, 1999; Dakhli & De Clercq, 2004). The link from human capital to innovation has been extensively researched in advanced countries. The literature on this topic that covers developing economies is rather limited. For developing economies, cross-country analysis of the impact of human capital on innovation based on national-level data is rather limited. However, firm-level empirical studies in low-income countries affirm that human capital is a key factor in the pursuit of technological change (Lee & Kang, 2007; Crespi & Zuniga, 2011). Human capital is important because it provides economies with the basic infrastructure of knowledge needed for innovation. Shortage of human capital has been known to be one of the key bottlenecks in stimulating innovation in low-income countries (Georgeet et. al., 2016; Feng, Y., 2003). As a result, previous research on this topic has suggested that nation states need to focus on investment in human capital through education and training to foster innovation (Kogut & Zander, 1992; Dakhli & De Clercq, 2004; Annelies van Uden et al., 2016; George et al., 2016).

2.5. Institutions, Human Capital, and Innovation

Despite numerous studies on the relationship between human capital and political institutions, they appear to be inconclusive about the association of political regime with human capital. Following Lipset's (1959) hypothesis, empirical findings affirm that states need to achieve high level of education in order to sustain democratic order (Barro, 1999; Castello-Climent, 2008; Acemoglu et al., 2005; Jeroen and Jakob de, 2013). These strands of literature argue that the direction of causality is from human capital to political institutions. However, there exists substantial empirical literature stating that the direction of causality is from political

institutions to human capital (Feng y., 2003; Ross, 2006). Democracies are better in promoting development of human capital through education and training (Brown and Hunter, 2004), thus spurring innovation. A number of studies have reported a positive and significant causal association running from democracy to human capital (Helliwell, 1994; Lake and Baum, 2001; Feng, 2003; Ross, 2006; Jeroen and Jakob de., 2013). One of the many reasons why democracies focus on human capital development is democracy itself–failure to pay proper attention to education in a democratic society may result in the replacement of political decision makers through periodic elections (Brown and Hunter, 2004).

Meanwhile, authoritarian regimes tend to undermine human capital development; this is because they fear the politics of displacement, wherein educated people are likely to threaten an authoritarian regime (Feng Y., 2003). Thus, authoritarian systems run the risk of undermining innovation. However, as noted by Ames Barry (1987, p. 42), "Even in the absence of overt electoral challenges, conservative autocrats may want to enhance primary education for developmental reasons as well as to maintain as much legitimacy as possible among the popular sectors". Furthermore, authoritarian systems with planned participatory socialism could promote human capital development for achieving social and economic transformation (Devine, 1988; Albert and Hahnel, 1991; Cockshott and Cottrell, 1993). However, there is strong empirical evidence that authoritarian dictators who are interested in private consumption or political power are motivated to take actions that have adverse effect on their economies (Robinson 2001; Bueno de Mesquita et al. 2003; Acemoglu and Robinson, 2006). Based on the explanations made so far, the following conceptual framework is developed for this study.

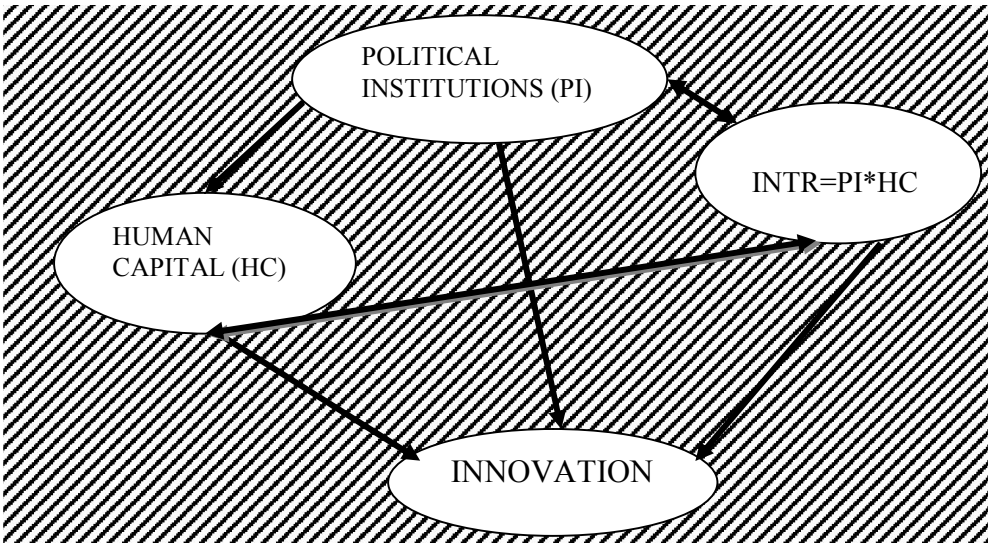

Fig.2a: Model for Studying the Impact of Political Institutions on Innovation

Source: Adapted from Edinaldo Tebaldi & Bruce Elmslie (2008)

2.6. Research Methods

Model Specification

This research employs two strategies–A and B. Strategy A is based on linear panel data econometric methods suitable for testing interaction models (i.e. the single equation structural model). Strategy B is based on the causal process logic to dissect the direct and indirect effects of political institutions on innovation using the simultaneous equations structural model.

Strategy A: The specification in this approach used the empirical models of Lee Weng Chang and Siong Hook Law(2017), and Edinaldo Tebaldi & Bruce Elmslie (2013) for analysis. Following from these literatures, the following model specification was used for empirical estimation:

$$\ln(SJA_{it}) = \theta + \alpha_1(HC_{it}) + \alpha_2(POL_{it}) + \alpha X_{it} + \varepsilon_{it} \quad \text{.....(1)}$$

$$\ln(SJA_{it}) = \theta + \alpha_1(HC_{it}) + \alpha_2(POL_{it}) + \alpha_3(HC_{it} * POL_{it}) + \alpha X_{it} + \varepsilon_{it} \quad \text{.....(2)}$$

In the equation, human capital (HC_{it}), Polity2 (POL_{it}), and a range of macroeconomic control variables (X_{it}) are used to explain cross-country differences in innovation. Innovation is measured by the index for scientific and technical journal publications $\ln(SJA_{it})$. The substantive motivation for including the interaction term between human capital and Polity2 in the estimation model under Strategy A is based on the consideration that human capital has a bigger effect on innovation in democratic regimes than autocratic ones. Thus, the effect of HC_{it} on $\ln(SJA_{it})$, which varies according to different values of Polity2 (POL_{it}), can be obtained from the expected value in the expression in Eq. 2 as the partial derivative of $\ln(SJA_{it})$ with respect to HC_{it}.

$$\partial \ln(SJA_{it}) / \partial HC_{it} = \alpha_1 + \alpha_3 POL_{it} \quad \text{.....} \quad (2.1)$$

Similarly, the effect of Polity2 (POL_{it}) on $\ln(SJA_{it})$ can be given as

$$\partial \ln(SJA_{it}) / \partial POL_{it} = \alpha_2 + \alpha_3 HC_{it} \quad \text{.....} \quad (2.2)$$

The data has been subjected to different econometric tests to identify the resilience of the results. The general method of moments (GMM) is the primary tool employed. This is because it provides more efficient econometric specification to deal with problems of cross-dependence, endogeneity, and heteroscedasticity (Greene, 2012; Hall, 2005; Doris et al., 2011). The GMM generates results with robust standard errors when cross-dependence and heteroscedasticity are present (Arellano and Bond, 1991; Arellano, 2003; Hall, 2005). It relies on internally generated instruments making it exempted from the need for external instruments. To check for robustness of the results, the linear panel econometric test of the fixed effect and random effect models were employed. The problem with these linear models is that they offer relatively weaker predictions in the existence of heteroscedasticity and cross-dependence problems (Greene, W. H. 2012). The robust standard errors (Driscoll and Kraay, 1998) developed for the fixed effects panel data model with the cross-dependence problem is applied to rectify the estimation bias (Hoechle, D., 2007).

Strategy B: In this case, the structural equation models used were based on the causal process logic to identify, the direct and indirect effects, if any, of political institutions on innovation. The specification used for the analysis is based on the empirical models of Jeroen Klomp and Jakob de Haan(2013) and Claude Diebolt & Ralph Hippe (2019). The basic specification of this model starts from Eq. 2 after consideration of the causal process in the basic variables of interest, including the interaction term. This generates the following two simultaneous equations:

$$\ln(SJA_{it}) = \theta + \alpha_1(HC_{it}) + \alpha_2(POL_{it}) + \alpha_3(HC_{it} * POL_{it}) + \alpha X_{it} + \varepsilon_{it} \quad .....(2)$$

And,

$$HC_{it} = \delta_1(POL_{it}) + \varepsilon_{it} \quad ....(2.3)$$

Thus, in order to assess the effect of Polity2 (POL_{it}) on $\ln(SJA_{it})$, its relationship to HC_{it} has to be taken into account, so that:

$$\partial(HC_{it}) / \partial POL_{it} = \delta_1 \quad .....(2.4)$$

Further, the partial derivative of Eq. 2, with respect to Polity2, (POL_{it}) gives us the total effect of Polity2 (POL_{it}) on $\ln(SJA_{it})$ as:

$$\partial \ln(SJA_{it}) / \partial POL_{it} = \alpha_1 \partial HC_{it} / \partial POL_{it} + \alpha_2 + \alpha_3(HC_{it} + \delta_1 POL_{it}) ....(2.5)$$

By substituting Eq. 2.4 into Eq. 2.5 we get:

$$\partial \ln(SJA_{it}) / \partial POL_{it} = \alpha_1\delta_1 + \alpha_2 + \alpha_3(HC_{it} + \delta_1 POL_{it}) ....(2.6)$$

This final equation indicates a direct main effect (α_2), an indirect effect $(\alpha_1\delta_1)$, the interaction effect $(\alpha_3 HC_{it})$, and a combined interaction-indirect effect $(\alpha_3\delta_1 POL_{it})$. Thus, the effect of Polity2 (POL_{it}) on $\ln(SJA_{it})$ depends on the value of HC_{it} to a greater extent than one would

expect from the interaction effect alone. This means that if we omit all the terms related to the indirect effect, we can represent the direct main and interaction effects as:

$$\alpha_2 + \alpha_1\delta_1 \text{..... ....} \quad (2.7)$$

The Data

Most of the data used in this study have been widely employed in the empirical literature that posits the role of institutions in the growth process. It relies on a panel dataset consisting of observations for 35 developing countries in sub-Saharan Africa for the period 1995–2015.Appendix TableA1lists the countries and mean values of the key variables in the sample. Countries are selected for this study primarily on the basis of availability of reliable data spanning the sample period. The dependent variable in the sample is the logged value of the index for scientific and technical journal publications; the annual value is obtained from the world development indicators and web of science citations.

The basic variables used as regressors are the measures of regime types (i.e. Polity2, Democracy, and Autocracy indices) taken from the Polity IV project and Human capital, whose value is taken from the human capital index of the Penn World Table. There are three fundamental reasons for using Polity2 as the measure of democracy. First, Polity2 is based on a comprehensive definition of democracy that includes electoral rules and various measures of the openness of political institutions; further, it provides detailed information on aspects of institutionalised democracy and autocracy in a country at any point of time (Thomas P. and Eric N., 2010). Second, the coding of Polity2 facilitates the use of the POLITY regime measure in time series analyses (Marshall, Monty G., and Keith Jaggers, 2007). Third, Polity2 considers democracy as a continuum and, hence, avoids the loss of information caused by the use of a dichotomous measure of democracy (Hadenius, A. and Teorell, J.,2005). Human capital index is based on the average years of schooling (Barro J. and Lee, 2013) and an assumed rate of return to education, based on Mincer equation estimates around the world (Psacharopoulos George, 1994). Range of macroeconomic control variables (X_{it}) including gross domestic product per capita, population size, size of urban population, investment, middle income dummy, fixed capital formation, and trade,

expressed as a percentage of the size of the economy, are used to explain cross-country differences in innovation. The summary statistics, variable description, and the source of data are presented in Table A2 of the Appendix. The correlation matrix is presented in Table A3 of the appendix.

The results in Fig. 2b–2d are based on the average values of the sampled countries over the study period (1995–2015). Fig. 2b presents Polity2 and innovation, measured as the logged value of the number of journal articles published in the sampled countries. The fitted line shows a strong positive relationship between the journal article publications and Polity2. Further, Fig. 2c shows a strong positive correlation between human capital and innovation. Fig.2d implies a strong positive correlation between Polity2 and human capital.

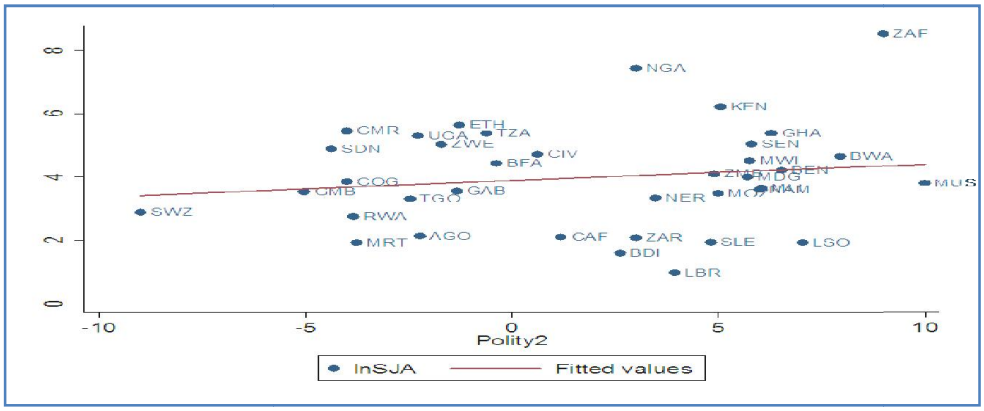

Fig. 2b: Scatter plot of Innovation vs. Polity2

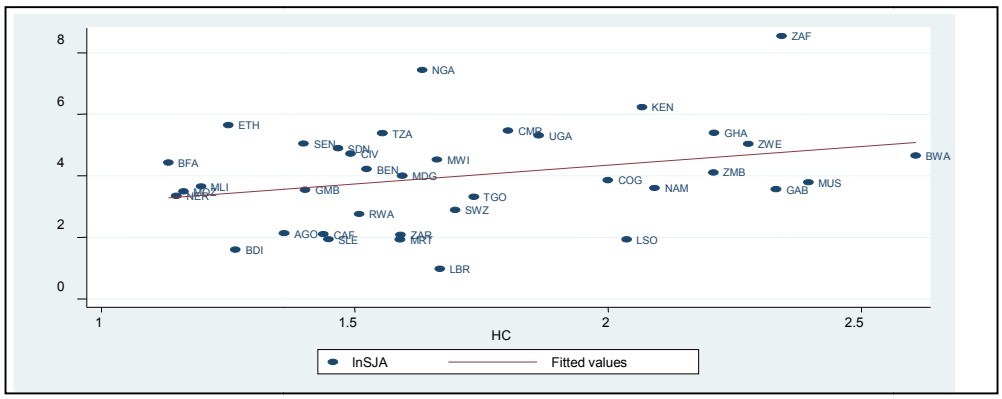

Fig. 2c: Scatter plot of Innovation vs. Human Capital

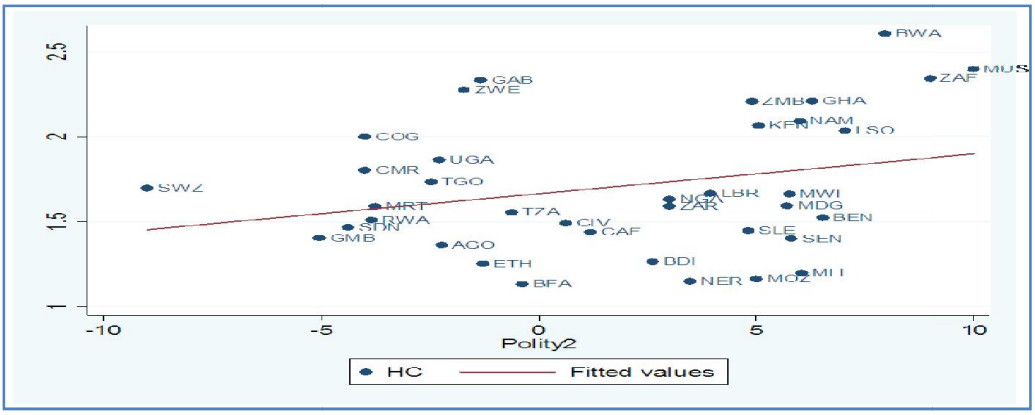

Fig. 2d: Scatter plot of Polity2 vs. Human Capital

2.7. Empirical Results

Results for Strategy A

Table 2A presents the regression results for Polity2 using the GMM regression technique. As hypothesised, democracy and human capital are important factors in determining the innovative capacity of countries. Human capital is statistically significant at the 1% level in all the models tested, while its interaction term with Polity2 has a negative sign and is insignificant. Polity2 is also statistically significant at the 5% level in all except the interaction model. Column (3), for example, tells us that a point higher in the human capital index ratio cumulatively causes innovation to increase. Similarly, the improvement in Polity2, in general, causes an increase in the level of innovation. The addition of the control variables in column (4) does not cause a noticeable change in the results. The negative coefficient on the interaction term implies that the conditional marginal effect of Polity2 is inversely proportional to the level of human capital development (see figures 2e and 2f). The insignificant coefficient on the interaction term implies that the conditional effect of democracy on innovation is not supported by the available evidence. However, the interaction term is negative for Polity2 and human capital. Table A1 in the Appendix reveals that similar findings are obtained with the use of one lagged values of human capital and Polity2.The fixed effects tests are reported in Table A4 of the Appendix.

Table 2A: Effect of Polity2 on Innovation

	GMM(IV)					GMM(*xtabond2*)	
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
$lnSJA_{-1}$						.852***	.8606***
						(.01925)	(.01879)
POL	0.0622***		0.0318***	0.0173**	0.0493	.01942**	.01998
	(0.0118)		(0.0104)	(0.0072)	(0.0354)	(.00944)	(.03559)
HC		1.6441***	1.5345***	1.4829***	1.5382***	.2076**	.19508**
		(0.14535)	(0.1354)	(0.1833)	(0.0222)	(.1051)	(.109801)
POL* HC					-0.0183		.011856
					(0.0186)		(.01942)
lnGDPPC				-0.0192	-0.0117	.06485	.06288
				(0.1284)	(0.1297)	(.1281)	(.13231)
lnPOP				0.3629**	0.3503**	.1786**	.09211
				(0.1641)	(0.1623)	(.07579)	(.06248)
lnEMP				0.1003	0.1008	-.04262	.0552696
				(0.1217)	(0.1214)	(.08756)	(.07285)
lnUPOP				0.5062***	0.4944***	.0896*	.071695
				(0.1291)	(0.1325)	(.05155)	(.05315)
lnTRD				-0.9705***	-0.9870***	-.1234**	-.07359
				(0.1298)	(0.1312)	(.05936)	(.05917)
lnFCF				0.3258***	0.3231***	.0621*	.07119**
				(0.0971)	(0.0967)	(.03774)	(.03753)
lnCK				0.5325***	0.5431***	.00706	-.00451
				(0.1190)	(0.1174)	(.09301)	(.09301)
MID				0.0831	0.0837	-.02566	.00372
				(0.1396)	(0.1379)	(.07298)	(.07239)
_cons	3.7844***	1.1062***	1.2384***	-17.786***	-17.803***	-2.553***	-2.501***
	(0.0613)	(0.2417)	(0.2299)	(1.1887)	(1.1892)	(.5411)	(.54113)
Wald chi2(1)	27.93	127.93	131.59	2042.49	2248.86	11002.58	10973.81
(Prob> chi2)	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared;	0.0355	0.1427	0.1513	0.6807	0.6810		
Root MSE	1.7188	1.6205	1.6123	0.99245	.99188		
AR(1)						-14.26	-14.27
AR(1)						5.96	6.00
Sargan overid.						237.00	240.40
N(Obs)	723	723	723	712	712	669	669

*lnSJA: log of scientific and technical journal articles index; l.lnSJA: lagged value of log of scientific and technical journal articles index; POL: polity2 index; HC: human capital, POL*HC: interaction term for polity2 and human capital; lnGDPPC: log of GDP per capita; lnPOP: log of population size; lnEMP: log of total employment in personnel; lnUPOP: log of urban population; lnTRADE: log of trade as percentage of GDP; lnFCF: log of fixed capital formation, lnCK: log of stock of capital in investment; MID: middle income country dummy*

*Notes: Regression results for the system (gmm) are obtained by Arellano-Bond dynamic panel-data estimation of first-difference equations using generalized method of moments (GMM). All available lagged values of the dependent variables in each previous time period are used as instrumental variables in first-differencing. ***, **, * indicates significance at $\rho < 0.01$, $\rho < 0.05$ & $\rho < 0.1$ respectively.*

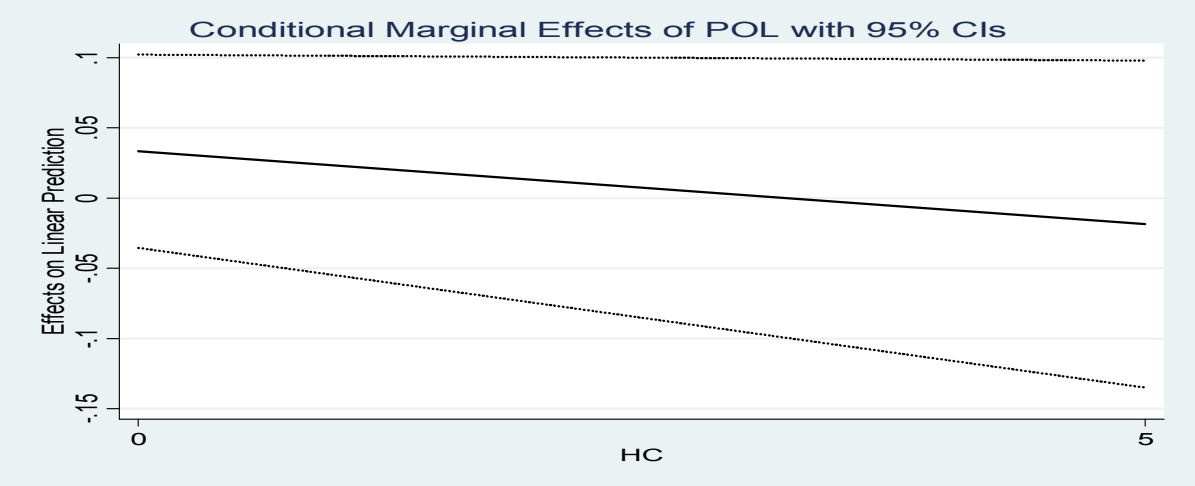

Fig 2e: Conditional Marginal Effects polity2: Control Variables added

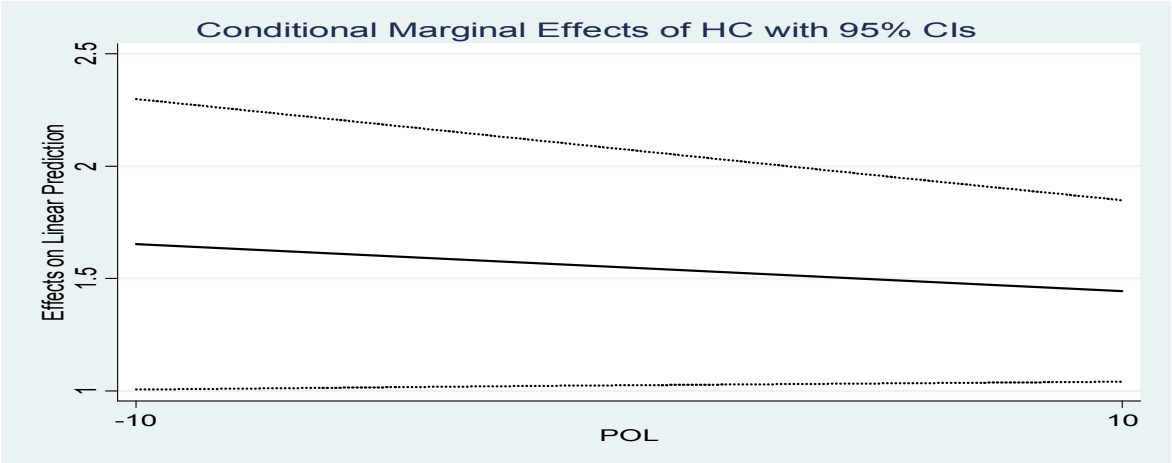

Fig.2f: Conditional Marginal Effects of human capital: Control Variables added

Table 2B presents the results of the GMM estimation for democracy and autocracy scores as measures of political institutions. Democracy and human capital, which have strongly significant coefficients at the 1% level, appear to be positively associated with innovation. Column (4), for example, indicates that an increase in the democracy score generates improvement in innovation. Similarly, an increase in human capital is generally associated with an improvement in innovation. Turning to the interaction term between democracy and human capital, it is observed that its coefficient is negative and statistically insignificant, signifying that the marginal conditional effects of these two explanatory variables are inversely proportional (seeFigs.2g, 2h, 2i, and 2j).

Turning to autocracy as the regime type, the results indicate that human capital development enhances innovative capacity, while a rise in the autocracy score tends to adversely affect cross-country differences in innovation. The findings in column (4) suggest that an increase in human capital development is generally associated with an improvement in innovative capacity. In contrast, an increase in the autocracy score is generally associated with a decrease in innovative capacity. The positive coefficient in the interaction model signifies that the marginal effects of the two main explanatory variables on innovation are directly proportional. The results in column (5) suggest that an increase in the autocracy score is generally associated with an increase in cross-country differences in innovation, provided human capital increases too. By the same logic, an increase in human capital is, on average, associated with an increase

in innovation, given that the autocracy score also increases by one point. The general trend that emerges from the interaction model is that the marginal effects of the two main explanatory variables (autocracy and human capital) are directly proportional (see: Figs. 2g, 2h, 2i, and 2j). However, the insignificant coefficients on the interaction terms show that the assumption is not actually supported by the data. Similarly, the marginal effects in Figs. 2g and 2h, where the confidence interval never seems to fall within the commonly accepted significance thresholds, does not support the assumption of the conditional effect of institutions. The findings for lagged values of democracy/autocracy and human capital are presented in Table A5 and Table A6, respectively, of the Appendix. The fixed effects tests for the democracy and autocracy scores are reported in Table A8 of the Appendix.

Table 2B: Effect of democracy - autocracy on innovation

General Methods of Moments(GMM)										
Political Institution: Democracy										
Political Institution: democracy						**Political Institution: Autocracy**				
	GMM(IV)			GMM(*xtabond2*)		GMM(IV)			GMM(*xtabond2*)	
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
$lnSJA_{-1}$				.8421***	.8573***				.8509****	.8532***
				(.01985)	(.01859)				(.01892)	(.01893)
DEM;ATR	0.051**	0.042***	0.051***	.0288**	.05587	-0.111***	-0.036*	-0.038*	-.04178**	-.05185
	(0.018)	(0.012)	(0.015)	9.0149)	(.05816)	(0.022)	(0.020)	(0.021)	(.01936)	(.07849)
HC	1.51***	1.456***	1.483***	.3086**	.15191**	1.528***	1.514***	1.512***	.2133**	.21664*
	(0.131)	(0.184)	(0.190)	(.1255)	(.10861)	(0.141)	(0.183)	(0.184)	(.10058)	(.11421)
INTR			-0.005		-.031193			0.001		.027479
			(0.003)		(.03097)			(0.003)		(.045015)
lnGDPPC		-0.025	-0.026	.1509**	-.008005		-0.045	-0.045	.18373	.15759
		(0.133)	(0.133)	(.06803)	(.13016)		(0.130)	(0.131)	(.12858)	(.12922)
lnPOP		0.367**	0.365**	-.06325	.09689		0.368**	0.368**	.2269***	.12129*
		(0.156)	(0.155)	(.08531)	(.0608)		(0.182)	(0.182)	(.08195)	(.06783)
LnEMP		0.090	0.089	.13242	.01947		0.075	0.075	-.00988	.08096
		(0.118)	(0.111)	(.05679)	(0.0735)		(0.142)	(0.142)	(.08358)	(.07304)
LnUPOP		0.5368**	0.530***	-.1449**	.08927*		0.5058**	0.506***	.05573	.04082
		(0.131)	(0.131)	(.06151)	(.05129)		(0.131)	(0.132)	(.04945)	(.05148)
lnTRD		-1.02***	-1.01***	.0652	-.07442		-0.97***	-0.97***	-.11508**	-.10373*
		(0.130)	(0.131)	(.03795)	(.06037)		(0.134)	(0.134)	(.05766)	(.05995)
lnFCF		0.309***	0.311***	.0652*	.07801**		0.329***	0.328***	.06606*	.07445**
		(0.0972)	(0.097)	(.03795)	(.03796)		(0.0979)	(0.0981)	(.03759)	(.03781)

lnCK		0.535***	0.536***	.06889	.03558		0.550***	0.551***	-.07994	-.05991
		(0.120)	(0.120)	(.09448)	(.09355)		(0.120)	(0.120)	9.09313)	(.09272)
MID		0.066	0.070	.00297	.01458		0.097	0.096	-.057002	-.024812
		(0.140)	(0.140)	(.07202)	(.072046)		(0.139)	(0.140)	(.07476)	(.07323)
_cons	1.15***	-17.66***	-17.6***	-2.856***	-2.537***	1.55***	-17.6***	-17.6***	-2.289***	-2.388***
	(0.234)	(1.186)	(0.19)	(.54459)	(.55891)	(0.240)	(1.217)	(1.220)	(.54581)	(.56759)
Wald chi^2	135.68	2111.12	2112.42	11080.94	11003.89	135.02	2050.06	2142.56	10977.29	10965.13
Prob>chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.1505	0.6829	0.6831			0.1643	0.6801	0.6801		
Root MSE	1.6152	.99029	.98998			1.6021	.99469	.99468		
AR(1)				-14.18	-14.44				-14.29	-14.30
AR(1)				5.94	6.03				5.94	5.99
Sargan ovd.				239.82	241.11				234.90	239.09
N(Obs)	719	708	708	668	668	719	708	708	668	668

lnSJA: log of scientific and technical journal articles index; l.lnSJA: lagged value of log of scientific and technical journal articles index; POL: polity2 index; HC: human capital, INTR: interaction term for democracy /autocracy and human capital; lnGDPPC: log of GDP per capita; lnPOP: log of population size; lnEMP: log of total employment in personnel; lnUPOP: log of urban population; lnTRADE: log of trade as percentage of GDP; lnFCF: log of fixed capital formation, lnCK: log of stock of capital in investment; MID: middle income country dummy

*Notes: Regression results for the system (gmm) are obtained by Arellano-Bond dynamic panel-data estimation of first-difference equations using generalized method of moments (GMM). All available lagged values of the dependent variables in each previous time period are used as instrumental variables in first-differencing. ***, **, * indicates significance at $\rho < 0.01$, $\rho < 0.05$ & $\rho < 0.1$ respectively.*

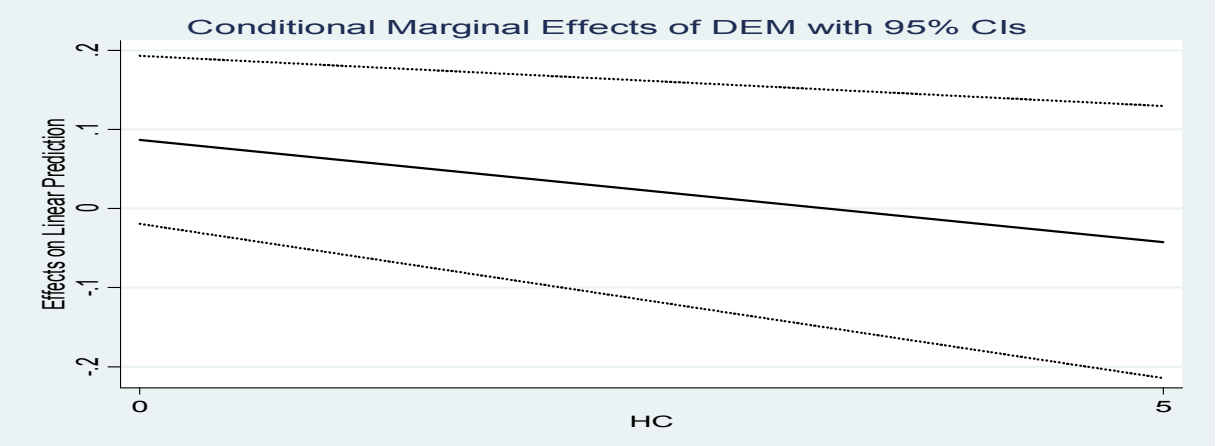

Fig.2g: Conditional Marginal Effects of democracy: control variables added

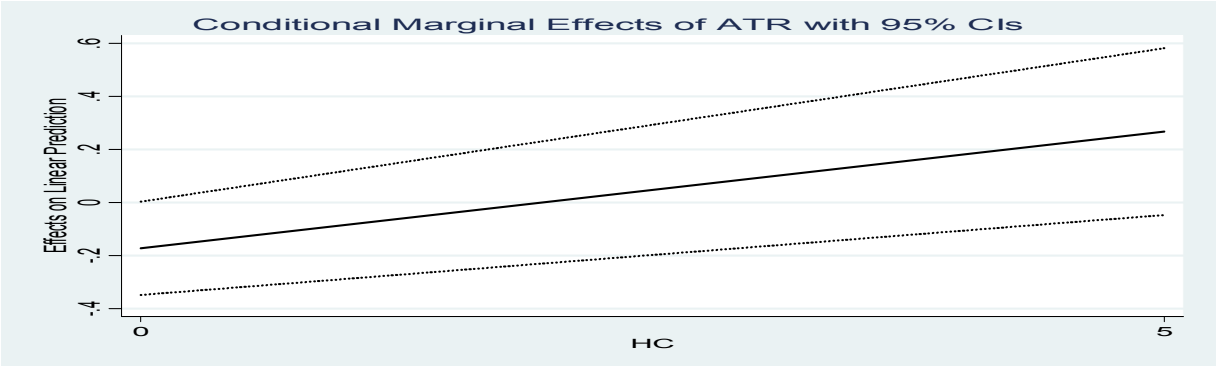

Fig. 2h: Conditional Marginal Effects of Autocracy: control variables added

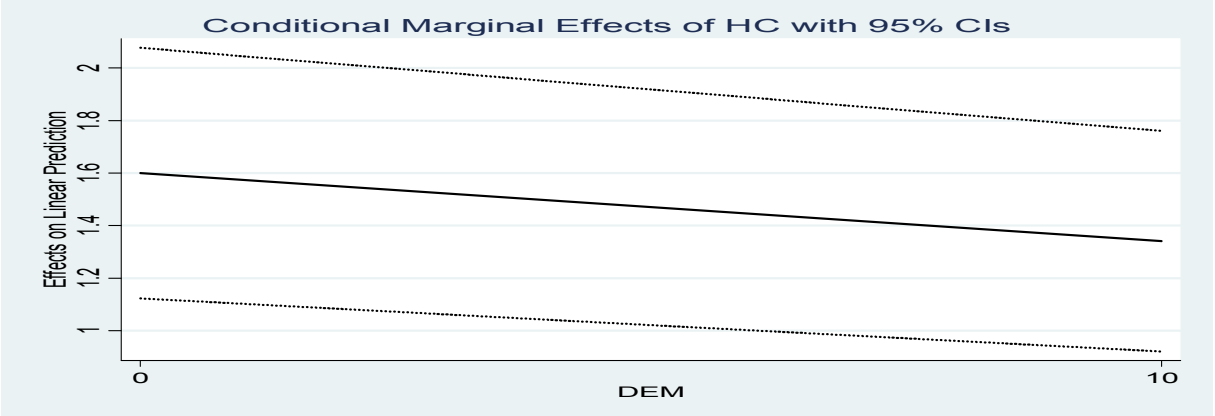

Figure 2i: Conditional Marginal Effects of Human Capita: control variables added

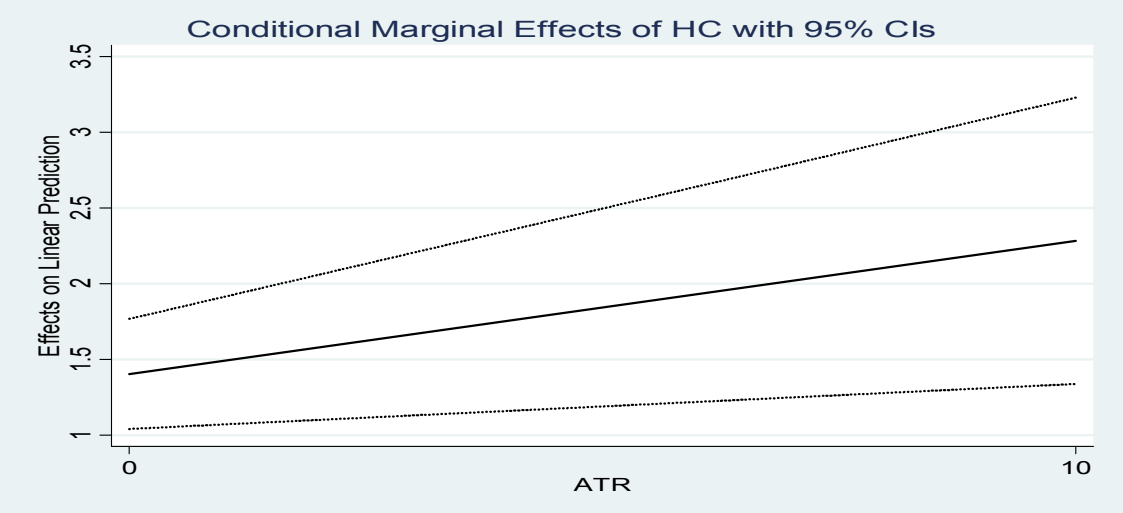

Figure 2j: Conditional Marginal Effects of Human Capital: control variables added

Structural Equation Models

Table 2C presents the results of the structural equation models, where the political institution is classified according to the value of the Polity2 score. The results of the basic model–model (1)–have a positive coefficient, as expected, that is significant at the 1% level and confirm that political institutions have an effect on human capital. As expected, the impact of human capital on innovation is also confirmed–the coefficient has a positive sign and is significant at the 1% level. These results corroborate the strong evidence for the indirect effect of political institutions on innovation. The findings confirm those of earlier studies on the effect of political regimes on human capital development in sub-Saharan Africa (Bossuroy, T., and D. Cogneau., 2013).

When the interaction term and the covariates are added to the model (i.e. model [3]), the results reported above do not change; however, the direct effect is significant only at the 10% level. The interaction between political institutions on human capital has the expected positive sign and is significant at 1%. The effect of human capital on innovation is also confirmed because the coefficient has a positive sign that is highly significant. Hence, the indirect impact of political institutions on innovation is supported with evidence. The coefficient on the interaction term is found to be negative and insignificant, thereby confirming results of the linear models. The negative coefficient implies that the conditional marginal effect of Polity2 on the human capital development index is inversely proportional. The evidence analysed provides strong support for the direct and indirect impact of political institutions on innovation. Table A7of the Appendix shows that these results hold when the time period for the main independent variables are varied jointly, as well as separately, to account for possible lags in the effect of democracy on human capital.

Table 2C: Dependent Variable: Scientific Journal Articles		
Estimates of Structural Equation Models		
Political Institution: Polity2		
(1)	(2)	(3)

Variable	Coef.	Z	Coef.	Z	Coef.	Z
HC <-						
POL	0.0198***	7.23	0.0212***	7.69	0.0207***	7.52
	(0.0028)		(0.0028)		(0.0028)	
_cons	1.6592***	123.43	1.6615***	123.66	1.6634***	123.2
	(0.0134)		(.01344)		(0.0135)	
lnSJA <-						
HC	1.5345***	11.33	1.4651***	7.96	1.5382***	7.60
	(0.1355)		(.18395)		(0.2023)	
POL	0.0318***	3.06	0.0153**	2.14	0.0493*	1.39
	(0.0104)		(0.00713)		(0.0354)	
POL*HC					-0.0183	-0.98
					(0.0187)	
lnGDPPC			-0.0102	-0.08	-0.0117	-0.09
			(0.1287)		(0.1298)	
lnPOP			0.3467**	2.11	0.3503**	2.16
			(0.1643)		(0.1624)	
lnEMP			0.1273	1.05	0.1007	0.83
			(0.1211)		(0.1215)	
lnCK			0.5335***	4.47	0.5431***	4.62
			(0.1195)		(0.1175)	
lnFCF			0.3478***	3.66	0.3231***	3.34
			(0.0949)		(0.0967)	
lnUPOP			0.4919***	3.82	0.4944***	3.73
			(0.1288)		(0.1326)	
lnTRD			-0.9647***	-7.39	-0.987***	-7.52
			(0.1305)		(0.1313)	
MID			0.0781	0.56	0.0837	0.61
			(0.1404)		(0.1380)	
_cons	1.2384***	5.38	-17.949***	-15.22	-17.8025	-14.96
	(0.2301)		(1.1796)		1.1901	
R2(HC)	0.0683		0.0691		0.075	
R2(lnSJA)	0.1513		0.717		0.6817	
log likelihood	-3945.1		-7433.6106		-8870.35	
Wald χ^2(HC)	52.28***		59.16		56.56***	
Wald χ^2(lnSJA)	131.40***		2055.55		2245.70***	

N(Obs)	723	718	712

, , *** indicate significance at 10%, 5% and 1% levels respectively; robust standard errors in brackets*

*lnSJA: log of scientific and technical journal articles index; l.lnSJA: lagged value of log of scientific and technical journal articles index; POL: polity2 index; HC: human capital, POL*HC: interaction term for polity2 and human capital; lnGDPPC: log of GDP per capita; lnPOP: log of population size; lnEMP: log of total employment in personnel; lnUPOP: log of urban population; lnTRADE: log of trade as percentage of GDP; lnFCF: log of fixed capital formation, lnCK: log of stock of capital in investment; MID: middle income country dummy*

Table 2D presents the results when the basic components of Polity2 (i.e. democracy and autocracy) are used as measures of political institutions. As expected, the Democracy score has a positive sign that is statistically significant at the 1% level in both the basic and preferred models. Both the basic model, that is, model (1), and the preferred model (2) confirmed the positive and statistically significant effect of democracy on human capital development. Similarly, the impact of human capital on innovation is also confirmed by the expected positive sign; further, it is statistically highly significant. As a result, the indirect and positive impact of democracy on innovation via human capital is confirmed. The interaction term for democracy has a negative coefficient, but is statistically insignificant, thereby confirming the results of the preceding econometric tests.

Autocracy score is with negative sign and statistically significant at the 1% level. The result reveals that autocracy negatively affects human capital. However, human capital positively affects innovation with high statistical significance at the 1% level. Hence, the indirect impact of autocracy on innovation is confirmed to be negative. The direct effect of autocracy on innovation is dependent on the interaction term, which has a positive but statistically insignificant coefficient. This implies that the marginal conditional effect of autocracy on innovation increases is directly proportional to the human capital development index score. The findings obtained on varying the time periods for the main independent variables are presented in Tables A9 and A10 in the appendix for democracy and autocracy, respectively.

The results in these tables revealed that the interaction term is significant and negative for democracy, while it is positive and significant for autocracy.

Table 2D: Dependent Variable: Scientific Journal Articles						
Estimates of Structural Equation Models						
	Political Institution: Democracy			**Political Institution: Autocracy**		
Variable	*(1)*	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
HC <-						
DEM/ATR	0.0404***	0.0425***	0.0419***	-0.0303***	-0.0337***	-0.0324***
	(0.0045)	(0.00454)	(0.0046)	(0.0056)	(0.00568)	(0.00567)
_cons	1.5436***	1.5409***	1.5443***	1.7605***	1.772***	1.7702***
	(0.01762)	(0.01778)	(0.0179)	(0.0229)	(0.0230)	(0.0231)
lnSJA <-						
HC	1.5099***	1.437***	1.4827***	1.5276***	1.494***	1.5119***
	(0.1312)	(0.1845)	(0.1901)	(0.1406)	(0.1839)	(0.1843)
DEM/ATR	0.0507***	0.0385***	0.0513***	-0.11083***	-0.0299**	-0.0377*
	(0.0184)	(0.0117)	(0.0149)	(0.0222)	(-0.0195)	(0.0213)
INTR			-0.0052			0.00094
			(0.0033)			(0.00272)
lnGDPPC		-0.0146	-0.0261		-0.0352	-0.04453
		(0.1333)	(0.1332)		(0.1309)	(0.1307)
lnPOP		0.3542**	0.3645**		0.3453*	0.3679**
		(0.1564)	(0.1554)		(0.1812)	(0.1821)
lnEMP		0.1141	0.0891		0.1102	0.0752
		(0.1176)	(0.1182)		(0.1383)	(0.1403)
lnCK		0.5336***	0.5358***		0.5485***	0.55062***
		(0.1204)	(0.1197)		(0.1201)	(0.11962)
lnFCF		0.3329***	0.3108***		0.3495***	0.32814***
		(0.09503)	(0.0973)		(0.0956)	(0.09815)
lnUPOP		0.5205***	0.536***		0.4914***	0.50551***
		(0.13073)	(0.131)		(0.1307)	(0.13151)
lnTRD		-0.9962***	-1.0088***		-0.9646***	-0.9725***
		(0.1302)	(0.1305)		(0.1342)	(0.134197)
MID		0.0598	0.0697		0.09186	0.0957
		(0.1406)	(0.1399)		(0.1406)	(0.139715)
_cons	1.1482***	-17.82901	-17.633***	1.5505***	-17.84***	-17.636***

	(0.2344)	(1.1782)	(1.1909)	(0.240)	(1.2021)	(1.2212)
R^2(HC)	0.1065	0.1179	0.1148	0.0317	0.0394	0.03653
R^2(lnSJA)	0.1505	0.6845	0.6826	0.1643	0.6833	0.67970
log likelihood	-3558.730	-7041.1489	-9108.590	-3352.591	-6796.654	-8832.178
Wald χ^2(HC)	79.57***	87.62	84.44***	28.93***	35.22***	32.68***
Wald χ^2(lnSJA)	135.49***	2110.32	2109.44***	134.83***	2078.3***	2139.53***
N(Obs)	719	708	708	719	708	708

, , *** indicate significance at 10%, 5% and 1% levels respectively; robust standard errors in brackets*

lnSJA: log of scientific and technical journal articles index; l.lnSJA: lagged value of log of scientific and technical journal articles index; POL: polity2 index; HC: human capital, INTR: interaction term for democracy /autocracy and human capital; lnGDPPC: log of GDP per capita; lnPOP: log of population size; lnEMP: log of total employment in personnel; lnUPOP: log of urban population; lnTRADE: log of trade as percentage of GDP; lnFCF: log of fixed capital formation, lnCK: log of stock of capital in investment; MID: middle income country dummy

2.8. Discussion and Conclusion

This chapter aims to contribute to the literature concerning the dynamics between political institutions, particularly regime types, human capital formation, and innovation in developing countries. It relies on empirical panel data set from 35 countries in sub-Saharan Africa. As expected, democracy is confirmed to be positively associated with innovation in developing countries, while autocracy is found to adversely affect innovative capacity of nation states. Democratic development is confirmed to positively impact innovative capacity directly and indirectly, through its impact on human capital development. The finding confirms prior empirical studies that democracy improves overall economic performance (Przeworski et al., 2000), and stimulates human capital accumulation (Baum and Lake, 2003).Taking into consideration the results of the previous studies (North, 1990; Acemoglu et al., 2001; Hall and Jones, 1999; Rodrik et al., 2004), this suggests that improvements in freedom—basic political and civil liberties — is essential to foster innovative capacities of developing countries. This is because democracy's protection of freedoms of basic political and civil rights offers ways for

countries to harness their innovative capacity. That is, democracy entails decentralisation that promotes not only the creation of knowledge, but also its diffusion. Siegle, Joseph T., etal.(2004) affirm that 'democracies are open: they spur the flow of information and free flow of ideas, every bit as much as the flow of goods, fosters efficient, customised, and effective policies'. As a result, decentralised systems successfully encourage creativity and innovation, something that their centralised counterparts cannot do owing to their restrictions on political and civil liberties. Democracy also promotes the free flow of information among economic agents and this possibly contributes to innovation because the information networking could lead to emergence of new ideas and innovations. The available evidence strongly supports the view that the practices of nation states to improve human capital formation at the national level play a critical role in bringing about technological change in developing countries. The finding is consistent with those of preceding studies related to human capital and innovation (Dakhli & De Clercq, 2004; Gradstein, 2004; Annelies van Uden et.al, 2016). Thus, the improvement of human capital formation provides a better knowledge infrastructure for developing countries. This knowledge infrastructure is useful to foster creativity and innovation—a key factor for technological change and economic prosperity. Overall, the results suggest that developing countries need to focus on democratic institutionalisation, as well as investment in human capital formation through education, research, and training.

The result is consistent with available facts concerning democratic development and innovation in the economies of sub-Saharan Africa. For instance, the global innovation index indicates that since 2012, most countries among the group of innovation achievers have been from sub-Saharan Africa (Cornell University et al., 2018). Developments in institutions and business sophistication has played a major role in helping the region as a whole to catch up with Central and Southern Asia in terms of innovation. Armed by the institutional progress observed in economies such as South Africa, Mauritius, Botswana, Namibia, Rwanda, and Burkina Faso (Cheeseman Nic, 2015), sub-Saharan Africa had its highest scores in institutions and market sophistication in 2017(Cornell University et al., 2018). While large-sized economies, such as South Africa, Kenya, Botswana, and Namibia expanded their investment in infrastructure development, others such as Mauritius, Rwanda, Senegal, and Zimbabwe are achieving progress in innovation through investment in human capital development (ibid). However, sub-Saharan Africa is the least innovative region in the world, despite the strong

performance of individual countries such as South Africa, Mozambique, Mauritius, Kenya, Rwanda, Malawi, and Botswana (Cornell University et al., 2018). In terms of democratisation, The Economist Intelligence Unit's democracy index awarded full-democracy status only to Mauritius (Democracy Index, 2017). The bulk of African countries are identified either as hybrid regimes or authoritarian. For instance, three of the five countries at bottom of the list of the democracy index (i.e. Chad, the Central African Republic, and the Democratic Republic of Congo are from sub-Saharan Africa. These are also identified as the least innovative countries of the region (Cornell University et al., 2018). The literature on Africa provides strong evidence that substantial proportion of the continent is democratising although many countries are half way between democracy and authoritarianism (Cheeseman Nic, 2015). For instance, the 2016 report on Freedom in the World indicates that only a quarter of the African states can be regarded as free; these include Mauritius, Namibia, Senegal, Benin, Botswana, Cape Verde, Ghana, and South Africa(Freedom House, 2017). These countries are likely to continue to make democratic gains and consolidate them over time but there is a risk of backlash owing to poor institutionalisation (Cheeseman Nic, 2015). However, there is a large group of African states, such as Burundi, the Democratic Republic of Congo, Kenya, Uganda, and Zimbabwe, where leaders with authoritarian inclinations are still attempting to hold out against increasingly confident and popular opposition parties (ibid). These countries are expected to experience authoritarian repression before a democratic breakthrough is achieved. In countries such as Cameroon, Chad, Uganda, Rwanda, and Ethiopia authoritarian governments had, until recently, established strong control over their political systems and so had little fear of elections. Nic Cheeseman affirms that the great authority wielded by leaders in these countries boosts the tendency to think of this group as belonging to the stable authoritarian category. Available evidence reveals that democratisation in sub-Saharan Africa has distinctive regional divergence. Southern and West Africa has significantly improved their democratic governance, but Central and East Africa have suffered major setbacks (Temnin John, 2018).

The negative coefficient on the interaction term of human capital with democracy, and the positive coefficient on the term for autocracy though insignificant suggest that, for developing countries, the impact of human capital on innovation could be better under autocracy than under democracy. The results from the interaction terms in the basic models do not support the conditional effect of democracy/autocracy on innovation. The opposite signs on the

coefficients of the interaction term in the models for human capital and democracy/autocracy warrant an explanation. It could be because of the fact that democracies face severe challenges in developing countries at early stages of their development (Lipset, 1959; Miller et al., 1996; Aslund et al., 2001; Dewatripont and Roland, 1992; Roland, 2001). First, democracies in developing countries face a severe challenge in exercising their discretionary power to allocate a budget for ensuring human capital formation. The rampant poverty, along with voters' ignorance, could guide them to vote for policies that are focused on short-term outcomes. It is clear that the outcome of investment in human capital development can only be observed in a meaningful way in the long term (Baldacci et.al, 2008). Second, people in democracies are free to make choices and these individual-level choices could lead to sub-optimal outcome at the social level. This problem is even pronounced in a context where there are supply-side constraints in human capital allocation—something commonly found in developing economies. Third, young democracies are weaker in governance than consolidated autocracies (Moyo D., 2012). The relatively rudimentary nature of democratic regimes in the African continent and their differences in terms of the overall instability of institutions might have influenced the relationships addressed in this study. For instance, a close look at the data used in this study indicates that the average Polity2 score ranges between -5 and 5 for countries in the sample, with some exceptions (i.e. Botswana, Benin, Mali, Lesotho, Senegal, and South Africa).This implies that most African countries have mixed regimes, with some elements of democracy mixed with strong autocratic features. Mixed regimes are essentially more unstable and prone to disturbances than either full democracies or full autocracies because of their low level of institutionalization (Gates et. al, 2006). On the other hand, autocracies could use their discretionary power for both investments in human capital and planned allocations. While self-serving authoritarian regimes are known for undermining human capital development (Feng Y., 2003), conservative autocrats with clear commitment to development and some sort of legitimacy tend to invest in human capital formation (Ames Barry, 1987). That is, authoritarian systems with planned participatory socialism could promote human capital development to achieve social and economic transformation (Davin Patt, 1988; Devine, 1988; Albert and Hahnel; 1991; and Cockshott and Cottrell; 1993). However, the insignificant coefficients in the interaction terms in the basic models imply that the assumption of the conditional effects of political institutions on innovation is not supported with evidence. Moreover, the coefficients

of the interaction terms are very low with very high standard errors. Hence, future research should examine situations under which democracy promotes and autocracy obstructs the effect of human capital on innovation. Moreover, additional research must examine how and why democratic development bolsters and reinforces the effect of human capital on innovation in developing economies. These questions are particularly important given that, for many scholars in the field, political institutions in sub-Saharan Africa have rarely been anything other than disappointing at best, and prone to systemic abuse of power, highly politicized, and treacherous at worst.

Chapter Three

Does Governance Quality Promote Innovation In Sub-Saharan Africa?

An Empirical Study across 37 Countries

3.1. Introduction

There are four fundamental reasons for conducting this investigation the nexus of governance quality and innovation. (1) the growing level absolute poverty in sub-Saharan Africa, the role of innovation in reduction of poverty, and the power of the quality of governance institutions in improvement of innovative capacity of states; (2) the existence of gaps and contentious arguments in the literature on the nexus of innovation and quality of governance institutions;(3) the development of new paradigms in the conceptualization and measurement of quality of governance institutions; and (4) the need to identify the direct and indirect effects of quality of governance institutions in the modeling exercises to present more nuanced policy implications.

First, over the last 30 years, absolute poverty has increased in Africa contrary to its sharp decline at the global level (from about 40% to under 20%). For instance, the 2015 World Bank report on Millennium Development Goals (MDGs) revealed that extreme poverty has been significantly decreased in all regions of the world, save sub-Saharan Africa. In sub-Saharan African countries the percentage of people living in absolute poverty has barely fallen. Still today, over 40% of people living in sub-Saharan Africa live in absolute poverty and the number of people living in absolute poverty has been increasing (Asongu, 2017a). Poverty across the continent may be lower than what current estimates suggest, though the number of people living in extreme poverty has grown substantially since 1990, according to the latest World Bank Africa poverty report (Kathleen et al., 2016). For many countries in sub-Saharan Africa multidimensional poverty has been decreasing, while income poverty has increased since 1990(Sabina Alkire et al., 2017). Over all, poverty rate for sub-Saharan Africa did decline, although overall number of poor went up due to demographic growth. This increase in the number of poor is in a complete contradiction with the recent narrative that, for over a decade, Africa has been rising with spectacular economic growth resurgence (Asongu, 2017a; Fosu, 2015b). Despite an overall picture of economic growth for the

continent, some Africans are being left behind. Two-thirds of the United Nations 'least developed countries' (classified as those at risk of remaining poor) are in Africa. Furthermore, innovation has been documented to be important in mitigating absolute poverty (Drucker, 1985; Schumpeter, 1934; Romer, 1990; Bornstein D, 2003; Patrick J., 2009; G. D. Bruton and D. J. Ketchen Jr., 2013; P. J. Robson and H. M. Haugh, 2009; A. Kanitkar, 1994), and the quality of governance institutions also influences innovation in developing countries (Aghion et al.,2009; Rudolf Sivak et al., 2011; Olson Mancur,1996; Rivera-Batiz, F., 2002).

The existing literature somehow documented the mechanisms through which quality of governance institutions affects nations' innovation capacity including the direct channel and indirectly via its impact on human capital development. Firstly, governance quality directly improves the policy environment thereby creating a better situation that can spur creativity and innovation. Secondly, quality of governance institution is instrumental in the development of human capital (Acemoglu et al., 2005; Castello-Climent, 2008; Jeroen and Jakob de, 2013) and human capital is, at the same time, the key factor that explains cross-country variation in innovation (Bourdieu, 1986; Maskell and Malmberg, 1999; Zahra & George, 2002; Dakhli & De Clercq, 2004; Mason et al., 2012). This implies that, the improvement in quality of governance institutions can enable countries with low levels of innovation to catch up with their counterparts with higher levels of innovativeness in two ways: directly by harnessing the policy environment that motivates innovation and indirectly through its positive impact on human capital formation.

Second, the governance quality—innovation nexus is still subject matter for academic and policy debates. Consequently, despite the theoretically hypothesized positive effect of quality of governance institutions on innovative capacity of countries, disagreements are noticeable in the limited literature on the role of governance institutions on innovation. For instance, Rudolf Sivak et al. (2011) have established that good governance has a strong positive impact on innovation. Furthermore, various studies have confirmed the importance of governance in terms of explaining cross-country differences in innovation (Ayyagari et al., 2007; World Bank, 2008; OECD 2010b). From theoretical perspective the nexus of innovation—governance institutions such as property right and the rule of law has been suggested (Grossman and Helpman, 1991). The existing literature also notes that the

capacity to ensure contract enforcement through an effective and independent legal system improves innovation (Rose-Ackerman, 2001; Baumol, 1990; Caselli and Coleman, 2001). On the other hand, there exists another strand of the literature, though very few that suggest the reverse, might be the case. In this lieu the OECD (2010a) notes the contentious effect of the strength of bankruptcy laws on innovation. Bankruptcy laws characterized by stringent rules may obstruct entrepreneurial development since they imply greater burden on innovators in the event of failure.

Third, the conceptualization of governance institutions has evolved in recent literature (North, 1990; Engerman and Sokoloff, 1997; Furubotn and Richter, 2005; Kaufmann et al., 2005). However, the idea of governance has been used without a complete conceptualization and measurement. For instance, "control of corruption" which is only one dimension of governance institution, has been employed by Kangoye (2013) as an indicator of governance. In contrast, the existing literature has also been relying on the notions of institutional, political, economic, and general governances without explicitly measuring it (Kaufmann et al. 2007a, 2007b). This problem of conceptualization and measurement of governance institutions has resulted in contentious and often inconsistent findings in empirical literature (Asongu, 2017). For instance it is conceptually flawed to use the term general governance unless it translates a composite variable that is composed of the different aspects of governance: voice and accountability, political stability/nonviolence, the rule of law, control of corruption, government effectiveness and regulation quality. The current paper deals with these conceptual flaws by employing a single composite general governance index constructed from these six different aspects of governance institutions by applying principal component analysis. The paper also treats each of the six governance indicators independently in the estimation of the impact of government quality on cross-country variation in innovation to empirically identify essential dimensions of governance quality that foster national innovation system.

Finally, it is essential to identify the direct and indirect channels via which governance quality influences innovation in the assessment of the innovation—governance quality nexus because comprehensive innovation—governance policies are not very likely to be effective unless they are cognizant of the various ways through which governance interacts with innovation and tailored differently across countries with different levels of governance

quality.

Given this backdrop, the current paper aims to contribute to the literature by empirically assessing the impact of governance quality on innovation. To this end, a comprehensive concept of governance is employed along with its particular components in the context of developing countries in sub-Saharan Africa.

3.2. Theory and Hypothesis

Hypothesis-1 below affirms that cross-country differences in quality of governance institutions are instrumental in explaining variation in innovation across countries. This claim is rooted in the fact that better governance institutions create amicable environment for creativity and entrepreneurial development, thereby nurturing innovation and economic development (Rudolf Sivak et al., 2011; Grossman and Helpman, 1991; North, 1990). Conversely, poorly governed countries are likely to be weak in their innovation performance. For Example, Sivak et al.(2011) offered empirical evidence that bureaucracy, in the form of permits posing a problem on firms, can deter firms from innovating themselves, moving them towards the licensing of foreign technology, and corruption deters research and development. However, Ayyagari et al. (2007) empirically confirmed that governance quality is a very important factor that explains cross-country differences in innovation capacity. The existing literature suggests that governance aspects such as the capacity to ensure contract enforcement through an effective and independent legal system—the prevalence of the rule of law—improves innovativeness (Rose-Ackerman, 2001; Baumol, 1990; Caselli and Coleman, 2001).

Institutional theory suggests that a county's political, legal, social, and cultural institutions not only influence its economy, but also characterize the basic features of its economy (North, 1990; Acemoglu et al., 2002; Hall and Jones, 1999; Rodrik et al., 2004). The literature in growth theory has been increasingly affirming the importance of quality institutions in harnessing economic performance (Rodrik et al., 2004; Easterly and Levine, 2003; Hall and Jones, 1999). In light of these theoretical explanations, empirical inquiries found strong positive association between innovative capacity of a country and the quality of its institutions (Sala-i-Martin, 2002; Morck, R., et al., 2001). For example, Sala-i-Martin

(2002) underscored that "it is hard to come up with new and better technologies if an economy does not have the right institutions" (p. 18). This is due to the fact that quality institutions play a pivotal role in both the creation and diffusion of cutting edge new technologies (Freeman, 1987). Similarly, Lundvall (1992) claims that quality institution also facilitates cooperation among economic agents very often result in the creation of new technologies.

Hypothesis 1: Differences in quality of governance institutions is positively associated with cross-country variation in innovative capacity of states

Previous studies, both at firm level and cross-country level, have documented strong positive impact of governance institutions on human capital development (Castello-Climent, 2008; Acemoglu et al., 2005; Jeroen and Jakob de, 2013), and at the same time there exists conclusive empirical evidence for the positive impact of human capital on innovation and productivity improvement (Mason et al., 2012; Zahra & George, 2002; Bourdieu, 1986; Maskell and Malmberg, 1999; Dakhli & De Clercq, 2004). As a result, one is not at fault to argue that governance institutions influence innovation through their impact on human capital development. There is strong theoretical argument that links governance institutions to human capital development. First, the primacy of institutions in social and economic change has been established in the existing literature (Rodrik et.al, 2004). Second, countries with low level of development in their governance institutions neither properly utilize their human capital nor makes appropriate investment into human capital development. One possible counter argument to this theoretical explanation is that in the case of governance institutions the role is more likely to promote private initiatives. However, promoting private institutions presupposes for example, appropriate regulations, rule of law, corruption control, private property protection and quality government services. That means development of quality governance institutions is primordial to the promotion of private interests.

Existing evidence suggests that extremely corrupt countries are likely to under invest in the development of human capital formation by spending less on education, to overinvest in public infrastructure compared to private investment thereby adversely affecting innovation (Anokhin and Schulze, 2009; Esty and Porter 2002; Mauro, 1997; Tanzi and Davoodi, 2002). Other than

corruption, inefficiency in the bureaucratic structure can also be detrimental to innovation though the literature in this area is rather limited. For instance, Aghion et al. (2009) found that regulations in the electricity generation sector have reduced incentives to innovate and invest. In contrast, Nijsen et al. (2008) argued that although regulation to ensure competition is imperative, regulatory burden placed on businesses may be counterproductive in terms of innovation. Governments may also be able through regulation to influence access to finance, which the literature suggests is also a critical factor in facilitating innovation (Ayyagari et al., 2007; World Bank, 2008; OECD, 2010b). Therefore, the net effect of regulation on innovation is determined by the degree of the compliance cost on the one hand and the incentive effect on the other hand. Moreover, Heckman and Krueger (2003) argued that political instability and violence may disrupt social cohesion and thus reduce the capacity of the community to increase their social capital as well as interpersonal and institutional trust which are important for innovation. This implies that political instability negatively affects human capital development and thereby innovation (North, D. et. al., 2013; Collier, 2007; Griliches, 1990). The literature provides evidence that governance institutions that provide proper rule of law—guarantee private and intellectual property rights—influence human capital development and thereby innovation (Narayan et al., 2000; Black et al., 2000; Belton 2005; Gillian K. Hadfield, 2008). Similarly, Ngatat (2016) confirmed that with the lack of the rule of law, human capital development has been seriously lagging behind with students and teachers having difficulties in expressing findings because of strict rules imposed on the education systems. Consequently, given that human capital is instrumental in innovation process (Mason et al., 2012; Maskell and Malmberg, 1999; Dakhli & De Clercq, 2004) rule of law has the potential to affect innovation indirectly through its positive impact on human capital development.

Hypothesis 2: There is an indirect effect of governance institutions on innovation via human capital development. This is equivalent to saying that, the better the governance institutions, the better the human capital and the better the human capital, the better the innovation.

3.3. Research Methods and the Data

Methodology

This research employs two strategies: strategy "1" and "2". Strategy "1" is based on linear panel data econometric methods suitable for testing linear associations (i.e. single equation structural model). On the other hand, strategy "2" is based on the causal process logic to dissect the direct and indirect effects of political institutions on innovation using simultaneous equation structural model.

Strategy 1: The econometric model in this case relies on the empirical models of Benhabib & Spiegel (1994) and Cohen & Soto (2007) as its foundation for the analysis. Accordingly, the following model specification was used for empirical estimation:

$$INOV_{it} = \theta + \alpha_1(HC_{it}) + \alpha_2(GQ_{it}) + \alpha X_{it} + \varepsilon_{it} \text{ ....} (1)$$

The dependent variable in the equation ($INOV_{it}$) represents country level innovation index measured with three different proxy indicators: Index of Scientific and Technical Journal Publications, Total Factor Productivity and Global Innovation Index (Output Sub Index). The substantive justification for the use of alternative operationalization for country level innovation (i.e. Total Factor Productivity and Global Innovation Index) is to check whether the measurement of innovation matters in the investigation of the impact of governance quality on innovative capacity. Although total factor productivity is not necessarily an index measuring the innovative performance of a country (productivity gains might come from different sources, including innovation), it has been widely employed as measure of technological innovation in growth literature (Robert M. Solow, 1957; Ulku, 2004; David, 2004). Global Innovation Index" is an annual ranking of countries by their capacity for, and success in, innovation. It is published by Cornell University, INSEAD, and the World Intellectual Property Organization, in partnership with other organizations and institutions(Charles H. Matthews, Ralph Brueggemann, 2015) and is based on both subjective and objective data derived from several sources, including the International Telecommunication Union, the World Bank and the World Economic Forum(Jean-Eric Aubert, 2010). The index is available starting from 2007. The GII is computed by taking a simple average of the scores in two sub-indices, the Innovation Input Index and Innovation Output Index, which are composed of five(i.e.

institutions, human capital and research, infrastructure , market sophistication, business sophistication) and two pillars(i.e. Knowledge and technology outputs, Creative outputs) respectively. Each of these pillars describes an attribute of innovation, and comprise up to five indicators, and their score is calculated by the weighted average method (Cornell University et. al., 2017). In this research only the output index is used because the input index essentially derived from institutions and human capital. That means the main dependent variable is Index of Scientific and Technical Journal Publications. Human capital (HC_{it}) is index for human capital development based on the average years of schooling(Barro & Lee, 2013), and an assumed rate of return to education, based on Mincer equation estimates around the world(Psacharopoulos, George,1994), governance quality(GQ_{it}), is operationalized in terms of the Worldwide Governance Indicators (WGI) from the World Bank. Accordingly, general governance quality and the six components of governance quality indicators: Voice and Accountability(VA), Political Stability and Absence of Violence(PS), Government Effectiveness(GE), Regulatory Quality(RQ), Rule of Law(RL) and Control of Corruption(CC) are employed in this research. The general governance quality in this research is composite from the aforementioned six governance indicators by applying Principal Component Analysis (PCA). The substantive motivation for including the six governance quality indicators independently in the estimation models is to identify the dimensions of government quality that are more essential to harness innovative capacity of countries. Estimate of these governance indicators ranges from approximately -2.5 (weak) to 2.5 (strong) governance performances. Range of macroeconomic control variables (X_{it}) including GDP per capita, economic growth rate, population size, size of urban population, investment, middle income dummy, fixed capital formation and trade as percentage of the size of the economy are used to explain cross-country differences in innovation. This choice follows from the literature. For instance, Tansuğ Ok (2015) argued that urbanization encourages innovation through contact between people which may be either planned or serendipitous. Similarly, population growth has been documented to have a positive effect on technological progress or innovation (Kremer, M., 1993; Fisher, R.A., 1930). Klaus E. and Stephen L. P. (2010) provides evidence that larger markets, in the sense of more people or more open trade, support a larger variety of goods, resulting in a more crowded product space thereby facilitating process innovation, as larger firms can amortize research and development costs over more goods. There exists evidence for

positive effect of investment into infrastructure development on innovation (Rudolf Sivak et al., 2011).

Based on the need to apply a composite measurement of governance quality, principal component analysis was employed to bundle the six governance indicators developed by Kaufmann et al. (2011) into a single composite index: general governance quality. This technique has been employed in previous studies related to African governance issues (Asongu and Nwachukwu, 2016c) and it is an econometric approach that is used to bundle a set of strongly correlated variables into smaller set of uncorrelated indicators referred to as principal components. The principal components represent a substantial variation of information in the combined constituent indicators (Asongu, 2017a).

Consistent with the criterion by Jolliffe (2002) and Kaiser (1974), this paper retained only those common factors that have an eigenvalue greater than the mean. As it can be observed from Table 3A, the eigenvalues add up to the sum of the variances of the variables in the analysis—the "total variance" of the variables. Because we are analyzing a correlation matrix, the variables are standardized to have unit variance, so the total variance is 6. The eigenvalues are the variances of the principal components. The first principal component has variance of 4.8983, explaining approximately 82 percent (4.8983/6) of the total variance. The second principal component has variance of 0.4180 or 6.97% (0.4180 /6) of the total variance. The third principal component has variance 0.3119 or 5.2% of the total variance. Similarly the fourth and the fifth principal components have 0.1912(3.19%) and 0.1004(1.67%) of the total variance respectively. The last principal component has only 0.0803(1.34%) of the total variance.

Table 3A.

Principal Component Analysis for Governance Institutions

	Component Matrix(Loadings)								
Variable	VA	PS.	GE	RQ	RL	CC	Eigen value	proportion	cumulative proportion
Comp1	0.3900	0.3679	0.4224	0.4208	0.4367	0.4079	4.8983	0.8164	0.8164
Comp2	0.1418	0.8464	-0.3435	-0.1935	-0.0143	-0.3284	0.4180	0.0697	0.8861
Comp3	0.8660	-0.3322	-0.1241	-0.0013	-0.0456	-0.3497	0.3119	0.0520	0.9380

Comp4	0.2430	-0.0065	-0.1963	-0.6595	-0.0244	0.6833	0.1912	0.0319	0.9699
Comp5	0.0196	0.0784	0.7868	-0.5326	-0.0547	-0.2962	0.1004	0.0167	0.9866
Comp6	0.1359	0.1781	0.1749	0.2587	-0.8963	0.2213	0.0803	0.0134	1.0000

The data has been subjected to different econometric tests in order to ensure the resilience of the results. Primarily, the instrumental variable approach to general method of moments is employed. This is because it is more efficient econometric specification to deal with problems of cross-dependence, endogeneity and heteroscedasticity. There exists strong evidence that genera methods of moments (GMM) generate results with robust standard errors in the presence of cross-dependence and heteroscedasticity (Arellano and Bond, 1991; Arellano, 2003; Hall, 2005. To check for robustness of the results, the linear panel econometric test of the fixed effect and random effect models were employed. The problem with these linear models is that they offer relatively weaker predictions in the existence of heteroscedasticity and cross-dependence problems (Greene, 2012). The Driscoll and Kraay (1998) robust standard errors developed for fixed effect panel data models is applied as suggested by Hoechle (2007) to rectify the estimation bias.

Strategy 2: In the second stage of the analysis, Structural Equation Models were used based on the causal process logic to identify, if any, the direct and indirect effects of governance institutions on innovation. The model specification in this approach is founded on the theoretical development by Tebaldi Edinaldo & Elmslie Bruce (2008) and the empirical models of Jonathon Adams-Kane & Jamus Jerome Lim (2016). The basic specification of this model starts from equation 1 above with due consideration of the causal process in the basic variables of interest. This generates two simultaneous equations as follows:

$$INOV_{it} = \theta + \alpha_1(HC_{it}) + \alpha_2(GQ_{it}) + \alpha\ X_{it} + \varepsilon_{it} \text{ ....} (2.1)$$

and,

$$HC_{it} = \delta_1(GQ_{it}) + \varepsilon_{it} \text{ ....} (2.2)$$

Accordingly, in order to assess the effect of governance quality (GQ_{it}) on innovation $(INOV_{it})$, its relationship to HC_{it} has to be taken into account, so that:

$$\partial(HC_{it})/\partial(GQ_{it}) = \delta_1 \quad \text{.....(2.3)}$$

And the partial derivative of Equation 2.1, now with respect to governance quality (GQ_{it}) gives us the total effect of the quality of governance (GQ_{it}) on innovation $(INOV_{it})$ as:

$$\partial(INOV_{it})/\partial(GQ_{it}) = \alpha_1 \partial(HC_{it})/\partial(GQ_{it}) + \alpha_2 \quad \text{.....(2.4)}$$

By substituting equation 2.4 into equation 2.5 we get:

$$\partial(INOV_{it})/\partial(GQ_{it}) = \alpha_1\delta_1 + \alpha_2 \quad \text{.....(2.5)}$$

This final equation indicates a direct main effect (α_2) of governance quality on innovation, and it's an indirect effect $(\alpha_1\delta_1)$, through its impact on human capital development. Thus, the effect of the quality of governance (GQ_{it}) on innovation $(INOV_{it})$ depends on the value of HC_{it} to a greater extent than one should expect from the direct effect alone. This means if we find significant association between quality of governance and human capital development, while at the same time the impact of human capital on innovation is also supported by evidence we have the total effect of governance quality on innovation as:

$$\alpha_2 + \alpha_1\delta_1 \quad \text{.....(2.6)}$$

Data

Most of the data used in this study have been widely employed by the empirical literature that

posits the role of institutions in growth process. It relies on a panel dataset consisting of 37 developing countries in sub-Saharan Africa for the period 1996–2016. The period is chosen because of constraints in data availability. For instance, good governance measurements from the World Bank Governance indicators are only available from 1996, while the latest year for other variables is 2016. The choice of countries is also guided by the availability of data. Observations are for annual periods, yielding (at maximum) twenty one time series data points per country and a total of 777 observations.

The summary of the key variables for countries pooled over the study period is presented in Appendix Table B1. Table B1 demonstrates that South Africa, Nigeria, Kenya, Ethiopia and Cameron are the top five countries in terms of innovation while, Liberia, Sierra Leone, Mauritania, Lesotho and Burundi are the bottom five countries. In terms of governance quality the five countries at the top include South Africa, Mauritius, Namibia, Botswana and Ghana while, Dem. Republic Congo, Sudan, Zimbabwe, Burundi and Central African Republic appears at the bottom. The description and sources of variables are presented in Appendix Table B2. The summary statistics can be found in Appendix Table B3. Appendix Table B4 provides the correlation matrix. From Appendix Table B4, it is apparent that some of the control variables are not employed because of multicollinearity issues or high degrees of correlation. The unused control variables are GDP per capita and population size.

Fig. 3a presents governance quality and innovation measured as logged journal article publications for the sampled countries averaged over the study period (1996–2016). The fitted line shows a strong positive relationship between the Journal Article Publications and governance quality. Also, Fig. 3b shows strong positive correlation between human capital and government quality. Fig.3c four implies positive correlation between innovation and human capital.

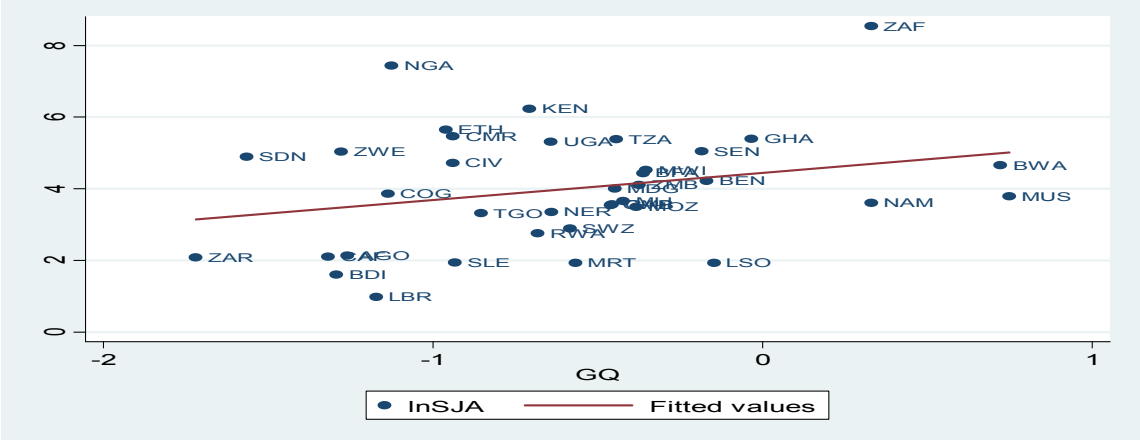

Fig. 3a: Scatter plot of Innovation vs. Governance Quality

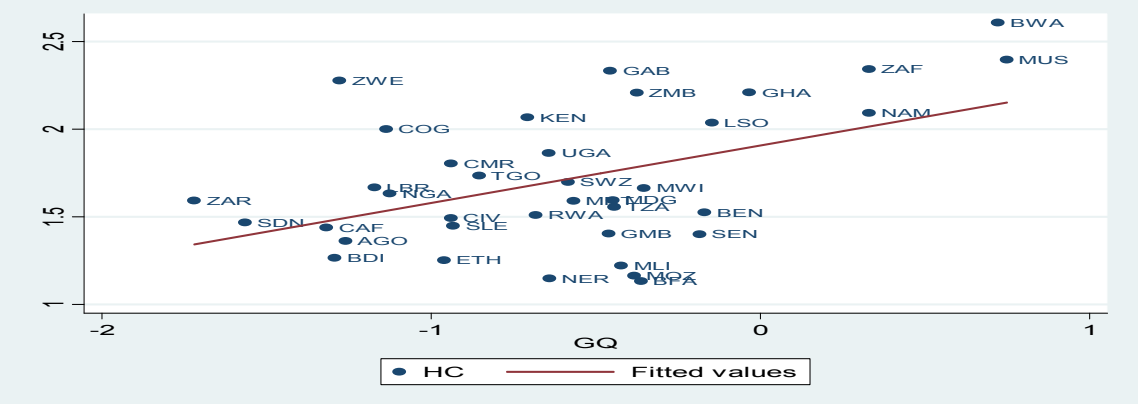

Fig. 3b: Scatter plot of Human Capital vs. Governance Quality

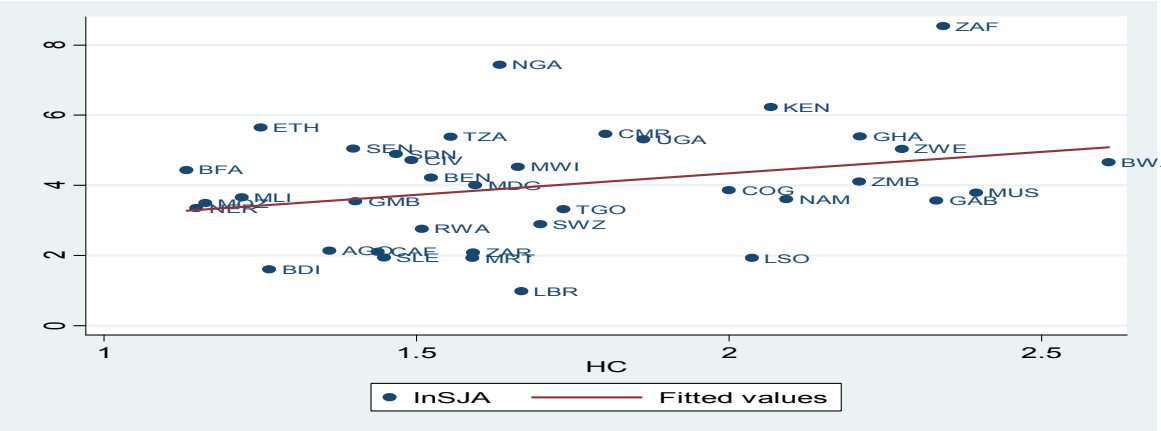

Fig. 3c: Scatter plot of Human Capital Vs. Innovation

3.4. Empirical Results

Tables 3B–3H, respectively, present findings related to general governance quality and the six components of governance quality indicators: voice and accountability, political stability and absence of violence, government effectiveness, and regulatory quality, rule of law and control of corruption. Each table is presented in three panels: the first at the top presents the instrumental variable related regressions. The second in the middle represents the OLS-random effect related regressions. The third at the bottom represents the fixed effect related regressions. The consistent differences observed in governance institutions estimated coefficients among the fixed effect, the random effect and the general methods of moments(IV) (in terms of sign, significance, and magnitude of significance) justify the importance of the implemented empirical strategy.

The following general findings can be established from Table 3B on the empirical relationship between general governance quality and innovative capacity of sub-Saharan African economies. First, in the sub-Saharan economies investigated in this study, improvement in general governance quality can be seen to positively affect innovative capacity of states. This is confirmed by very high statistical significance of the coefficients in all the models tested to assess the relationship between general governance quality and innovation. Second, the instrumental variables regressions—the most preferred regression models due to robustness as it corrects for problems of endogeneity—clearly vindicate that the positive impact of general governance quality is consistent across the three proxy variables adapted to measure innovation. Overall, the result implies that countries that are better in terms of development in the quality of their governance institutions are more innovative. Third, most of the statistically significant control variables appear to have the expected signs for their coefficients. The findings related to the six components of governance quality indicators are presented in Tables 3C -3H in the appendix-B.

Table 3B. Innovation and General Governance Quality (GQ).

	Foxed Effect			GLS-Random Effect			GMM(IV)			GMM(xtabond2)		
variable	lnSJA	TFP	GIO	lnSJA	TFP	GIO	lnSJA	TFP	GIO	lnSJA	TFP	GIO
										0.802***	.4307***	.443***
										(.8202)	(.0359)	(.0546)
GO	.255***	.204***	-4.515*	.3177**	.116***	1.5038	.7765***	.0392**	3.989***	.1839*****	.0118	2.872***
	(-.083)	(-.0321)	(-2.371)	(.1487)	(-.043)	(-1.741)	(-.0728)	(-.0123)	(-0.839)	(.5637)	(.0155)	(.99653)
GDPG	-.005	.003**	.102**	-.0051*	.0032*	.08057*	-.0089	.00234	.0702	-.00365	0057***	.1478**
	(-.0032)	(-.0011)	(-.0419)	(-.0031)	(-.002)	(-.0475)	(-.0069)	(-.0016)	(-.1338)	(.00497)	(.00126)	(.06971)
HC	.819***	.218***	-1.004	1.398***	.0624	.3339	.9811***	.03096	-.2367	.1818**	.00416*	.66389**
	(-.2217)	(-.0726)	(-8.695)	(-.3076)	(.102)	(-1.484)	(-.1249)	(-.0249)	(-.8329)	(.0901)	(.0221)	(.59312)
FCF	-.0067**	.0012	.0532	-.0027	.0012	-.0103	-.0011	.0029**	-.192***	.00012	.00098	.12526**
	(-.0026)	(-.0011)	(-.0554)	(-.0035)	(-.001)	(-.0429)	(-.0045)	(-.0008)	(-.0458)	(.00209)	(.00068)	(.04083)
TRD	-.0006	-.0006	.0256*	-.0006	-.0006	.03287	-.0091***	-.001***	.0339**	-.00133**	-.00038*	.01884
	(-.0009)	(-.0004)	(-.0148)	(-.0012)	(-.004)	(-.0202)	(-.0012)	(-.0003)	(-.0168)	(.00056)	(.00022)	(.01224)
MID	.1926***	-.0224	4.36***	.2884***	-.0224	2.297*	.1336	-.00214	.3044	.0362	.00048	.117854
	(-.066)	(-.0238)	(-549)	(-.094)	(.024)	(-1.384)	(-.1219)	(-.0152)	(-.9566)	(.05602)	(.0165)	(.79294)
lnEMP	1.821***	.0062	-2.213	1.058***	.0062	.78099	.5382***	(-.0119)	(.7277)	.1152***	-.00733	.322177
	(.1995)	(-.0729)	(-8.579)	(-.1543)	(-.0729)	(-.8824)	(-.0667)	-.0096	-.5978	(.0328)	(.00936)	(.47456)
lnCK	.4812***	-.077**	-1.255	.4654***	-.077**	.1014	.5275***	.0196**	.36218	:0811***	.00939	.224345
	(-.0962)	(-.0324)	(-4.046)	(-.1542)	(-.0324)	(-.8115)	(-.0705)	(-.0098)	(-.4787)	(.02647)	(.00889)	(.45634)
lnUPOP	.7628***	.312***	3.9174	1.063***	.185***	1.0862	.3726***	0.119**	.56277	.06014	.0638***	-.006592
	(-.253)	(-.0856)	(-11.089)	(-0.295)	(-.0566)	(-1.795)	(-.0893)	(-.0138)	(-.9003)	(.03774)	(.01388)	(.621527)
_cons	-39.2***	1.446*	67.395	-29.41***	1.446*	-1.4227	-19.01***	.0502**	2.349	-3.26**	.1909*	4.31761
	(2.3952)	(-.8689)	(-90.002)	(-2.457)	(-.8688)	(-9.433)	(-.9256)	(-.1751	(-6.5106)	(.499)	(.11504)	(6.3325)
Wald chi2	181.82	14.38	13.84	754.18	76.16	32.81	291.26	166.86	87.78	13040.32	411.73	195.74
(Prob>	0.000	0.000	0.000	0.000	0.000	0.0001	0.000	0.000	0.000	.0000	0.000	0.000
R^2 *within*	0.7043	.2152	0.0758	0.697	0.1986	0.0368	0.7404	0.2119	0.2474			
AR(1)	-	-	-	-	-	-	-	-	-	-13.94	-16.93	-4.21
AR(1)	-	-	-	-	-	-	-	-	-	5..17	-0.69	-0.22
Sargarn	-	-	-	-	-	-	-	-	-	265.71	195.30	144.11
N(Obs)	733	506	236	733	506	236	733	482	216	698	482	206
Countries	37	25	30	37	25	30	37	25	30	37	25	30

*,** , *** indicate significant at 10%, 5% and 1% levels; *lnSJA: log of scientific and technical journal articles index; l.lnSJA: lagged value of log of scientific and technical journal articles index; GQ: governance quality index; HC: human capital, GDPG: Rate of GDP growth; lnUPOP: log of urban population size; lnEMP: log of total employment in personnel; TRADE: trade as percentage of GDP; FCF: fixed capital formation as percentage of GDP, lnCK: log of stock of capital in investment; MID: middle income country dummy*

The following general findings can be established from Table 3C on the impact of voice and accountability on cross-country differences in innovation. First, voice and accountability has a positive and statistically significant influence on innovation. That means differences in the development of voice and accountability explains cross-country differences in terms innovation capacity. Second, the empirical result is found to be consistent for the three proxy variables adapted to operationalized country level innovation. Particularly, the instrumental variable models confirmed this consistent and statistically significant association between innovation and voice and accountability as measure of quality of governance institution. This finding implies the positive development in voice and accountability system would improve the innovative capacity of countries. Finally, most of the statistically significant control variables have the expected signs.

The following findings can be established from Table 3D concerning the effect of political stability and non violence on cross-country variation in innovation capacity. First, political stability and absence of violence has positive and statistically significant effect on innovation capacity. Second, the result appears to be consistent in almost all of the models tested to evaluate this association. The instrumental variable test results—the most preferred regression models due to robustness as it corrects for problems of endogeneity—clearly indicate that the positive and statistically significant impact of political stability and absence of violence on innovation is consistent. The implication of this result is that countries with stable political systems combined with low level of violence provide cordial environment to nurture innovation and creativity. Third, most of the significant control variables appear with the expected signs.

The following general findings can be established from Table 3E about the impact of government effectiveness in terms of explaining cross-country differences in innovation. First, from the sub-Saharan economies under this study, government effectiveness can be seen to positively affect innovation. Its coefficient is statistically highly significant. Put it in a different way, differences in government effectiveness explain cross-country variations in innovative capacity. Second, the result is consistent in most of the econometric models tested to assess the association. Notably, the instrumental variable models confirmed the

strong positive effect of government effectiveness on innovation including cases in which innovation is operationalized by different proxy variables. Third, almost all of the control variables appear to be with their respective expected signs.

The following general findings can be summarized from Table 3F on the association between regulatory quality and cross-country differences in innovation. First, regulatory quality is with a positive coefficient and statistically highly significant in almost all econometric models tested. That means regulatory quality has a strong positive impact on innovation implying that cross-country differences in regulatory quality is the source of cross-country variation in innovation capacity. Second, the result is consistent across the specifications tested. Particularly the instrumental variables models revealed that countries need to improve their regulatory quality to improve their success in terms of innovation. Finally, the most of the statistically significant control variables appear to have the expected signs.

The following general findings can be established from Table 3G concerning the impact of rule of law on innovation. First, rule of law is statistically highly significant and with the expected positive sign. In other words, cross-country differences in the rule of appears to have a strong positive impact on innovation implying that countries with better rule of law are also better in their innovation capacity. Second, the result is consistent in almost all of the econometric specifications tests to assess the association between rule of law and cross-country differences innovation. The models with the instrumental variables confirmed the consistency of the strong positive effect of rule of law including when innovation is operationalized through different proxies. Generally speaking, the finding implies that improvement of the rule of law is essential to enhance the innovative capacity of countries. Third, most of the statistically significant control variables are with the expected signs.

The following general findings can be established from Table 3H on the relationship between control of corruption and cross-country variation in innovation. First, the results indicate that in almost all of the econometric models tested corruption control has a positive coefficient and is statistically significant implying that improvement in corruption control contributes positively to enhancement of the innovative capacity of countries. Put it in a different way, the lesser the prevalence of corruption in the governance system, the more innovative a country is. This finding is more lucid in the results from the econometric

specification with the instrumental variables—the most preferred regression models due to robustness as it corrects for problems of endogeneity. Second, the result appears to be consistent across the three alternative variables used to operationalized innovation level. Finally, most of the statistically significant control variables are with the expected signs for their coefficients.

Tables 3I–3K, respectively, present findings related to general governance quality and the six components of governance quality indicators: voice and accountability, political stability and absence of violence, government effectiveness, and regulatory quality, rule of law and control of corruption for the structural equation models developed evaluate the indirect effect institutions on cross-country variations in innovation. Each table is presented in seven panels in line with the instruments used to operationalized governance institutions. First, Table 3I presents the results when innovation is measured in terms of index of scientific and technical journal articles. Second, Table 3J presents the results when innovation is measured in terms of total factor productivity. Finally, Table 3K presents the results when innovation is measured by the output sub index of the global innovation index. The consistent differences observed in governance institutions estimated coefficients within each table (in terms of sign, significance, and magnitude of significance) justify the importance of the implemented empirical strategy.

Table 3I. Governance Institutions and Innovation

Dependent Variable: Scientific Journal Articles							
Estimates of Structural Equation Models							
Variable	GQ	VA	PS.	GE	RQ	RL	CC
HC <-							
GQ	0.2906***	0.223***	0.145***	0.3294***	0.258***	0.275***	0.262***
	(0.0225)	(0.0203)	(0.0139)	(0.0214)	(0.0296)	(0.023)	(0.0258)
_cons	1.8778***	1.83***	1.787***	1.9197***	1.849***	1.879***	1.859***
	(0.02081)	(0.020)	(0.0193)	(0.0204)	(0.0218)	(0.0212)	(0.0223)
lnSJA <-							
HC	0.9811***	1.1156***	1.1499***	0.9447***	1.051***	0.953***	1.101***
	(0.12416)	(0.1248)	(0.1349)	(0.1286)	(0.1274)	(0.1247)	(0.1236)
GQ	0.7765***	0.435***	0.4115***	0.7458***	0.7899***	0.776***	0.648***
	(0.07235)	(0.05562)	(0.0463)	(0.0743)	(0.0769)	(0.0748)	(0.0659)
GDPG	-0.00897	-0.00186	-0.0068	-0.00764	-0.0074	-0.0087	-0.00379
	(0.00687)	(0.00694)	(0.0068)	(0.00694)	(0.0071)	(0.0066)	(0.0069)
FCF	-0.00107	0.00366	0.0022	0.00072	-0.0027	-0.0023	0.00288

	(0.00447)	(0.00474)	(0.0047)	(0.00447)	(0.0045)	(0.0044)	(0.0046)
TRD	-0.0091***	-0.011***	-0.011***	-0.0087***	-0.0075**	-0.009***	-0.01***
	(0.00115)	(0.00126)	(0.0014)	(0.00115)	(0.0011)	(0.0011)	(0.0012)
MID	0.13361	0.1463	0.16969	0.18899	0.1266	0.11244	0.0629
	(0.12112)	(0.1229)	(0.1208)	(0.12345)	(0.1189)	(0.1206)	(0.1255)
lnEMP	0.5383***	0.3894***	0.5226***	0.5439***	0.560***	0.5541***	0.49***
	(0.06622)	(0.06913)	(0.0649)	(0.0675)	(0.0672)	(0.0671)	(0.0685)
lnCK	0.5275***	0.5906***	0.5745***	0.4662***	0.482***	0.5195***	0.575***
	(0.07004)	(0.0734)	(0.0705)	(0.0749)	(0.0707)	(0.0704)	(0.0732)
lnUPOP	0.3726***	0.2819***	0.2396***	0.4501***	0.401***	0.4763***	0.435***
	.0887593	(0.0948)	(0.0872)	(0.09091)	(0.0883)	(0.0892)	(0.0925)
_cons	-19.01***	-18.46***	-19.98***	-17.85***	-18.55***	-19.33***	-19.96***
	(0.91993)	(1.0088)	(0.9451)	(1.0019)	(0.9246)	(0.8897)	(0.9464)
R2(HC)	0.19156	0.1368	0.1262	0.2278	0.1472	0.1831	0.1363
R2(lnSJA)	0.73348	0.7142	0.7148	0.7299	0.7392	0.7348	0.7133
log likelihood	-13103.66	-13329.40	-13490.73	-13064.40	-13107.2	-13122.57	-13120.9
Wald χ2(HC)	166.39	107.39	108.55	236.28	75.72	142.57	102.67
Wald χ2(lnSJA)	2653.98	2384.83	2189.43	2713.22	2925.53	2865.58	2585.74
N(Obs)	733	733	733	733	733	733	733

, , *** indicate significant at 10%, 5% and 1% levels respectively; robust standard errors in brackets*

lnSJA: log of scientific and technical journal articles index; l.lnSJA: lagged value of log of scientific and technical journal articles index; GQ: governance quality index; HC: human capital, GDPG: Rate of GDP growth; lnUPOP: log of urban population size; lnEMP: log of total employment in personnel; TRADE: trade as percentage of GDP; FCF: fixed capital formation as percentage of GDP, lnCK: log of stock of capital in investment; MID: middle income country dummy

Table 3J. Governance Institutions and Innovation.

Dependent Variable: Total Factor Productivity(TFP)							
Estimates of Structural Equation Models							
Variable	GQ	VA	PS.	GE	RQ	RL	CC
HC <-							
GQ	0.3292***	0.2298***	0.1869***	0.3649***	0.2891***	0.325***	0.279***
	(0.0257)	(0.0240)	(0.01599)	(0.0242)	(0.03928)	(0.0267)	(0.0294)
_cons	1.914***	1.853***	1.834***	1.949***	1.8798***	1.933***	1.882***
	(0.02243)	(0.02361)	(0.0222)	(0.02197)	(0.02422)	(0.0227)	(0.0241)
TFP <-							
HC	0.00525	0.0117	0.00616	0.00333	0.00916	0.00749	0.00978
	(0.0268)	(0.02641)	(0.02707)	(0.02723)	(0.0272)	(0.0269)	(0.02662)
GQ	0.0301**	0.01027	0.0204***	0.02695**	0.0452***	0.0229**	0.0216**
	(0.01186)	(0.00957)	(0.00768)	(0.01117)	(0.01243)	(0.01163)	(0.0115)

GDPG	0.0029*	0.0033**	0.00297**	0.00299**	0.00281*	0.0031**	0.00311**
	(0.00155)	(0.00158)	(0.00154)	(0.00156)	(0.00149)	(0.0016)	(0.0016)
FCF	0.0024***	0.0027***	0.00239***	0.0025***	0.00212***	0.0024***	0.0026***
	(0.00084)	(0.00085)	(0.00085)	(0.00085)	(0.0008)	(0.00085)	(0.00086)
TRD	-0.00084***	-0.0009***	-0.0009***	-0.0079***	-0.0075***	-0.0081**	-0.0081***
	(0.00024)	(0.00024)	(0.00023)	(0.00024)	(0.00023)	(0.00024)	(0.00024)
MID	-0.01024	- 0.00896	-0.00579	-0.00886	-0.01309	-0.0115	-0.01213
	(0.01481)	(0.01489)	(0.01518)	(0.01488)	(0.01442)	(0.01475)	(0.01473)
lnEMP	-0.01187	-0.0164*	-0.01295	-0.01197	-0.00755	-0.01185	-0.01234
	(0.00953)	(0.00902)	(0.00919)	(0.00946)	(0.00977)	(0.00962)	(0.00958)
lnCK	0.01494	0.01733*	0.01852**	0.01315	0.00957	0.01481	0.0159*
	(0.00933)	(0.00926)	(0.00929)	(0.00948)	(0.00952)	(0.0093)	(0.00919)
lnUPOP	0.1285***	0.1278***	0.1198***	0.1328***	0.1302***	0.133***	0.13398***
	(0.01335)	(0.01351)	(0.01367)	(0.01359)	(0.0133)	(0.0137)	(0.01403)
_cons	0.33895*	0.3181*	0.29339	0.36618**	0.4021**	0.3184*	0.28278
	(0.18972)	(0.18735)	(0.19466)	(0.19199)	(0.18889)	(0.1913)	(0.19608)
R2(HC)	0.23398	0.14645	0.18563	0.27134	0.16782	0.24257	0.15723
R2(lnSJA)	0.2381	0.2272	0.23781	0.23699	0.24765	0.23322	0.23033
log likelihood	-7945.45	-8099.99	-8168.414	-7932.31	-7958.15	-7939.39	-7976.42
Wald χ2(HC)	163.92	91.76	136.65	227.66	54.18	147.89	89.85
Wald χ2(lnSJA)	171.35	162.76	176.14	170.37	184.67	166.89	165.66
N(Obs)	506	506	506	506	506	506	506

, , *** indicate significant at 10%, 5% and 1% levels respectively; robust standard errors in brackets*

lnSJA: log of scientific and technical journal articles index; l.lnSJA: lagged value of log of scientific and technical journal articles index; GQ: governance quality index; HC: human capital, GDPG: Rate of GDP growth; lnUPOP: log of urban population size; lnEMP: log of total employment in personnel; TRADE: trade as percentage of GDP; FCF: fixed capital formation as percentage of GDP, lnCK: log of stock of capital in investment; MID: middle income country dummy

Table 3K.Governance Institutions and Innovation

Dependent Variable: Global Innovation Index(Output Sub Index)							
Estimates of Structural Equation Models							
Variable	GQ	VA	PS.	GE	RQ	RL	CC
HC <-							
GQ	0.3911***	0.2738***	0.2233***	0.4525***	0.3197***	0.3708***	0.3117***
	(0.04993)	(0.03948)	(0.02985)	(0.04547)	(0.072698)	(0.05831)	(0.04858)
_cons	1.9847***	1.9067***	1.90334***	2.0422***	1.9352***	1.978***	1.9592***
	(0.03244)	(0.03381)	(0.03375)	(0.03065)	(0.03671)	(0.03407)	(0.03751)
GIO <-							
HC	0.283355	0.78547	0.96417	0.29833	0.35623	0.42603	1.23854
	(0.85337)	(0.82305)	(0.84808)1	(0.89234)	(0.81493)	(0.83484)	(0.88459)

GQ	3.1265***	1.8158***	1.2704***	3.7489***	3.6788***	2.959***	0.89479
	(0.86987)	(0.58547)	(0.66292)	(0.8941)	(0.72445)	(0.76914)	(0.71732)
GDPG	0.057719	0.08099	0.06631	0.046535	0.06943	0.05275	0.07134
	(0.12673)	(0.13436)	(0.13973)	(0.12203)	(0.11818)	(0.13407)	(0.14639)
FCF	-0.1385***	-0.1101***	-0.0899**	-0.14665***	-0.1563***	-0.138***	-0.0914**
	(0.04227)	(0.03861)	(0.03718)	(0.04649)	(0.04234)	(0.04221)	(0.04117)
TRD	0.02922*	0.02435	0.02427	0.03633**	0.0421***	0.0371**	0.03233*
	(0.01584)	(0.01626)	(0.01635)	(0.01552)	(.015716)	(0.01682)	(0.01714)
MID	0.05271	-0.07733	0.163912	-0.17908	-0.18151	-0.22697	-0.45436
	(0.90736)	(0.91538)	(0.99825)	(0.89396)	(0.88138)	(0.92319)	(0.96355)
lnEMP	0.518577	-0.04305	0.24543	0.66206	0.64596	0.65625	0.00237
	(0.58217)	(0.53655)	(0.59649)	(0.56737)	(0552012)	(0.5971)	(0.55105)
lnCK	0.56392	0.696533	0.82287*	0.36734	0.46093	0.45881	0.8778**
	(0.46328)	(0.45234)	(0.44489)	(0.47302)	(0.46611)	(0.47744)	(0.4419)
lnUPOP	1.01981	1.14215	0.99961	1.5705**	0.92578	1.6495**	1.4777*
	(0.828388)	(0.82219)	(0.86813)	(0.79914)	(0.79745)	(0.79605)	(0.77764)
_cons	-3.395208	-0.51775	-8.64644	-1.13483	-2.89373	-5.7937	-8.8667
	(6.28619)	(6.46729)	(6.08396)	(6.31835)	(6.36878)	(6.1516)	(6.03216)
R2(HC)	0.24518	0.17532	0.17566	0.30822	0.16679	0.21814	0.16942
R2(GIO)	0.22932	0.2047	0.1758	0.261423	0.27373	0.22227	0.15683
log likelihood	-4394.037	-4486.461	-4480.7371	-4383.372	-4423.298	-4401.8512	-4429.798
Wald χ2(HC)	61.33	48.09	55.97	99.02	19.34	40.44	41.16
Wald χ2(lnSJA)	92.36	88.21	80.05	99.96	105.88	90.05	74.19
N(Obs)	236	236	236	236	236	236	236

, , *** indicate significant at 10%, 5% and 1% levels respectively; robust standard errors in brackets*

lnSJA: log of scientific and technical journal articles index; l.lnSJA: lagged value of log of scientific and technical journal articles index; GQ: governance quality index; HC: human capital, GDPG: Rate of GDP growth; lnUPOP: log of urban population size; lnEMP: log of total employment in personnel; TRADE: trade as percentage of GDP; FCF: fixed capital formation as percentage of GDP, lnCK: log of stock of capital in investment; MID: middle income country dummy

The following general findings can be established from Table 3I concerning the direct and indirect association between governance quality indicators and cross-country variation in innovation, innovation being measured in terms of index of scientific and technical journal publication. The results indicate that all proxy indicators of institutional quality (general governance quality, voice and accountability, political stability and absence of violence, government effectiveness, and regulatory quality, rule of law and control of corruption) have positive coefficients and are statistically highly significant for their association with human capital development. At the same time, the findings vividly depict

that human capital development has statistically significant and positive impact on innovation. Hence, the finding implies the existence of indirect positive association running from institutional quality through human capital development to innovation. Furthermore, the findings show that the direct impact of quality of governance institutions on innovative capacity of countries is positive and statistically highly significant. Overall, the findings imply that quality of governance institutions affects innovation directly and indirectly through its positive effect on human capital development. That means countries with better quality of governance institutions are endowed with better knowledge infrastructure that is essential for improvement of creativity and innovation. Finally, most of the statistically significant control variables appear to have the expected signs.

The following general findings can be established from Table 3J concerning the direct and indirect effect of governance quality indicators and cross-country variation in innovation when innovation is measured in terms of total factor productivity. The results clearly indicate that the impact of governance quality human capital development is positive and statistically highly significant. Similarly, the impact of human capital on innovation is found to be positive but insignificant. However, the insignificant result does not undermine the established theoretical and empirical link between human capital development and innovation (Baron and Kenny, 1986; Bourdieu, 1986; Maskell and Malmberg, 1999; Zahra & George, 2002; Dakhli & De Clercq, 2004; Mason et al., 2012). Hence, the findings can arguably confirm the indirect impact of governance institutions on innovation through its positive impact on human capital development. Besides, the findings also indicate that the direct effect of quality of governance institutions on cross-country differences in innovation is positive and statistically highly significant. Furthermore, most of the significant control variables in the estimated models have the expected sign.

The following general findings can be established from Table 3K about the direct and indirect effect of governance quality indicators and cross-country variation in innovation when innovation is measured in terms of the output sub index of the global innovation index. First, the effect of institutional quality on human capital development is positive and statistically highly significant. Second, the impact of human capital on innovation is also confirmed to be positive, but statistically insignificant. Taken together, these two results indicate that the indirect effect of governance institutions on innovative capacity of countries

is positive (Baron and Kenny, 1986; Zahra & George, 2002; Dakhli & De Clercq, 2004; Mason et al., 2012). Third, the direct effect of governance institutions on cross-country variations in innovation is positive and statistically significant. Generally speaking, the findings imply that quality of governance institution positively affects innovation directly as well as indirectly through its impact on human capital development.

3.5. Conclusions and Policy Implications

This study aims to contribute to the governance quality and innovation nexus by addressing the research question: how do the different governance institutions affect innovation capacity of states? To this end, the paper employed one composite governance indicator – general governance quality (GGQ) and six different indicators of governance institutions from world governance indicators (i.e. Voice and Accountability (VA), Political Stability and Absence of Violence (PS), Government Effectiveness (GE), Regulatory Quality (RQ), Rule of Law (RL) and Control of Corruption (CC). The general governance quality is composite from these six indicators of quality of governance institutions by applying the principal component analysis. The empirical evidence is based on a panel of 37 sub-Saharan African countries for the period 1996–2016 using linear econometric models and structural equation models. The methodological reasons underpinning my choice of these estimation techniques is that linear models estimate only the direct effects of governance institutions while the structural equation models are useful to test for both direct and indirect effects of governance institutions on innovation.

Based on the empirical results, quality of governance institutions does indeed advance innovation capacity of states. The empirical findings strongly support the direct and indirect effects of governance institutions on cross-country variation in innovation. In other words, governance institutions appear to influence innovation through their positive impact on human capital in addition to their direct effect. It is essential to highlight how these findings contribute to the literature about the conceptualization and measurement of governance quality in accordance with the fundamental motivation of this paper – that is to contribute to the developing paradigm shift in the conceptualization of governance quality while empirically testing the effect of governance on innovation. In the very few previous studies

(Zahra & George, 2002; Dakhli & De Clercq, 2004; Mason et al., 2012; Kangoye,2013), the positive association between governance quality (general governance (GGQ), Voice and Accountability (VA), Political Stability and Absence of Violence (PS), Government Effectiveness (GE), Regulatory Quality (RQ), Rule of Law (RL), Control of Corruption (CC)) and innovation would have been deficient in terms of empirical validity. Consequently, this article offered the empirical validity that is useful to corroborate the relationship between these concepts of governance quality and innovation. This is because the literature in the study of institutions purports to the use of general governance without empirical validity (see: Asongu and Nwachukwu 2017b). This paper has tried to demonstrate from the findings that the positive association between general governance quality– constructed from the six world governance indicators using principal component analysis– and innovation hold out empirical verifications. In other words, the conceptualization of general governance quality employed in this paper involves all the six dimensions of governance from the World Governance Indicators of the World Bank.

Concomitant with the empirical findings observed, this article contributes to the literature in its evaluation of the role of governance quality on innovation by using new concept of governance with meticulous attention on developing countries in sub-Saharan Africa. These empirically informed results advance the existing literature which has established that governance quality explains cross-country variations in innovation (Ngatat, 2016; Gillian K. Hadfield, 2008; Belton 2005; Sala-i-Martin, 2002; Rudolf Sivak et al., 2011; Baumol, 1990). The findings imply that poorly governed countries are less innovative compared with countries with better governance institutions. For instance, in countries where the rule of law is weak, the incentive to innovate is poor because the lack of proper rule of law implies that no guarantee for protection of private property such as patent rights, copy rights and trademarks (Ngatat, 2016; Mason et al., 2012; Gillian K. Hadfield, 2008). Similarly, in countries in which corruption and abuse of power prevails, social allocation o f resources is guided preferentially rather than ethically. In these governance contexts, science and research are marginalized because those in power fear that talent threatens their main aim—controlling access to public and private resources (Alina Mungiu-Pippidi, 2015; Anokhin and Schulze, 2009; Esty and Porter 2002).This is because corruption not only increases the cost of investment into innovation but also undermines it because governments

that buy political support tend to under invest into education and research—the returns are seen as too general and materialized only in the long run. Underdevelopment of talent due to this reason undermines innovation. Consistent with previous studies (North, D. et. al., 2013; Collier, 2007; Griliches, 1990) political stability is found to be one of the most determining governance institutions in explaining cross-country variations in innovation. This is due to the fact that political stability plays essential role in harnessing social capital as well as entrepreneurial skills and the institutional trust needed to promote innovation. In line with the literature (Nijsen et al., 2008; OECD, 2010b; Aghion et al., 2009), government effectiveness and regulatory quality are also found to be among essential factors in explaining cross-country differences in innovation. This is because while, the bureaucratic effectiveness of governments entail lower cost of investment into innovative endeavors, improved regulatory quality is important to ensure competition which is imperative in triggering innovation initiatives. Besides, governments may influence through regulation access to key resources such as finance, which the literature suggests is also a critical factor in facilitating innovation. But, excessively restrictive regulation that places burden on economic agents may be counterproductive in terms of innovation. In summary, my main hypothesis which asserts that quality of governance institutions explain cross-country differences in innovation has been empirically confirmed. Furthermore, the findings in this article have established the direct and indirect effects of governance quality on innovative capacity of countries. That is, in addition to their direct effect, quality of governance institutions play important role in advancing innovation through their positive impact on human capital development—key to promote innovation.

Chapter Four

Innovation and Economic Growth in Sub-Saharan Africa: Why Institutions Matter? *An empirical study across 37 Countries*

4.1. Introduction

There are four basic reasons for undertaking this study: (1) the narrative of Africa rising which is becoming the center stage of scholarly debate on African development, the ironic rise of absolute poverty despite the overall economic growth record that the continent experienced in the last decade, and the power of institutional quality and innovative capacity in spurring economic growth; (2) the controversy in the literature about the nexus of institutional quality, innovation and economic performance; (3) the development of new and alternative approaches to the conceptualization and Operationalization of institutional quality for use in statistical modeling; and (4) the need to dissect the direct and indirect impacts of institutional quality on economic performance in the modeling exercises to provide more nuanced policy inferences.

First, the literature on African development is revealing that Africa has enjoyed robust economic growth in the last decade (Kathleen et al., 2016; Asongu, 2017; Fosu, 2015b). However, the economic growth couldn't curb the problem of absolute poverty in the Continent (Asongu, 2017; Kathleen et al., 2016; Sabina Alkire et al., 2017). Although poverty rate for sub-Saharan Africa did decline, the overall number of poor has increased due to demographic growth. The literature in economic growth and development provides unwavering evidence that institutional quality and innovative capacity play key role in growth process. For instance, some authors (North & Thomas, 1973; Engerman & Sokoloff, 1997; Rodrik, 2003; Sala-i-Martin, 2002; Easterly &Levine, 2003; Glaeser et al., 2004; Acemoglu et al., 2005) offer strong evidence that the quality of institutions plays a key role in determining the long-run economic performance. In addition, the literature in indigenous growth theory postulates that innovation plays significant role in terms of explaining economic growth (Romer, 1990; Lucas, 1998; Grossman & Helpman, 2001; Aghion & Howitt, 1992; Jones, 1995; Young, 1998; Segerstrom, 1998; Bornstein, 2003; Patrick, 2009; Bruton & Ketchen, 2013; Robson & Haugh, 2009). Furthermore, the available evidence also

indicates the importance of quality of institutions in explaining cross-country differences in innovative capacity of countries (Aghion et al., 2009; Sivak et al., 2011; Mancur, 1996; Rivera-Batiz, 2002).

The existing literature in development discourse provides mechanisms through which institutional quality influences long term economic performance. There exits evidence that institutional quality spurs economic growth directly and indirectly through its positive impact on innovation. Institutional quality directly improves the policy environment thereby creating an enabling situation that can spur economic growth (Rodrik et al., 2004; Aghion et al., 2009; Sivak et al., 2011). Secondly, quality of an institution is influential in the development of innovative capacity of states (Acemoglu et al., 2005; Castello-Climent, 2008; Jeroen & De Jakob, 2013) and innovation capacity is the key factor that explains cross-country variation in long run economic performance (Rodrik, 2003; Patrick, 2009; Bruton & Ketchen, 2013; Robson & Haugh, 2009). This implies that, the development of quality institutions enables countries with low levels of economic growth to achieve economic catch-up in two ways: directly by harnessing the policy environment that motivates growth promoting economic activities (Acemoglu et al., 2005; Jeroen & De Jakob, 2013) and indirectly through its positive impact on the development of innovativeness (Tebaldi & Elmslie, 2008; Rodrik, 2003; Robson & Haugh, 2009).

Second, the conceptualization and operationalization of institutions have evolved in recent literature (North, 1990; Engerman & Sokoloff, 1997; Furubotn & Richter, 2005; Kaufmann et al., 2005). However, the concept of institutions has been employed without a complete definition and measurement in the existing literature. For example, Kangoye (2013) employed "control of corruption" as an indicator of institutional quality. However, corruption control measures only a single aspect of governance. On top of that, the literature in economic growth modeling, based on institutional theory, used the concepts of institutional, political, economic, and general governances without unequivocally measuring those factors (Kaufmann et al. 2007a, 2007b). Asongu (2017) argued that the conceptualization and measurement problem of institutions have yielded controversial and very often inconsistent empirical findings. The current paper uses two different measures of institutions to deal with the conceptual flaws. First, it uses the polity IV project indexes of regime types for autocracy/democracy. Second, the paper relies on composite general

governance index constructed from the six different measures of World Governance Indicators by applying principal component analysis. The paper treats each of the regime types indicators independently in the estimation of the impact of institutional quality on cross-country variation in economic growth, to empirically identify the role of governance institutions and regime types in fostering economic performance.

Finally, it is important to empirically spotlight the direct and indirect channels via which institutional quality affects economic growth in the evaluation of the economic growth-institutional quality nexus because comprehensive growth- institutional development policies are not expected to be effective without considering the various ways through which institutions interact with economic performance and tailored differently across countries with different levels of institutional development. Given this background, the current paper aims at adding to the literature through empirical evaluation of the influence of institutional quality on economic performance. To this effect, a comprehensive concept of governance institution and regime types are used in the context of Sub-Saharan African economies.

4.2. Theory and Hypothesis

Previous studies have provided strong evidences that institutions play crucial role in explaining cross-country differences in economic performance. This is because of the fact that quality institutions foster economic productivity by creating congenial environment for investment and creativity (North, 1990; Acemoglu & Robinson, 2013; Rodrik, 2007). Acemoglu and Robinson (2013) argued that that government effectiveness in services, from tangible public infrastructure to intangible institutions like the rule of law are essential determinants of cross-country differences in economic performance. The literature in development policy discourse offers unwavering evidence that countries with better institutional quality excel in achieving higher and sustained economic growth (Przeworski et al., 2000; Todaro & Smith, 2009; Toh, 2016; Phillip, 2006). Przeworski et al. (2000), among others, economic growth and development is the outcome of democracy. Similarly, but lightly differently, Barro (1996) suggests a nonlinear relationship between democracy and economic performance in which democracy enhances growth at low levels of political freedom but depresses growth when a moderate level of freedom has already been attained. In a complete contradiction to these

empirical studies, there exists evidence that affirms that more political rights do not have an effect on growth (Barro, 1997). Countries that could not develop quality institutions suffer from low level of economic growth and vicious circle of poverty traps (Haggard, S., & Tiede, L.B., 2011; Tanzi and Davoodi, 2002 Blackburn et al., 2006; Baliamoune Lutz and Ndikumana, 2008). For instance, Blackburn et al. (2006) asserts that corruption generates low level of economic performance leading into poverty traps. Jong-a Pin (2009) argues that political instability and low levels of voice and accountability derives low level of economic growth. In countries and time periods with a high propensity of government collapse, economic growth is significantly lower than otherwise (Alberto et.al, 1996). Generally speaking, the literature in growth theory has been progressively pointing to the role of quality institutions in promoting economic performance (Hall &Jones, 1999; Easterly & Levine, 2003; Rodrik, et al, 2004).

Hypothesis 1: Differences in quality of institutions is positively associated with cross-country difference in economic performance.

Institutional theory and empirical evidence at cross-country levels have strong positive influence of institutional quality on innovative capacity of countries (Edinaldo Tebaldi & Bruce Elmslieet, 2008; Siegle et al., 2004; Mauro, 1997; Drezner, 2002; Esty & Porter 2002; Tanzi & Davoodi, 2002; Anokhin & Schulze, 2009). Meanwhile, unwavering empirical evidence points to the impact of innovation on cross-country differences in economic performance (Argentino Pessoa, 2007; Filippetti, Achibugi, 2011; Chu, 2010; Howells, 2005; Yang, 2006; Pianta, 2011). Based on these theoretical and empirical dispositions, we can argue that institutional quality affects economic performance through its impact on innovation, in addition to its direct effect. Countries that have achieved better level of institutional quality towards democratic governance tend to achieve higher growth rate (Claude Ake, 2003; Todaro Smith, 2009; Alence, 2004; Knutsen, 2010). Siegle et al. (2004) claim that "democracies are open: they spur the flow of information and free flow of ideas, every bit as much as the flow of goods, fosters efficient, customized, and effective policies." Acemoglu et al. (2018) offer empirical evidence that democracy increases future GDP by encouraging investment, increasing schooling, inducing economic reforms, improving public good provision, and

reducing social unrest. Furthermore, evidences indicate that the political power structure of a country plays critical role in influencing the effectiveness of national innovation policies (Drezner, 2002; North, 1990). That is, technological leadership requires devolution of political decision-making power as a necessary condition (Drezner, 2002). Argentino Pessoa (2007) concludes that innovation policy must always consider the complexity of the economic growth process and the other ways, besides the ones based on formal R&D indicators, in which technology has an impact on growth. Corruption and inefficiency in the bureaucratic structure are detrimental to innovation (Mauro, 1997; Aghion, Veugelers, and Serre, 2009; Tanzi & Davoodi, 2002). Poorly governed countries are less innovative compared with countries endowed with quality institutions (Belton, 2005; Gillian K. Hadfield, 2008), and hence, experiences low level of economic performance (Kiertisak Toh, 2016).

Hypothesis 2: There is an indirect effect of institutions on economic performance via innovation. This is equivalent to saying that, the better the quality of institutions, the better the innovative capacity and the better economic performance.

4.3. Research Methods and the Data

Model Specification

This investigation relies on two approaches. First, it uses linear econometric specifications that are suitable for panel data analysis. Second, it relies on structural equation models to identify the direct and indirect effects of institutional development on economic performance. The first approach is based on the theoretical developments by Aghion and Howitt (1992), Romer(1986), and Schumpeter(1934), and empirical models of Hassan, I., & Tucci, C. L. (2010), and Siddiqui Danish Ahmed & Ahmed Qazi Masood(2009) with the following econometric specification, which is used for empirical estimation:

$$GDPG_{it} = \theta + \alpha_1(INNOV_{it}) + \alpha_2(IQ_{it}) + \alpha X_{it} + \varepsilon_{it} \quad \text{.....(1)}$$

$$GDPG_{it} = \theta + \alpha_1(INNOV_{it}) + \alpha_2(IQ_{it}) + \alpha_3(INNOV_{it} * IQ_{it}) + \alpha X_{it} + \varepsilon_{it} \quad \text{...(2)}$$

The dependent variable in the equation ($GDPG_{it}$) represents the annual growth at country level gross domestic product. Innovation ($INNOV_{it}$) is measured by index of Scientific and Technical Journal Publications. Institutional quality (IQ_{it}) is operationalized with two different proxy indicators: the Worldwide Governance Indicators (WGI) from the World Bank and the Polity IV indicators of regime types. For governance quality indicator, a composite governance quality is constructed from the six components of governance quality indicators: Voice and Accountability (VA), Political Stability and Absence of Violence (PS), Government Effectiveness (GE), Regulatory Quality (RQ), Rule of Law (RL) and Control of Corruption (CC) by applying principal component analysis. The motivation for including the interaction term between innovation and institutional quality in the estimation technique is based on the assumption that innovation has a bigger effect on economic growth in countries with better institutional quality. Range of macroeconomic control variables (X_{it}) including lagged value of growth in GDP per capita, level of human capital development, gross capital formation, inflow of foreign direct investment, government consumption spending, household consumption spending, inflation, domestic credit to the private sector, labour force participation and trade as percentage of the size of the economy are used to explain cross-country differences in innovation.

The result of the principal component analysis for Eigenvalue and factor loading are presented in Table 4A. Table 4A shows that the Eigenvalue add up to the sum of the variances of the variables in the analysis—the total variance of the variables. The variables are standardized to have unit variance due to the fact that we are analyzing a correlation matrix. So, the total variance is 6. The eigenvalues are the variances of the principal components. The first principal component has variance of 4.8983, explaining approximately 82 percent (4.8983/6) of the total variance. The second principal component has variance of 0.4180 or 6.97% (0.4180 /6) of the total variance. The third principal component has variance of 0.3119 or 5.2% of the total variance. Similarly the fourth and the fifth principal components have 0.1912(3.19%) and 0.1004(1.67%) of the total variance, respectively. The last principal component has only 0.0803(1.34%) of the total variance.

Table 4A.

Principal Component Analysis for Governance Institutions

	Component Matrix(Loadings)								
Variable	VA	PS.	GE	RQ	RL	CC	Eigen value	proportion	cumulative proportion
Comp1	0.3900	0.3679	0.4224	0.4208	0.4367	0.4079	4.8983	0.8164	0.8164
Comp2	0.1418	0.8464	-0.3435	-0.1935	-0.0143	-0.3284	0.4180	0.0697	0.8861
Comp3	0.8660	-0.3322	-0.1241	-0.0013	-0.0456	-0.3497	0.3119	0.0520	0.9380
Comp4	0.2430	-0.0065	-0.1963	-0.6595	-0.0244	0.6833	0.1912	0.0319	0.9699
Comp5	0.0196	0.0784	0.7868	-0.5326	-0.0547	-0.2962	0.1004	0.0167	0.9866
Comp6	0.1359	0.1781	0.1749	0.2587	-0.8963	0.2213	0.0803	0.0134	1.0000

The data have been subjected to different econometric tests, in order to identify the consistency of the results. Principally, the instrumental variable approach to general method of moments is applied. This is because of its power in correcting for the problems of cross-dependence, endogeneity and heteroscedasticity. Econometric evidence proved that genera methods of moments (GMM) generate results with robust standard errors in the existence of cross-dependence and heteroscedasticity (Arellano &Bond, 1991; Arellano, 2003; Hall, 2005). To assess the resilience of the results, the fixed effect and random effect models were also applied. Greene, W. H. (2012) claims that these linear models offer relatively weaker results in the existence of heteroscedasticity and cross-dependence in the data sets. The Driscoll and Kraay (1998) robust standard errors are applied to deal with the estimation bias.

The second approach, which uses Structural Equation Models based on the causal process logic to identify, if any, indicates the direct and indirect effects of institutional quality on economic performance. It follows from the theoretical developments of Mankiw et al. (1992), Edinaldo Tebaldi & Bruce Elmslie (2008) and the empirical models of Dowson (1998), Furman et al. (2002), Hassan and Tucci (2010), d'Agostino, Giorgio & Scarlato, Margherita(2016), and Silve Florent & Plekhanov Alexander (2015). The causal chain postulated in the mediation process is presented in Figure 1. The model assumes a three-variable system such that there are two causal paths feeding into the dependent variable (i.e. growth in gross domestic product): the direct impact of the independent variable (i.e. institutional quality) and the impact of the mediator (i.e. innovation capacity) on the

outcome variable (Baron Kenny, 1986). The principal econometric specification of this approach takes off from equation 1, thereby rendering due attention to the causal process in the basic variables of interest. This generates two simultaneous equations as follows:

$$GDPG_{it} = \theta + \alpha_1 (INNOV_{it}) + \alpha_2 (IQ_{it}) + \alpha X_{it} + \varepsilon_{it} \quad \ldots\ldots (2.1)$$

And,

$$INNOV_{it} = \delta_1 (IQ_{it}) + \varepsilon_{it} \quad \ldots\ldots (2.2)$$

Accordingly, in order to assess the effect of institutional quality (IQ_{it}) on growth in gross domestic product $(GDPG_{it})$, its relationship to $INNOV_{it}$ has to be taken into account, so that:

$$\partial (INNOV_{it}) / \partial (IQ_{it}) = \delta_1 \quad \ldots\ldots (2.3)$$

And the partial derivative of Equation 2.1, now with respect to institutional quality (IQ_{it}) gives us the total effect of the quality of institutions (IQ_{it}) on growth in gross domestic product $(GDPG_{it})$ as:

$$\partial (GDPG_{it}) / \partial (IQ_{it}) = \alpha_1 \partial (INNOV_{it}) / \partial (IQ_{it}) + \alpha_2 \quad \ldots\ldots (2.4)$$

By substituting equation 2.3 into equation 2.4 we get:

$$\partial (GDPG_{it}) / \partial (IQ_{it}) = \alpha_1 \delta_1 + \alpha_2 \quad \ldots\ldots (2.5)$$

This final equation indicates a direct main effect (α_2) of institutional quality on growth in gross domestic product, and it's indirect effect $(\alpha_1 \delta_1)$, through its effect on innovation capacity. Thus, the effect of the quality of institutions (IQ_{it}) on growth in gross domestic product $(GDPG_{it})$ depends on the value of $INNOV_{it}$ to a greater extent than one should

expect from the direct effect alone. This means if we find significant association between quality of institutions and innovation, while at the same time the effect of innovation on growth in gross domestic product is also supported by evidence we have the total effect of institutional quality on growth in gross domestic product as:

$$\alpha_2 + \alpha_1 \delta_1 \qquad (2.6)$$

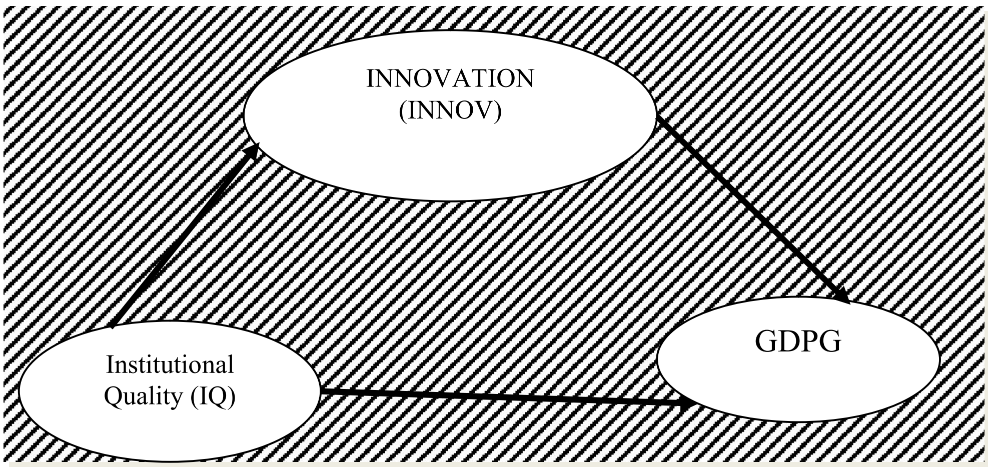

Fig. 4A: Causal chain of the mediation paths

The data

The data employed in this study is panel dataset consisting of 37 developing countries in Sub-Saharan Africa for the period 1996–2016. The choice of the time period and selection of countries is guided by the availability of complete data. Observations are taken as annual time series data for 21 years, for every country selected, resulting (at most) in a total of 777 observations.

Appendix (Table C1) presents the statistical summary of the key variables for countries pooled together for over the study period ranging from 1996 to 2016. Table C1 also displays that countries such as Angola, Mozambique, Rwanda, Ethiopia and Liberia are at the top in terms of economic growth, while Democratic Republic of Congo, Zambia, Swaziland, Burundi, Gabon and Central African Republic appear at the bottom. In terms of democracy score, Ghana, Botswana, Mauritius, South Africa, Lesotho and Benin are at the top, while

Gambia, Cameron, Swaziland, Sudan, Rwanda, Zimbabwe and Central African Republic appear at the bottom. Owing to governance quality, countries at the top include South Africa, Mauritius, Namibia, Botswana and Ghana while, Democratic Republic of Congo, Sudan, Zimbabwe, Burundi and Central African Republic appear at the bottom. It also demonstrates that the most innovative countries include: South Africa, Nigeria, Kenya, Ethiopia and Cameron while, Liberia, Sierra Leone, Mauritania, Lesotho and Burundi appear to be the least innovative countries. The description and sources of variables are presented in Appendix (Table C2). The summary statistics is presented in Appendix (Table C3). Appendix (Table C4) provides the correlation matrix. From Appendix (Table C4), reveals that the institutional quality indicators employed are highly correlated, justifying their use as substitutes.

Figure 4b- 4f present the scatter plots for sampled countries averaged over the study period (1996–2016). Figure 4b indicates that there is positive association between polity2 and economic growth. The fit line shows a positive relationship between the Journal Article Publications and governance quality. Figure 4c shows that innovation and economic growth are positively correlated. Figure 4d shows the presence of very strong positive correlation between innovation and poltiy2. Figure 4e displays that governance quality is positively correlated with economic growth. Finally, Figure 4f indicates very strong positive correlation between governance quality and innovation.

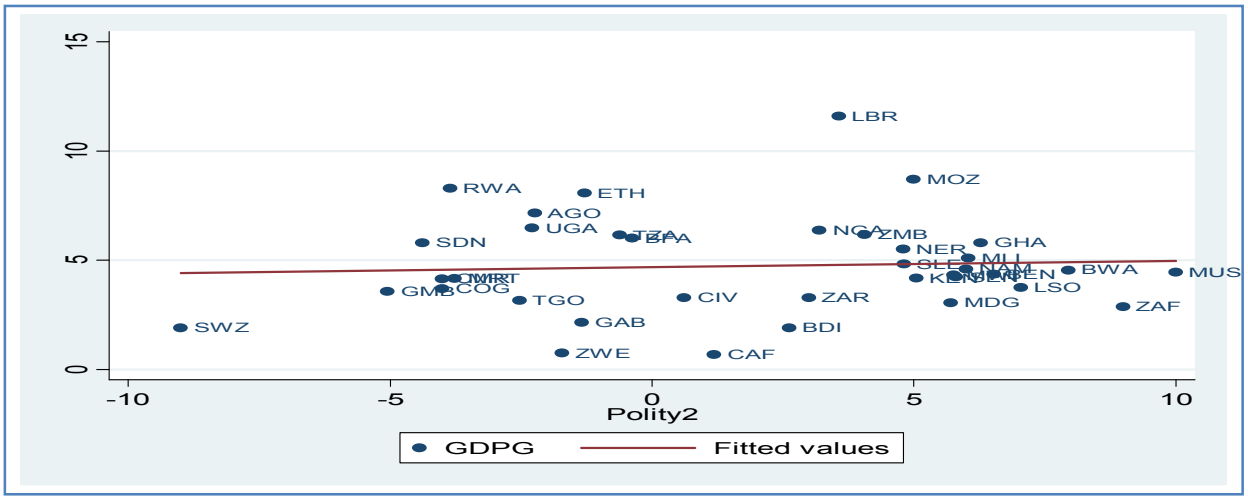

Fig. 4b: Scatter plot of GDP growth vs. Polity2

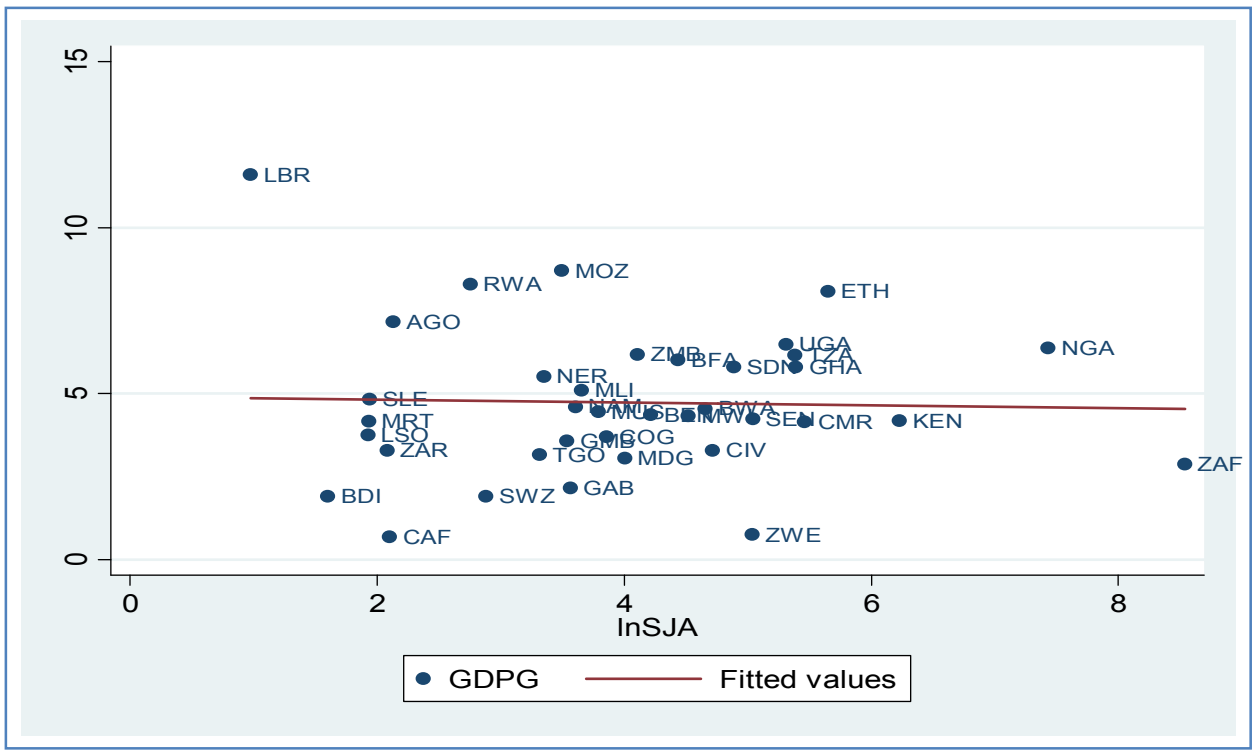

Figure 4c: Scatter plot of GDP growth vs. Innovation

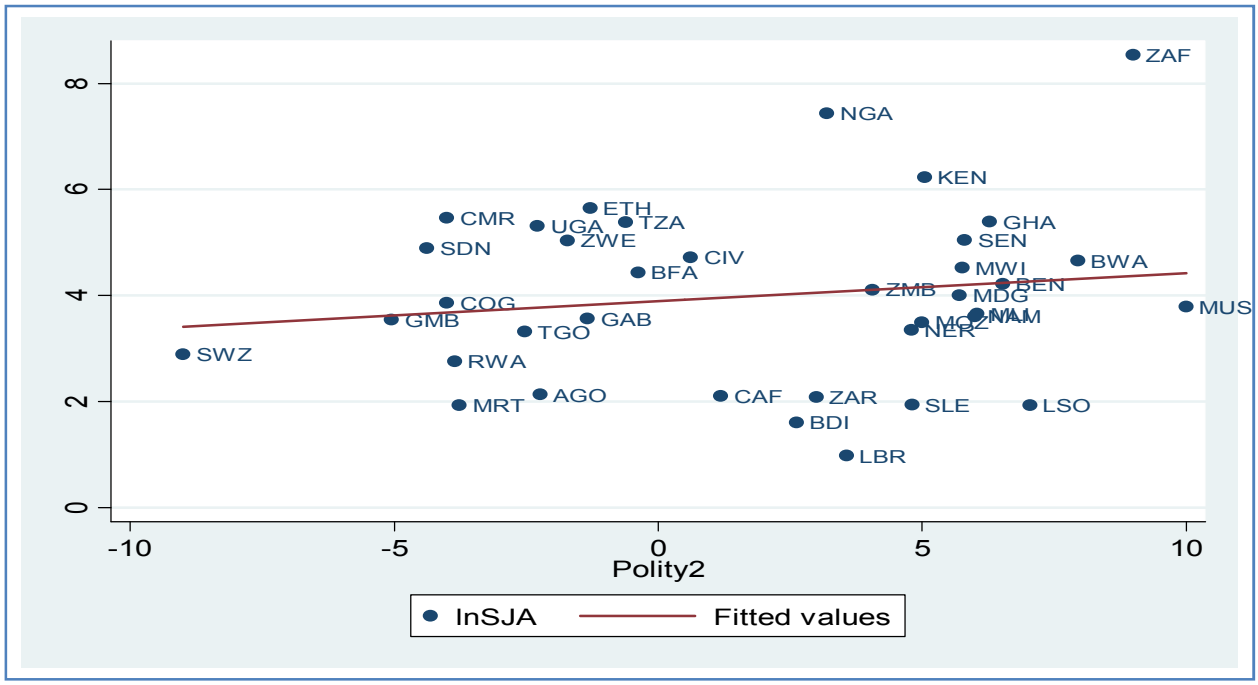

Fig. 4d: Scatter plot of innovation vs. Polity2

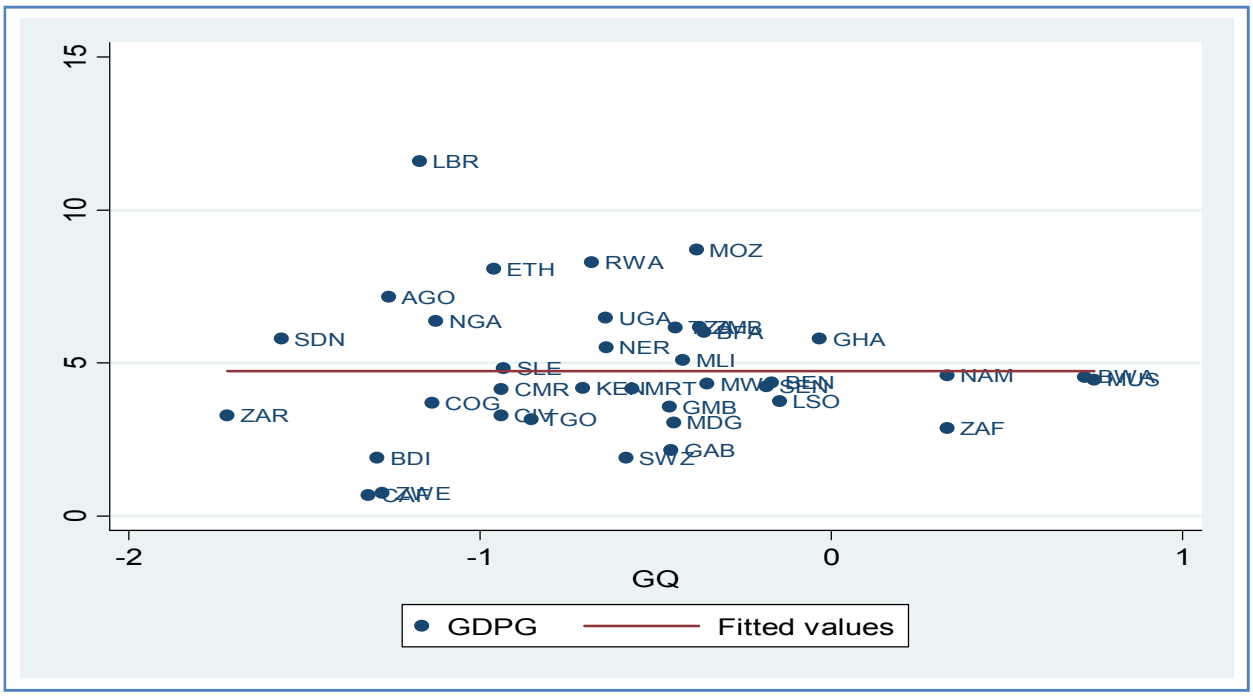

Fig. 4e: Scatter plot of GDP growth vs. Governance Quality

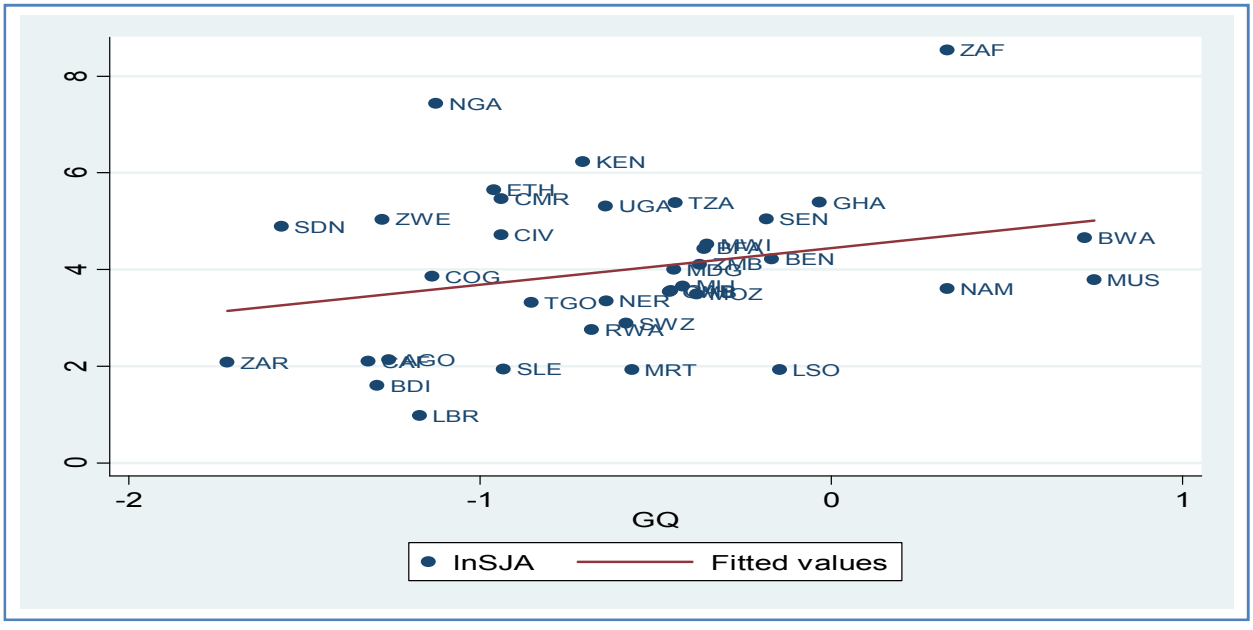

Fig. 4f: Scatter plot of innovation vs. Governance Quality

4.4. Empirical Results

Results for linear models

Tables 4B and 4C presented findings related to institutions, innovation and economic growth in Sub- Saharan African economies. These Tables are presented in three panels: the first, at the bottom, presents the results when polity2 is used as measure of the quality of political institutions. The second, in the middle, represents the results when democracy score is used to measure quality of political institutions. The third, at the top, represents the results for autocracy score as a measure of the quality of political institutions. Under each of these three measures of political institutions, four panels of results were presented: the IV(gmm), the fixed effect, the random effect and the IV(gmm), with interaction term between intuitional quality and innovation included in the model. The consistent differences observed in governance institutions estimated coefficients among the fixed effect, the random effect and IV (gmm) (in terms of sign, significance, and magnitude of significance) justify the importance of the implemented empirical strategy.

Table 4B and 4C presents results for the effect of regime types and innovation on economic growth. The following general findings can be established from Table 4B on the empirical association between quality of political institutions and economic growth in Sub-Saharan African economies. Firstly, in the Sub-Saharan economies examined in this research, improvement in democratization and innovative capacity of states can be seen to positively affect economic growth. As expected, autocracy appears to be negatively related with economic growth. This is confirmed by very high statistical significance of the coefficients in all the models tested to assess the relationship between quality of political institutions and economic growth. Second, the instrumental variables regressions— the most preferred regression models due to robustness as it corrects for problems of endogeneity — clearly reveal that the positive impact of democracy is consistent across alternative econometric specifications tested. The result implies that countries that achieved better level of political development towards democracy are in a better position in terms of economic growth (Claude Ake, 2003; Todaro & Smith, 2009; Alence, 2004; Knutsen, 2010). Similarly, the result implies that better level of innovative capacity induces economic growth. Third, most of the statistically significant control variables appear to have the expected signs for

their coefficients.

Contrary to the expected results, the effect of the interaction between democracy and innovation appears to be negative and insignificant at 5% level (see Figures 4f and 4h). However, the interaction term for autocracy is positive but insignificant at the 5% level (see Figures 4i and 4j). The literature provides strong evidence that early democracies are poor in terms of institutionalization when compared with their established autocratic counterparts (Moyo, 2012; Cheeseman Nic, 2015). The relatively rudimentary nature of institutional development and its different manifestations in terms of the overall instability of institutions might have influenced social and economic development in different ways (Gates et. al., 2006; Mansfield &Snyder, 2007) because low level of institutionalization makes countries prone to instability (Gates Scott, 2006; Nic Cheeseman, 2015).

Table 4D provides empirical findings concerning the effect of governance institutions and innovation on economic performance in Sub-Saharan African economies. The following general findings can be established concerning the association between quality of governance intuitions, innovation and economic growth. Firstly, for the cases investigated in this study, improvement in quality of governance institutions has a positive and statistically significant impact on economic growth. The IV (gmm) model— the preferred model—offers very strong evidence for the positive impact of development in quality of governance institutions on economic growth. Second, as expected, innovation appears to induce economic growth. That is, variation in innovative capacity of states is one of the major sources of cross-country differences in economic performance. These results are found to be consistent across tested alternative econometric specifications. Third, most of the statistically significant control variables appear to have the expected signs for their coefficients.

In contrast to the expectation, the interaction term for quality of governance institution with innovation appears to be negative and statistically insignificant, in the preferred model (see Figures 4k and 4l). The level of development of governance institutions is very low in Sub-Saharan African economies. That is, the minimum level of institutional development must be achieved for the conventional explanation to be observed. The data used in this study indicates that the mean value of governance score for cases investigated in this study is −0.60737 — a figure much lower than the neutral score of zero. In a situation where

governance institutions are underdeveloped, improvement in institutions requires series of intuitional reforms. Such a reform tends to be disruptive in its immediate ramifications. When institutional innovation takes place driven by its actors due to conflict and cooperation among them (Collin Crouch, 2005; Regini, 2014; Streeck, W., 2011, Streeck & Thelen, 2005), it leads into disruption of the existing pattern of interaction until certain level of institutional maturity is reached (Gates et. al., 2006). The short term disruption to existing patterns of social and economic interaction, due to institutional innovation, cannot be avoided regardless of the nature of the reform. It does not matter whether institutional reform is due to reformist state agenda (radical) or the friction among actors (i.e., gradual process).

Table 4B.Political Institutions, Innovation and Economic Growth

Dependent Variable: GDP growth; IQ: Polity2						
Variable	INT	RE	FE	IV(gmm)	GMM(xtabond2)	
$GDPG_{-1}$					*0.16134	0.1564*
					(0.09094)	(.0909)
GDPPCGlag	0.1292**	0.1382**	0.0013	0.1362***	0.29341***	0.2834***
	(0.0571)	(0.0609)	(0.0658)	(0.0599)	(0.10663)	(0.10704)
Polity2	0.1234***	0.1149**	0.317***	0.1322***	0.18661**	0.1799***
	(0.0372)	(0.0573	(0.1046)	(0.0414	(0.09112)	(0.08959)
INT	-0.00016*					-.00012
	(0.00007)					(0.000106)
SJA	0.0018***	0.00055**	-0.000056	0.0056***	0.00074***	0.00163**
	(0.00062)	(0.00028)	(0.000240	(0.00017)	(0.000253)	(0.000865)
HC	-2.0935	-1.97	-1.286	-1.807*	2.408**	2.458***
	(1.5644)	(0.7563)	(2.445)	(0.56)	(0.70348)	(0.70513)
TRADE	0.0228**	0.0218*	.0365**	0.0222**	0.03211***	0.0325***
	(0.0091)	(0.01264)	90.0159)	(0.00963)	(0.00748)	(0.007474)
INF	-0.0184***	-0.018***	-0.025***	-0.021***	-0.0178***	-0.0182***
	(0.00560	(0.0064)	(0.0058)	(0.0053)	(0.00549)	(0.00549)
HCE	-0.0069	-0.00701	-0.01514	-0.01105	-0.014945	-0.01404

	(0.0145)	(0.0217)	(0.0326)	(0.0148)	(0.01408)	(.01405)
DCP	-0.0193**	-0.0276**	-0.0538	-.0307***	-0.04069	-0.03285*
	(0.0098)	(0.0123)	(0.0353)	(0.0096)	(0.01395)	(0.01485)
FDI	-0.1025	-0.10268	-0.122***	-0.0919	0.14687**	0.1464**
	(0.0855)	(0.0497)	(0.0277)	(0 .0909)	(0.03239)	(0.03235)
GCE	-0.0099	-0.0181	-0.03077	-0.0115	-.043645	-0.0365**
	(0.038990	(0.0555)	(0.0853)	(0.0417)	(0.04541)	(0.0458)
GCF	0.086**	0.0869**	0.0594	0.0691*	0.0897***	0.08974***
	(0.0375)	(0.0398)	(0.0413)	(0.0393)	(0.03269)	(0.03264)
LFP	0.0595***	0.0559*	0.0265	0.0497**	0.05971***	0.06177***
	(0.0205)	(0.0297)	(0.0732)	(0.0216)	(0.02073)	(0.0208)
_cons	1.5015	1.9723	3.907	2.574	3.23023	2.77054
	(2.4884)	(3.3967)	(5.755)	(2.664)	(2.39037)	(2.4118)
Wald chi2	105.86	74.16	9.34	91.26	87.23	88.23
R^2 within	0.1209	0.0715	0.1023	0.1221	AR(1)=-7.44	AR(1)=-7.41
R^2between		0.4394	0.1277		AR(2)= 0.43	AR(2)= 0.43
					Sargan=255.8	Sargan=151.7
N	649	649	649	593	619	619

SJA: of scientific and technical journal articles index; GDPG-1 : lagged value of log of GDP growth polity2: polity2 index; HC: human capital, INT: interaction term for polity2 and innovation; GDPPCGlag: lagged value of GDP per capita growth; TRADE: trade as a percentage of GDP;INF: inflation rate; HCE: household consumption spending as a percentage of GDP; DCP: domestic credit to the private sector; FDI: foreign direct investment as percentage of GDP; GCE: government consumption expenditure as percentage of GDP; GCF: gross capital formation n as a percentage of GDP; EMP: employment level as percentage of the total population.

*Notes: Regression results for the system (gmm) are obtained by Arellano-Bond dynamic panel-data estimation of first-difference equations using generalized method of moments (GMM). All available lagged values of the dependent variables in each previous time period are used as instrumental variables in first-differencing. ***, **, * indicates significance at $\rho < 0.01$, $\rho < 0.05$ & $\rho < 0.1$ respectively.*

Table 4C.Political Institutions, Innovation and Economic Growth .

	IO: Democracy Score						IO: Autocracy Score					
Variable	IV(gmm)	FE	RE	INT	GMM(xtabond2)		IV(gmm)	FE	RE	INT	GMM(xtabond2)	
GDPG-1					.165014	.160518					.159698*	.157946*
					(.091876)	(.09178)					(.09021)	(.09225)
GDPPCGlag	0.1305**	0.00095	0.1403**	0.1307**	.30598**1*	.29573***	0.1291**	0.01353	0.1444**	0.1464**4	.2981***	.3053***
	(0.0624)	(.06582)	(0.0613)	(0.0582)	(.10761)	(.10787)	(0.0833)	(0.0651)	(0.06009)	(0.0583)	(.10614)	(.108195)
IQ	0.1633**	0.481***	0.16288*	0.1686**	.2068**	.19719**	-	-0.1883	-0.1778	-0.2058**	-.4189**	-.39815**
	(0.0731)	(0.1097)	(0.09775)	(0.0679)	(.10974)	(.11289)	(0.0833)	(0.2962)	(0.13006)	(0.0931)	(.1981)	(.195468)
INT				-0.00018**		-.000134				.000022		.0001997
				(0.00076)		(.000111)				(0.00054)		(.000706)
SJA	0.00057**	-0.00014	0.00057**	0.0019***	.00076***	.00178**	0.0053**	-0.00024	0.00053*	0.006***	.0662***	.0067***
	(0.00018)	(0.00024)	(0.00029)	(0.00065)	(.000255)	(.000898)	(0.00053)	(0.00024)	(0.00029)	(0.0002)	(.000255)	(.00259)
HC	-1.739***	-0.3693	-1.9476	-2.0368	2.2803***	2.3152**	-1.643**	1.2682	-1.8055**	-1.684*	2.2413**	2.249***
	(0.57127)	(2.1828)	(0.775820	(0.57198)	(.71763)	(.717086)	(0.5619)	(2.6259)	(0.7067)	(0.5718)	(.68274)	(.715881)
TRADE	0.0197**	0.038**	0.02008	0.0207**	.0297***	.02993***	0.0212**	0.0357**	0.0211*	0.0216**	.0317***	.03256**
	(0.0096)	(0.0158)	(0.0127)	(0.00903)	(.007342)	(.007329)	(0.00968)	(0.0159)	(0.0124))	(0.0094)	(.00752)	(.007873)
INF	-	-	-0.0178***	-0.0183***	-.01778***	-.01817***	-	-0.026***	-0.019***	-0.021***	-.01815**	-.0191***
	(0.0054)	(0 .0065)	(0.0066)	(0.0057)	(.00557)	(.005573)	(0.0053)	(0.00496)	(0.0064)	(0.00515)	(.00547)	(.005523)
HCE	-0.00714	-0.01569	-0.00531	-0.0048	-.010359	-.009442	-0.00557	-0.0113	-0.0021	-0.0047	-.009120	-.0101148
	(0.01598)	(0.0323)	(0.0219)	(0.0153)	(.01389)	(.01387)	(0.0150)	(0.03315)	(0.0207)	(0.0145)	(.01332)	(.013297)
DCP	-	-0.0572	-0.0286**	-0.0197**	-.04046***	-.03222	-0.027**	-0.0625*	-0.0239*	-0.0269**	.03639**	.03606**
	(0.0095)	(0.0351)	(0.01265)	(0.0097)	(.014864)	(.015886)	(0.0089)	(0.0344)	(0.0128)	(0.0087)	(.01328)	(.01325)
FDI	-0.09087	-0.1236**	-0.10027	0.10002	-.144***	.14378**	-0.0921	-0.1320	-0.1028**	-0.0976	.14689**	1.432***
	(0.09212)	(0.0368)	(0.0526)	(0.0869)	(.03254)	(.032482)	(0.0903)	(0.0334)	(0.0490)	(0.0876)	(.03263)	(.032724)
GCE	-0.00721	-0.03849	-0.02006	-0.01176	-.045102	-.037687	0.00315	-0.000074	-0.01016	0.00274	-.028602	-.034007
	(0.0437)	(0.08719)	(0.05715)	(0.0412)	(.046278)	(.04658)	(0.0426)	(0.0859)	(0.0521)	(0.0396)	(.045011)	(.045361)
GCF	0.07198*	0.05774	0.0887**	0.089**	.09333***	.09402***	0.07216*	0.0687*	0.0896**	0.0772**	.0924***	.08572**
	(0.0406)	(0.0417)	(0.03906)	(0.0379)	(.03273)	(.03267)	(0.0402)	(0.0412)	(0.0418)	(0.0379)	(.03306)	(.03387)
LFP	0.04625**	0.00643	0.05399*	0.0583***	.05664***	.05964***	0.0444**	-0.04121	0.0518*	0.0465**	.0509**	.05149**
	(0.0219)	(0.06005)	(0.03015)	(0.0207)	(.020811)	(.02096)	(0.0217)	(0.07132)	(0.0289)	(0.0212)	(.02086)	(.021318)
_cons	2.1391	2.67401	1.6562	1.0584	2.55017	2.02580	2.7598	4.6161	2.0081	2.4531	4.0348	4.1157
	(2.7968)	(5.6834)	(3.4046)	(2.5262)	(2.3575)	(2.39449)	(2.7745)	(5.690)	(3.4134)	(2.6524)	(2.5804)	(2.61488)
Wald chi2	82.55	9.30	62.20	99.19	84.92	86.47	89.46	9.45	70.23	91.25	86.62	
R^2 *within*	0.1160	0.1034	0.0694	0.1177	AR(1)=-8.26	AR(1)=8.2	0.115	0.0894	0.0628	0.1198	AR(1)=8.3	AR(1)-7.9
R^2*between*		0.0510	0.4239		AR(2)=- 45	AR(2)=.44		0.0220	0.4569		AR(2)=.49	AR(2)=0.5
N	590	648	648	648	618		590	648	648	620	618	618

SJA: of scientific and technical journal articles index; GDPG-1 : lagged value of log of GDP growth polity2: polity2 index; HC: human capital, INT: interaction term for democracy/autocracy and innovation; GDPPCGlag: lagged value of GDP per capita growth; TRADE: trade as a percentage of GDP;INF: inflation rate; HCE: household consumption spending as a percentage of GDP; DCP: domestic credit to the private sector; FDI: foreign direct investment as percentage of GDP; GCE: government consumption expenditure as percentage of GDP; GCF: gross capital formation n as a percentage of GDP; EMP: employment level as percentage of the total population. *Notes: Regression results for the system (gmm) are obtained by Arellano-Bond dynamic panel-data estimation of first-difference equations using generalized method of moments (GMM). All available lagged values of the dependent variables in each previous time period are used as instrumental variables in first-differencing. ***, **, * indicates significance at p < 0.01, p < 0.05 & p < 0.1 respectively.*

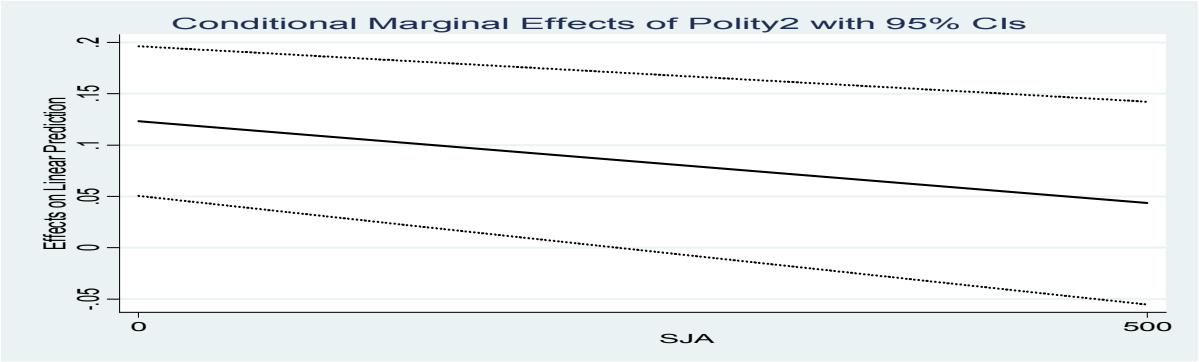

Fig.4g: Conditional Marginal Effects of democracy: control variables added

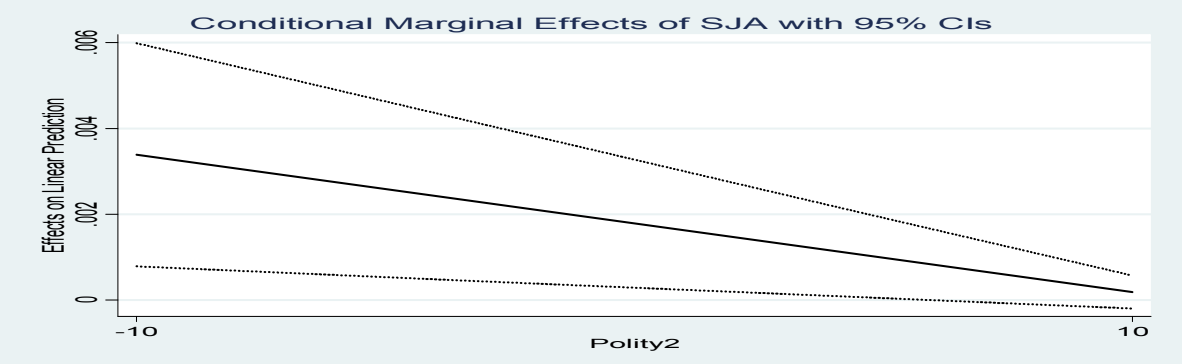

Fig.4h: Conditional Marginal Effects of democracy: control variables added

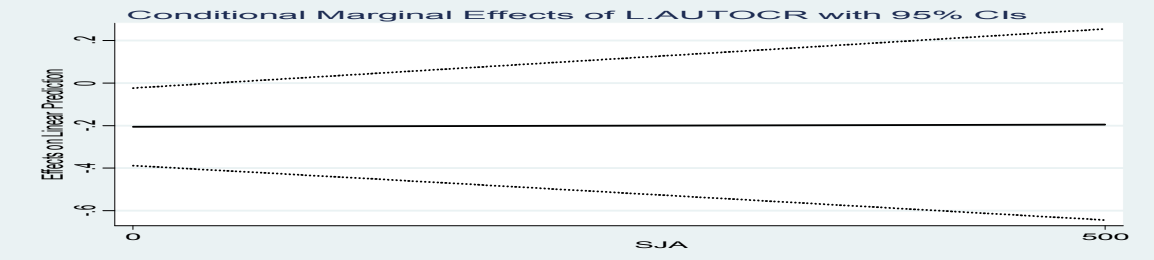

Fig.4i: Conditional Marginal Effects of democracy: control variables added

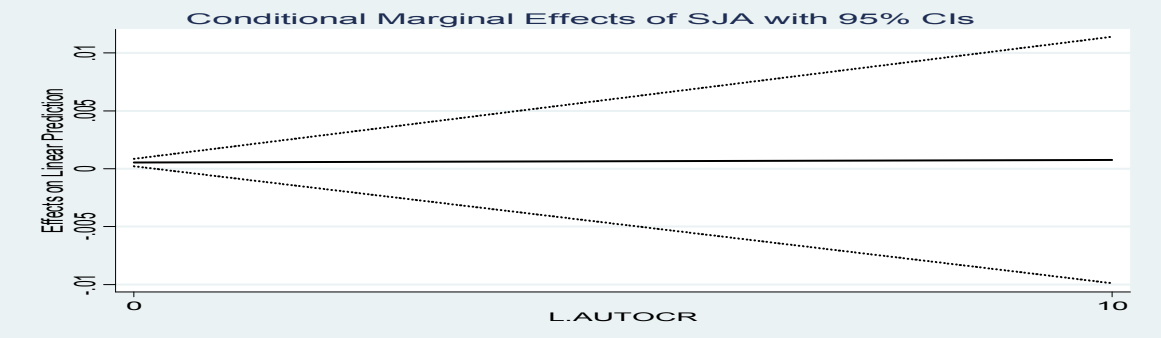

Fig.4j: Conditional Marginal Effects of democracy: control variables added

Table 4D.Governance Institutions, Innovation and Economic Growth

	IQ: Principal Component 1						IQ: Principal Component 2					
Variable	IV(gmm)	FE	RE	INT	GMM(xtabond2)		IV(gmm)	FE	RE	INT	GMM(xtabond2)RE	
GDPG-1					.26999***	.26752**					.2737***	.27413***
					(.105884)	(.10598)					(.10538)	(.105466)
GDPPCGlag	0.13222**	-.00915	.132228 **	.114276*	.40004**	.39732***	.145749**	.017567	.145749**	.1315765*	.3819***	.37819**
	(0.06008)	(.06640)	(.063345)	(.061313)	(.11436)	(.11472)	(.057727)	(.067085)	(.062333)	(.0597927)	(.112949)	(.113175)
IQ	0.3483**	1.0496*	.34824**	1.0481***	.70283**	.560202**	-.132086	.658045	-.132086	.4402986*	.248407	.22443
	(.15623)	(.65576)	(.17223)	(.3992968)	(.289074)	(.28309)	(.32922)	(.61336)	(.483419)	(.2577914)	(.64453)	(.710167)
INT				-.000272**		-.0001985*				-.0003028		-.000637
				(.0001299)		(.0001001)				(.0001716)		(.000748)
SJA	0.00074**	-.00009	.000739**	.00109***	.00107***	.00127***	.000534***	-.000266	.000534**	.000806**	.00633**	.0002217
	(.000196)	(.000267)	(.000332)	(.0002645)	(.000292)	(.000351)	(.000172)	(.0002389)	(.0003157)	(.0002089)	(.0025)	(.0005006)
HC	-2.2446**	1.97527	-2.24468**	-2.6363**	3.1219**	2.9413***	-1.6834**	1.8837	-1.6834	-2.0867***	1.878***	1.6944**
	(0.62014)	(3.1167)	(.824008)	(.6787767)	(.81999)	(.819264)	(.55412)	(2.58016)	(.7309241)	(.5774073)	(.66518)	(.68768)
TRADE	.02121**	.0365**	.021209*	.023539**	.036165***	.03484***	.020010**	.034895**	.02001	.0203815*	.03238**	.03027***
	(.009223)	(0.0159)	(.013205)	(.0094295)	(.007357)	(.007341)	(.008767)	(.015876)	(.012652)	(.0090895)	(.007987)	(.0080103)
INF	-.01532**	-0.025***	-.015324**	-.01659***	-.015653***	-.01718***	-	-.02525***	-.01906***	-.01753***	-.0253***	-.02463***
	(00563)	(0 0058)	(00648)	(0056497)	(006146)	(006131)	(005753)	(005436)	(006797)	(0056729)	(005599)	(0056081)
HCE	-.00232	-0.01514	-.002303	-.0013551	-.011698	-.010821	.0009407	-.0121195	.0009407*	-.0024061	-.006617	-.0053735
	(0.01452)	(0.0326)	(.021409)	(.0146636)	(.012815)	(.012819)	(.014618)	(.03288)	(.02112)	(.01461)	(.01297)	(.0130797)
DCP	-.0359***	-0.0538	-.035931**	-.034765**	-.05249**	-.03115*	-.021148**	-.064739*	-.021148	-.0182565	-.021453	-.0239051
	(.01057)	(0.0353)	(.014445)	(.0123098)	(.017499)	(.017813)	(.00858)	(.03451)	(.0135882)	(.0113642)	(.01314)	(.0140969)
FDI	-.08731	-0.122***	-.08731	-.0802019	-.141793	.14336***	-.102428	-.13538**	-.102429**	-.0938704	.15704**	.15837***
	(.08782)	(0.0277)	(.05388)	(.0902751)	(.033244)	(.033282)	(.086997)	(.03258)	(.049278)	(.0880756)	(.032587)	(.032666)
GCE	-.026159	-0.03077	-.0261592	-.0266478	-.0507743	-.038209	-.009515	.0112118	-.0095152	-.0218169	-.028959	-.023347
	(.03960)	(0.0853)	(.052109)	(.040696)	(.047044)	(.047113)	(.042451)	(.089222)	(.052777)	(.0399006	(.04763)	(.047883)
GCF	.07601**	0.0594	.07607**	.0723853*	.056255	.06353*	.09844***	.0673085*	.09844***	.0894922*	.09152**	.092572**
	(.03745)	0.0413	(.036595)	(.0383707)	.03559	(.035492)	(.037149)	(.040173)	(.038164)	(.0378483)	9.031955)	(.032071)
LFP	.0595***	0.0265	.05949**	.061438**	.06951***	.07245***	.05345***	-.0374084	.05345*	.059019**	.0598***	.06129***
	(.021227)	(0.0732)	(.03019)	(.0210357)	(.020568)	(.020952)	(.02068)	(.068328)	(.02895)	(.0209579)	(.020323)	(.020466)
_cons	2.4311	1.03625	2.43107	2.766579	3.81113	2.63873	.919703	2.95222	.919703	1.677106	.91577	.517186
	(2.4415)	(7.40315)	(3.34486)	(2.602184)	(2.5309)	(2.5291)	(2.49134)	(6.47642)	(3.33499)	(2.454046)	(2.26439)	(2.32015)
Wald chi2	82.51	12.01	63.89	96.93	93.79		74.80	8.48	59.96	87.94	87.40	87.27
R^2 *within*	0.1166	0.1038	0.0672	0.1256	AR(1)=-6.25	AR(1)=-6.25	0.1069	0.0910	0.0583	0.1121	AR(1)=-6.6	AR(1)=-6.6
R^2*between*		0.0208	0.4594		AR(2)=- 61	AR(2)=0.58		0.0057	0.4491		AR(2)=.67	AR(2)=.71
N	649	649	649	649	619		649	649	649	649	619	1619

SJA: of scientific and technical journal articles index; GDPG-1 : lagged value of log of GDP growth polity2: polity2 index; HC: human capital, INT: interaction term for governance and innovation; GDPPCGlag: lagged value of GDP per capita growth; TRADE: trade as a percentage of GDP;INF: inflation rate; HCE: household consumption spending as a percentage of GDP; DCP: domestic credit to the private sector; FDI: foreign direct investment as percentage of GDP; GCE: government consumption expenditure as percentage of GDP; GCF: gross capital formation n as a percentage of GDP; EMP: employment level as percentage of the total population. *Notes: Regression results for the system (gmm) are obtained by Arellano-Bond dynamic panel-data estimation of first-difference equations using generalized method of moments (GMM). All available lagged values of the dependent variables in each previous time period are used as instrumental variables in first-differencing. ***, **, * indicates significance at $\rho < 0.01$, $\rho < 0.05$ & $\rho < 0.1$ respectively*

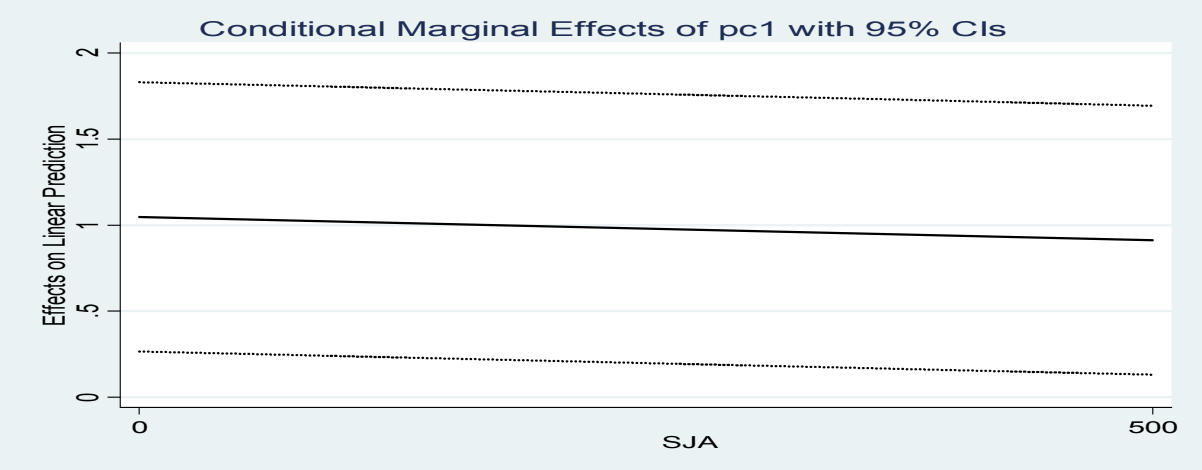

Fig.4k: Conditional Marginal Effects of Governance Institution: control variables added

Fig.4l: Conditional Marginal Effects of Innovation: control variables added

Structural Equation Models

Tables 4D and 4E present the results of the structural equation models for the nexus among institutions, innovation and economic growth in Sub-Saharan African economies. These Tables are presented in three panels based on the measures employed for institutional quality. In Table 4D, institutional quality is measured with regime types and in Table 4E institutional quality is measured with the principal component analysis indexes, generated from the World Bank's governance indicators dataset. For every institutional measure two sets of econometric specifications are reported. The first is without interaction term for institutions and innovation, while the second is with interaction term introduced into the models.

The following general findings can be established from table 4D concerning the direct

and indirect effect of political institutions on economic growth. First, the direct effect of democratization on economic growth is confirmed to be positive and statistically significant. Second, the effect of institutions on innovation is positive and statistically highly significant. At the same time, the effect of innovation on economic growth is found to be positive and statistically highly significant. Taken together, these results corroborate strong evidence for the direct and indirect effects of political institutions on economic growth. The findings confirmed earlier studies on the effect of political regimes on innovation and economic performance (Todaro and Smith, 2009; Alence, 2004; Knutsen, 2010; Rodrik, 2000).

When the interaction term and the covariates are added to the model (i.e. model (2)), the results reported above does not change to any noticeable degree. But, the coefficient of the interaction term is found to be negative and insignificant for democracy scores while it is positive and insignificant for autocracy score confirming results of the linear models. The negative coefficient implies that the conditional marginal effect of democracy decreases for every increase in innovative capacity index and vice versa. On the contrary the positive coefficient of the interaction for autocracy implies that the effect of innovation on economic growth is better under established autocracy. The result confirmed the argument that early democracy suffers from poor level of institutionalization compared with its established autocracy (Acemoglu & Robinson, 2006; Bollen & Jackman, 1985; De Meur & Berg-Schlosser, 1996; Helliwell, 1994; Huntington, 1991; Kim, 1998; Kopstein & Wittenberg, 2010; Lipset, 1981).

The following general findings can be established from table 4E about the association between governance institutions, innovation and economic growth in sub Saharan African economies. First, the direct effect of governance quality on economic growth is confirmed to be positive and statistically highly significant. Second, the effect of government quality on innovation is also positive and statistically highly significant. Similarly, the impact of innovation on economic growth is found to be significant and positive. As expected, governance quality appears to influence economic growth through two channels: directly and indirectly through its positive effect on innovative capacity of states.

When the interaction term between governance quality and innovation is introduced, the results reported in the basic specification do not change. The interaction term between governance quality and innovation appears to be negative and insignificant verifying the

results in the linear models.

Table 4E: Political Institutions, Innovation and Economic Growth

Estimates of Structural Equation Models						
	IQ: Polity2		IQ: Democracy Score		IQ: Autocracy Score	
Variable	(1)	(2)	(1)	(2)	(1)	(2)
SJA <-						
IQ	55.38***	55.38***	100.156***	100.156***	-103.05***	-103.05***
	(10.711)	(10.711)	(20.2131)	(20.2131)	(18.016)	(18.016)
_cons	250.92***	250.919***	-23.94***	-23.94***	573.422***	573.422***
	(26.816)	(26.816)	(38.944)	(38.944)	(82.754)	(82.754)
GDPG<-						
SJA	0.00056***	0.00179***	0.00057***	0.00057***	0.00054***	0.00054***
	(0..00017)	(0.000618)	(0.000169)	(0.000169)	(0.000165)	(0.000165)
IQ	0.1149 ***	0.1235***	0.1629**	0.1686**	-0.1778**	-0.17095*
	(0.03717)	(0.03723)	(0.06782)	(0.06799)	(0.08265)	(0.09436)
INTR		-0.000159*		-0.00018*		0.0000828
		(0.000072)		(0.000076)		(0.000469)
GDPPCGlag	0.1383***	0.1292**	0.14029**	0.1307**	0.14439**	0.14451**
	(0.05714)	(0.05713)	(0.05812)	(0.05828)	(0.0577)	(0.05746)
HC	-1.9708***	-2.0935***	-1.9476**	-2.0368**	-1.8055**	-1.78455**
	(0.55864)	(0.56482)	(0.56746)	(0.5724)	(0.5575)	(0.57766)
TRADE	0.0218***	0.0228**	0.0201 **	0.02068**	0.0211**	0.02086**
	(0.009002)	(0.00903)	(0.00904)	(0.0091)	(0.009028)	(0.009112)
INF	-0.0179***	-0.0184 ***	-0.0178***	-0.0183***	-0.0186***	-0.0186***
	(0.00554)	(0.00563)	(0.00562)	(0.00573)	(0.005598)	(0.00552)
HCE	-0.00702	-0.00693	-0.00531	-0.00481	-0.00208	-0.00196
	(0.0144)	(0.01437)	(0.01535)	(0.01533)	(0.01433)	(0.01432)
DCP	-0.0276**	-0.01929 **	-0.0286**	-0.01972**	-0.0239***	-0.02404***
	(0.00908)	(0.00982)	(0.00911)	(0.009723)	(0.00865)	(0.00868)
FDI	-0.1027	-0.10245	-0.10027	-0.10003	-0.10279	-0.10284
	(0.0866)	(0.08557)	(0.08791)	(0.08696)	(0.08613)	(0.08618)
GCE	-0.0182	-0.00994	-0.02006	-0.01176	-0.01016	-0.01072
	(0.04023)	(0.03998)	(0.04135)	(0.04117)	(0.04044)	(0.03973)
GCF	0.0869**	0.0861**	0.0887**	0.08904**	0.0896**	0.09031**
	(0.0378)	(0.03752)	(0.0382)	(0.03803)	(0.03824)	(0.03783)

LFP	0.0559***	(0.05952)	0.05399***	0.0583***	0.05184**	0.05214**
	(0.02055)	(0.02048)	(0.02075)	(0.02075)	(0.02062)	(0.020774)
_cons	1.9724	-17.82901	1.6563	1.05837	2.0081	1.95596
	(2.4881)	(1.1782)	(2.5236)	(2.52816)	(2.5326)	(2.5655)
R2(SJA)	0.0607	0.06067	0.07537	0.07537	0.04094	0.04094
R2(GDPG)	0.1538	0.35079	0.15074	0.37291	0.14534	0.14576
log likelihood	-32557.88	-39157.31	-32157.04	-38745.41	-32030.98	-8832.178
Wald χ2(SJA)	26.73***	26.73	24.55***	24.55***	32.72***	32.72***
Wald χ2(GDPG)	88.82***	105.70	82.58***	99.04***	82.24 ***	82.43 ***
N(Obs)	649	649	648	648	648	648

SJA: of scientific and technical journal articles index; GDPG-1 : lagged value of log of GDP growth polity2: polity2 index; HC: human capital, INT: interaction term for democracy/autocracy and innovation; GDPPCGlag: lagged value of GDP per capita growth; TRADE: trade as a percentage of GDP;INF: inflation rate; HCE: household consumption spending as a percentage of GDP; DCP: domestic credit to the private sector; FDI: foreign direct investment as percentage of GDP; GCE: government consumption expenditure as percentage of GDP; GCF: gross capital formation n as a percentage of GDP; EMP: employment level as percentage of the total population.

*Notes: Regression results for the system (gmm) are obtained by Arellano-Bond dynamic panel-data estimation of first-difference equations using generalized method of moments (GMM). All available lagged values of the dependent variables in each previous time period are used as instrumental variables in first-differencing. ***, **, * indicates significance at $\rho < 0.01$, $\rho < 0.05$ & $\rho < 0.1$ respectively.*

Table 4F: Governance Institutions, Innovation and Economic Growth

	Estimates of Structural Equation Models					
	IQ: Principal Component 1		IQ: Principal Component 2		IQ: Principal Component 3	
Variable	(1)	(2)	(1)	(2)	(1)	(2)
SJA <-						
IQ	327.9858**	327.9858**	186.7532***	186.753***	309.8734***	309.8734***
	(74.06087)	(74.06087)	(57.41322)	(57.4132)	(69.54654)	(69.54654)
_cons	342.286***	342.286***	351.885***	351.885***	328.797***	328.7972***
	(42.3859)	(42.3859)	(45.2828)	(45.2828)	(40.25513)	(40.25513)

GDPG<-						
SJA	0.00079***	0.001086***	0.000641***	0.00081***	0.000659***	0.001089***
	(0.000198)	(0.000265)	(0.000179)	(0.000209)	(0.0001839)	(0.000335)
IQ	1.0367***	1.04809***	0.384046	0.4402986*	0.60416*	0.63558*
	(0.398731)	(0.399605)	(0.256143)	(0.2579903)	(0.36150)	(0.359617)
INT		-0.000272*		-0.000303*		-0.000405*
		(0.00013)		(0.000172)		(0.000233)
GDPPCGlag	0.12195**	0.11428**	0.139957**	0.131577**	0.136549**	0.127322**
	(0.06111)	(0.06136)	(0.059548)	(0.0598389)	(0.0601482)	(0.059632)
HC	-2.54327*	-2.6363*	-1.9334**	-2.08667*	-2.073322*	-2.185805**
	(0.673666)	(0.67930)	(0.5669313)	(0.577853)	(0.625463)	(0.6281808)
TRADE	0.02334***	0.023539**	0.020123**	0.020382**	0.022114**	0.022492**
	(0.0094348)	(.0094368)	(0.009085)	(0.009097)	(0.009615)	(0.0096051)
INF	-0.01626***	-0.01659***	-0.01737***	-0.01753***	-0.01521***	-0.015598***
	(0.005557)	(0.005654)	(0.005559)	(0.005677)	(0.005623)	(0.005736)
HCE	-0.001183	-0.001355	-0.001448	-0.002406	-.0000722	-0.0000432
	(0.0146795)	(0.014675)	(0.014588)	(0.014621)	(0.014304)	(0.0142931)
DCP	-0.043796**	-0.03477**	-0.02778**	-0.018257	-0.031122**	-0.0213522*
	(0.011505)	(0.012319)	(0.00948)	(0.01137)	(0.009864)	(0.011746)
FDI	-0.081365	-0.080202	-0.096116	-0.09387	-.0904374	-0.089232
	(0.090915)	(0.090345)	(0.088509)	(0.088144)	(0.086883)	(0.086057)
GCE	-0.031306	-0.0266478	-0.023812	-0.021817	-0.019425	-0.013289
	(0.040887)	(0.040727)	(0.040079)	(0.039931)	(0.039215)	(0.038923)
GCF	0.072375**	0.072385**	0.090505**	0.089492**	0.081297**	0.081822**
	(0.038516)	(0.038403)	(0.037954)	(0.037877)	(0.037051)	(0.036929)
LFP	0.05743***	0.06144***	0.05499***	0.05902***	0.05999***	0.0650599**
	(0.020896)	(0.021052)	(0.020896)	(0.020974)	(0.0220582)	(0.021753)
_cons	3.13865	2.76658	1.6563	1.677106	1.582982	1.084194
	(2.60267)	(2.60419)	(2.5236)	(2.455939)	(2.37993)	(2.36287)
R2(SJA)	0.07824	0.078242	0.0250347	0.025035	0.06426	0.064277
R2(GDPG)	0.187338	0.23272	0.1544847	0.17803	0.160543	0.224899
log likelihood	-31294.021	-39157.31	-32157.04	-36769.609	-31293.846	-36765.499
Wald χ2(SJA)	19.61***	19.61	10.58 ***	10.58***	19.85***	19.85***
Wald χ2(GDPG)	86.01 ***	96.78	78.33***	87.81 ***	79.34***	88.36 ***
N(Obs)	649	649	-31406.213	648	648	648

SJA: of scientific and technical journal articles index; GDPG-1 : lagged value of log of GDP growth

polity2: polity2 index; HC: human capital, INT: interaction term for governance and innovation; GDPPCGlag: lagged value of GDP per capita growth; TRADE: trade as a percentage of GDP;INF: inflation rate; HCE: household consumption spending as a percentage of GDP; DCP: domestic credit to the private sector; FDI: foreign direct investment as percentage of GDP; GCE: government consumption expenditure as percentage of GDP; GCF: gross capital formation n as a percentage of *GDP; EMP: employment level as percentage of the total population.*

*Notes: Regression results for the system (gmm) are obtained by Arellano-Bond dynamic panel-data estimation of first-difference equations using generalized method of moments (GMM). All available lagged values of the dependent variables in each previous time period are used as instrumental variables in first-differencing. ***, **, * indicates significance at $\rho < 0.01$, $\rho < 0.05$ & $\rho < 0.1$ respectively.*

4.5. Conclusions and Policy Implications

This paper has aimed at contributing to the literature on the nexus between institutions, innovation and economic performance, in the context of developing countries. It relies on empirical panel dataset from 37 countries in Sub-Saharan Africa. As expected, democracy is confirmed to be positively associated with economic growth in developing countries, while autocracy is found to influence economic performance negatively. Political development towards democratization is confirmed to positively influence economic performance through two channels: directly and indirectly through its positive impact on innovative capacity of states.

The results in this study proved that stable democracy provides avenue for improvement in economic growth and development (North, 1990; Przeworski et al., 2000; Todaro & Smith, 2009; Oslon, 1993) and stimulates the innovativeness of countries (Hall, R. E. and C. I.& Jones, 1999; López-Claros, & Mata, 2009; Drezner, Daniel, 2002; Rodrik, 2007). Empirical evidences affirm that the impact of democratic political institutions on economic performance is more profound in underdeveloped economies than in consolidated democracies (Acemoglu et al., 2018; Pereira & Teles, 2010). This is due to the power of democratic political order in protection of fundamental political and civil rights, which in turn improves economic productivity.

In democracy, openness and free flows of information, every bit as much as the flow of goods, fosters efficient, customized, and effective policies (Siegle, Joseph et.al, 2004). Similarly, the empirical results suggest that quality of governance institutions does indeed advance economic growth. The empirical results offer strong evidence for the direct and indirect effects of governance institutions on cross-country differences in economic performance. This result is consistent with previous empirical studies that affirm poor governance itself is one of causes for some countries to remain poor and have low or negative growth rates (Kaufmann & Kraay, 2002; Easterly, 2001). For instance, corruption causes not only low level of economic performance but also generates poverty traps (Tanzi & Davoodi, 2002; Blackburn et al., 2006; Baliamoune Lutz & Ndikumana, 2008). Political instability and low levels of voice and accountability derive low level of economic growth. Higher degrees of political instability generates lower level of economic growth (Jong-aPin, 2009).On the other hand, strong rule of law offers better protection for private property rights thereby providing strong incentives for innovation and improvement in economic productivity. Conversely, the weakness of the government and the inability to provide law and order in the most basic sense constitute the most profound barrier to growth (Haggard, & Tiede, 2011). Acemoglu and Robinson (2013) claim that government effectiveness in delivery of ranges of public services; from tangible public infrastructure to intangible institutions like the rule of law are essential determinants of cross-country differences in economic performance. Evidence strongly supports that level of national innovation play critical role for improvement of economic performance in developing countries. The finding is consistent with those of previous studies on the nexus of innovation and economic growth (Filippetti, Achibugi, 2011; Howells, 2005; Yang, 2006; Bogliacino Pianta, 2011). Innovation spurs economic growth because it leads to higher productivity, meaning that the same input generates a greater output. As productivity rises, more goods and services are produced – in other words, the economy grows. Overall, the results suggest that developing countries need to focus on development of quality institutions as well as improvement of innovative capacity through research and development, investment into education and training, to improve their economic performance and to get out of poverty traps.

The result is consistent with existing evidences about institutional quality and economic performance in sub -Saharan African countries. African economies were described as hopeless

in terms of economic performance in 2002(Hopeless Africa, 2002). However, in about a decade many African economies have been able to witness unprecedented economic growth, resulting in the framing of Africa rising literature (Africa rising, 2011). Radelet (2010), claims that a number of African countries exhibit the characteristics of emerging economies. Kathleen et al. (2016) provide strong evidence that Africa has enjoyed robust economic growth in the last decade. But the growth is not uniform across Africa and country level variations are significant. About seventeen countries in sub-Saharan Africa (e.g., Angola, Chad, Equatorial Guinea, Ethiopia, Ghana, Liberia, Sierra Leone, Tanzania, Uganda, and Zambia) have experienced sustained high level of economic growth, rivaling those of rapid-growth, emerging economies in Asia (Kiertisak Toh, 2016). However, in countries such as Burundi, Central African Republic, Eritrea, Zimbabwe, Gabon, and many oil-exporting countries not only low growth rate is experienced, but also these economies remain fragile. Empirical evidences suggest that emerging economies in sub-Saharan Africa are different in terms of economic fundamentals and quality of institutions and governance from none emerging slow-growth group (Kiertisak Toh, 2016; Garner Phillip, 2006; Cornell University et al., 2018). Supported by the institutional development experienced in economies such as South Africa, Mauritius, Botswana, Namibia, Rwanda, and Burkina Faso (Cheeseman Nic, 2015), Sub- Saharan Africa has its highest scores in institutions and market sophistication in 2017(Cornell University et al., 2018). The Africanist literature provides strong evidence that substantial portion of the continent(Mauritius, Namibia, Senegal, Benin, Botswana, Cape Verde, Ghana, and South Africa) are moving towards democratic institutionalization(Cheeseman Nic, 2015; Freedom House, 2018). However, the Economist Intelligence Unit's democracy index awarded a full democracy status only to Mauritius and many African states which are identified to be in the hazy ground between democracy and autocracy. Similar to the variation in economic performance, institutional development, and particularly democratic development in Africa appears to exhibit regional divergence. Southern and Western African states have significantly improved their democratization and governance quality, while Central and East Africa have endured major backlash (Temnin John, 2018; House, 2018).

Chapter Five

Epilogue. What can we learn from analysis of the nexus of institutions, innovation and economic growth in Africa?

5.1. Introduction

Edinaldo Tebaldi & Bruce Elmslie (2008) contrary to previous studies suggests that a good way to study the role of institutions in promoting economic growth is not to study in terms of its direct effect alone, but to consider the impact of technological innovation in the nexus of institutions and economic performance. They argue that focusing only on the direct effect of institutions risks predefining the object and thus not seeing it as it really is. That means the dual effects of institutions are going to be overlooked if our analysis of the role of institutions fail to capture the indirect effect of institutions. When institutions are poorly developed such as in sub-Saharan African economies, one must take a comprehensive view to see it clearly. This is because improvement in institutions in such a context plays significant role directly and indirectly by harnessing sectoral policies. The alternative (Rodrik, 2000; Acemoglu et al., 2001; Easterly & Levine, 2003; North, 1990) is to consider the direct effect of institutions on economic performance. This project has first considered how political and governance institutions affect technological change, and then the effect of technological change in the nexus of institutions and economic performance. The role of technological change as a mediator or moderator has been analyzed within a particular context. The thesis has, thus, highlighted the dynamism of the interactions between institutions and innovation and how it is linked to economic performance. From this close examination of a particular type of institutions (i.e., political and governance) and their interactions with innovation, as well as the impact of these interactions on economic performance, it has been possible to shed light on some trends and directions of institutional change and economic performance. The findings in this research, along with previous researches in the area, help to improve our understanding of the development of institutions and economic performance in contemporary sub-Saharan Africa.

From the main thesis, this short epilogue has tried to briefly explain how technological change and various elements of political and governance institutions are related in promoting economic performance in sub-Saharan African economies, and what are the implications for policy making in this context. Understandably, it is difficult and even potentially dodgy to try to develop predictions, particularly about the future state of affairs. Nevertheless, it is important to consider some key themes and trends that have emerged through empirical examination of the role of institutions, and what might be the implications for future developments in the nexus of institutions, technological change and economic performance in sub-Saharan Africa.

There are significant disagreements among scholars of sub-Saharan African studies about the likely future directions of institutional development, particularly on the development of political and governance institutions in sub-Saharan Africa (Cheeseman, 2015; Gareth Austin, 2010; Temnin John, 2018). Partly, this is because of different theoretical perspectives playing into the diversity of African countries in terms of social, political and economic issues. Cheeseman (2015) affirms that significant portion of the African Continent is democratizing by acknowledging that the large bulk of African states are still in murky ground between democracy and autocracy. Temnin John (2018), based on data from the freedom house, provides evidence that democratic development in sub-Saharan Africa has distinctive regional divergence. While southern and western Africa have shown significant improvements in the development of democratic political and governance institutions, eastern and central Africa have experienced major backlash. In general, the institutional development in sub-Saharan African countries is relatively geared towards democratic institutionalization. Sub-Saharan African state institutions as a result are fairly complex, producing contradictory observations and conclusions on how the state politics functions (Cheeseman, 2015; John Stremlau, 2016; Jakkie Cilliers, 2016). In this brief epilogue, it is aimed at adding a piece of knowledge towards better understanding of the state of development in political and governance institutions in sub-Saharan Africa and the implications of these developments on economic growth in the Continent.

Scholars of African studies tended to focus on the question of how to reform the politics and governance of African states so that typical African states become liberal democrats. In this piece of contribution, the researcher claims that this is not only wrong question, but also

misguided and misinformed and, in fact, focusing on this consequentialist question will obscure our understanding of the contemporary African states as they actually are. I consider it's essential to take an objective view, to analyze the key trends in institutional development and how they might keep on developing in the future, without any presumption that a typical African state should evolve into a liberal democracy. It is, therefore, proposed that the relevant debate in future research should focus on which type of democracy (i.e., liberal democracy, consensus democracy or social democracy) would be viable for African states. To this effect, future researches need to focus on examination of specific country cases. This research underscores that institutions in sub-Saharan African states are indeed evolving with significant implication on innovation and economic growth that the Continent witnessed in recent periods (Africa rising, 2011; Kathleen et al., 2016; Asongu, 2017; Radelet, 2010). This is not to say that the development is uniform across sub-Saharan Africa. Also, it is not to say that institutions in Sub-Saharan Africa are developed enough. The large numbers of regimes in Africa are still quite identified as either authoritarian or hybrid. In terms of democratization, The Economist Intelligence Unit's democracy index awarded full-democracy status only to Mauritius in 2018. This signifies that there is still a long way to go for democracy to take root in sub-Saharan Africa. A quite significant number of African states are still authoritarian and weaknesses in freedom of speech, accountability and transparency are observable. However, what are the implications if current trends of democratization continue? Based on the evidence analyzed in this research, It could be said that: (1) Sub-Saharan Africa will become more democratic in the near future; (2) innovative capability of Sub-Saharan African states will be improved; and (3) Africa will maintain momentum in terms of its economic growth.

5.2. Democratic Africa is emerging

The general popular perception that Africa's democratic deficit puts the Continent behind the rest of the world in the most obscure of political terms is fading away. In spite of the fact that millions of people elsewhere in the world live under regimes that can be described as authoritarian, oppressive and undemocratic, Africa is considered as the most vulnerable to democratic deficit. Cheeseman and Klaas (2018) provide strong evidence that there is strong African bias regarding democracy and good governance. Available evidences show that large

portion of the African Continent is democratizing against the odds. According to the 2008 report of The Economist Intelligence Unit's democracy index, the number of successful "coups from within" in sub-Saharan Africa has been dropped substantially since early 2000s. The index identifies four categories of regime types: full democracy, flawed democracy, hybrid and authoritarian. It puts most African countries in murky ground between democracy and autocracy, awarding full democracy status only to Mauritius, a country with very strong rule of law. Freedom House, a think tank based in the United States (US), produces that around 1990 only 17 out of the 50 African countries on which it reported could be classified as 'free' or 'partly free'. Its most recent data, for 2019, indicates that 32 out of 54 countries are 'free' or 'partly free'. Democratic progress in sub-Saharan Africa is uneven (Temnin John, 2018) despite the fact that holding periodic election is becoming common in African states (Democracy Index, 2018). The drop in number of successful coups is an indicator of the progress in development of democratic institutions in sub Saharan Africa; especially it signifies that peaceful transition of power is emerging in sub-Saharan Africa. Some countries in sub-Saharan Africa appear to defy the narrative of a democratic deficit in the continent. In 2016: Nigeria, Liberia and Ivory Coast are named among the countries with the biggest development in political rights and civil liberties by the Freedom House. These countries were previously known for instability and internal conflicts. For the first time in Nigerian history, an opposition party obtained political power through elections in 2015. In recent reports countries such as Botswana, Ghana, Cape Verde and Benin have also been lauded as democratic examples. Specifically, Ghana has witnessed the achievement of an established democracy by electing an opposition for 50.5% of the votes over the 49.5% to the ruling party on 7 December 2016. Senegal and Ghana are examples of relatively well-governed states as a result of repeated and successful alternations of political power.

In East Africa the giants like Ethiopia, Kenya and Tanzania are moving towards the path of democratization. In Ethiopia for instance, a soft revolution from 2016 to 2018 has lead into replacement of a very repressive regime with a relatively democratic one. Freedom House witnessed the development in Ethiopia as follows: "Following sustained protests in Ethiopia; the ruling party installed a reformist Prime Minister who lifted a state of emergency, released political prisoners, and permitted more open political debate" (Democracy Index, 2019). In Tanzania presidential election has already resulted in peaceful transition of political power

though it is limited to intra party figures. The 2015's election was seen as the most competitive and unpredictable in the Tanzania's history (Ulimwengu Jenerali, 2015*)*. In Kenya, the opposition and the incumbent agreed to work together though it is after crisis in the aftermath of general elections in 2013. The most recent general election in Kenya was held on 8 august 2017 to elect the president, members of parliament and local governments. The reported results indicated that incumbent President Uhuru Kenyatta was re-elected with 54% of the vote. The result was contested by the main opponent, Raila Odinga, who refused to accept the results and requested the Supreme Court to annul the outcome. The court annulled the results of presidential election and ordered fresh elections. However, the court validated parliamentary and local election results. The move by the opposition party to challenge the outcome through institutional mechanism is a very good lesson, and perhaps less common in sub-Saharan Africa. In Central Africa, a positive development is emerging as far as democratization is concerned. In Democratic Republic of Congo- a nation severely torn with instability and internal conflict - an opposition is elected to office in 2018 defying the conventional narratives. The 2016 polls in Central African Republic culminated to ending persistent conflict for years, and the presidential runoff was concluded peacefully in spite of months of sectarian and ethnic violence, albeit with a lower turnout. The Southern African region is relatively more democratic compared with the rest of African regions (Temnin John, 2018). Electoral outcomes in this region of the Continent are less contentious. Nevertheless, election is only one face of democracy. As the then UN secretary general Kofi Annan said: "Democracy is not just about one day every four or five years when elections are held, but a system of government that respects the separation of powers, fundamental freedoms like the freedom of thought, religion, expression, association and assembly and the rule of law … Any regime that rides roughshod on these principles loses its democratic legitimacy, regardless of whether it initially won an election." As result, sub-Saharan African governments need to promote the rule of law if furtherance of democratic governance is to be realized. Jakkie Cilliers (2016:1) argues that "democracy in much of Africa is constrained from delivering on its development potential for three reasons. First, governance capacity is lacking. Second, the quality of electoral democracy is thin. Finally, neopatrimonialism undermines electoral democracy in Africa". This means Sub-Saharan African states need to focus on institutionalization of their democratic progress to avoid the risk of backlash. Cheeseman (2015) affirms that Sub-Saharan African countries are

likely to continue to make democratic gains and consolidate them over time but there is a risk of backlash owing to poor institutionalization. Furthermore, Cheeseman (2018) argues that against the historical posture of African political institutions such as constitutions, legislatures and judiciaries as weak and vulnerable to manipulation, leading some to claim that the continent is 'institution-less'. Recent developments including the consolidation of presidential term limits in a number of Sub-Saharan African countries demonstrate that this depiction is no longer tenable. Institutional conditions that create the rule of law and guarantee a broad range of civil liberties to all citizens are preconditions to institutionalization of democracy. Mohamed A. El-Khawas (2001) asserts that this aspect of democratization is being implemented slowly and unevenly among African countries, because it requires institution building and huge resources to make changes and to train people to perform new roles. As Jean-Germain Gros (1998:3) succinctly puts it, the major purpose of institutionalization of democracy is "to make intrastate and state-society relations more balanced. Separation of power . . . checks and balances, administrative decentralization and accountability, freedom of speech, press, assembly, and . . . civilian hegemony over the military are some of the components of the second phase of democratization." Hence, institutionalization of democracy needs to focus on the balance and exercise of power among the legislature, the executive and the judicial bodies of the government system.

Available evidences reveal that there is impressive progress in Sub-Saharan Africa in terms of the rule of law in particular and the development of governance institutions in general. The Ibrahim index of African governance, an annual assessment developed by the Mo Ibrahim Foundation, focuses on what happens between elections. It conceptualizes good governance as safety and rule of law, participation by citizens and a respect for human rights, sustainable economic opportunity, and human development. The 2018 index provides strong evidence for positive development in governance institutions across Africa. At the top of the index were Mauritius, Seychelles, Cape Verde, Namibia and Botswana, while Central African Republic, South Sudan, Eritrea, Libya and Somalia – all nations torn by conflict – were at the bottom of the list. Intra and interstate conflicts have been one of the major reasons that undermined institutional development and economic performance in African countries. Internal conflicts polarize societies and make it more difficult for governments to reach a consensus in investing in state capacity, while external conflicts mobilize domestic population against a common

enemy thereby helping in state capacity building (Babajide Adedoyin, 2019). Chester A. Crocker(2019) attributes the prospect of governance development in Africa to macro variables such as educational access (especially for women), climate change impact and mitigation, development and income growth rates, demographic trends, internet access, urbanization rates, and conflict events. Chester A. Crocker (2019) further emphasizes on the potential influence exerted by the region's leading states, measured in terms of size, population, economic weight, and overall political clout and leadership prestige. The positive development in a critical mass of the leaders—e.g., South Africa, Nigeria, Kenya, Ethiopia, Cote d'Ivoire, Algeria, Egypt—will pull some others along in their wake; of course, with a possibility for the reverse as well. Moreover, the Afro-barometer provides strong evidence that the critical mass in Sub-Saharan has strong demand for jobs, better economic management, reduced inequality and corruption and such outcome deliverables as health, education and infrastructure (Massa Coulibaly et.al, 2019). These outcomes entail efficacious and quality governance institutions (Chester A. Crocker, 2019). Although it is difficult to claim that such institutions will consistently emerge, public choice theory suggests that it is reasonable to expect that good governance institutions will evolve over time in response to the quest by the critical mass. It is vital not to overemphasize the institutional progress and its development in Sub-Saharan African countries as it is, but if these trends continue there is potential for democracy and good governance to flourish. One basic question for further investigation at this juncture is: what is the effect of democracy on good governance? It would be better if this question is left for future researches.

5.3. Innovative and Growing Africa in the making

The empirical findings in this research and the evidence in the literature suggest that Sub-Saharan Africa will be more innovative. Furthermore, the Continent is likely to maintain its track records of economic growth momentum. For instance, the global innovation index reports show that most countries among the group of innovation achievers category have been from Sub-Saharan Africa region (Cornell University et al., 2018). Available evidences indicate that progress in institutional development and business sophistication have played an essential role in helping the region as a whole to catch up with Central and Southern Asia in terms of innovation. The substantial improvement achieved in institutional development in economies

such as South Africa, Mauritius, Botswana, Namibia, Rwanda, and Burkina Faso has lead into highest scores in institutions and market sophistication in Sub-Saharan Africa in 2017(Cheeseman, Nic, 2015; Cornell University et al., 2018). There is difference in the approach employed by Sub-Saharan African countries to improve their innovative capability for instance, large-sized economies such as South Africa, Kenya, Botswana, and Namibia expanded their investment in infrastructure development, while others such as Mauritius, Rwanda, Senegal, and Zimbabwe are achieving progress in innovation through investment in human capital development (Cornell University et al., 2018). Kenya and Rwanda evolved as prominent examples in using technology to catalyse new areas of growth. The biggest innovations that are coming out of Sub-Saharan Africa is in the area of financial service, which has disrupted traditional financial models. Rwanda is a pioneer in digitalizing health care education and general government services. Ndubuisi Ekekwe (2015) provides strong evidence that in Sub-Saharan Africa, innovation is accelerating and the Continent is finding better ways of solving local problems, even as it attracts top technology global brands. However, Sub-Saharan Africa is the least innovative region in the world, despite the strong performance of individual countries such as South Africa, Mozambique, Mauritius, Kenya, Rwanda, Malawi, and Botswana (Cornell University et al., 2018).

The African Union has a vision dubbed 2063 which aspires to transform African politics, society and its economy (African Union, 2014a). In pursuing this, African Union gives emphasis to the importance of innovation and development of technological capability. To this end, science and technological strategy has been developed (African Union, 2014b). "Technology and Innovation Strategy for Africa 2024 (STISA-2024) places science, technology and innovation at the epicenter of Africa's socio-economic development and growth (ibid)." The strategy emphasizes the importance of investments in education, technical competences and training, because science, technology, research and innovation remain critical to Africa's economic prosperity. The vision of the African Union could be considered appropriate because the existing literature has affirmed the critical role of human capital formation for improvement of innovative capability (Bourdieu, 1986; Maskell & Malmberg, 1999; Dakhli & De Clercq, 2004). As far as the sub Saharan African region is concerned, the empirical results in chapters 2 &3 suggests that improvement in quality of political and governance institutions play crucial role in human capital development. There is strong

theoretical argument that links institutions to human capital development. For instance, the argument in favour of primacy of institutions in social and economic change has been established in the existing literature (Rodrik et.al, 2004). Jeroen Klomp and Jakob de Haan(2013) offered empirical evidence that democratic development positively affects human capital formation. This is because of the fact that the fear of being replaced in an electoral politics serves as strong incentive to invest into education and training — the key for human capital formation. Brown and Hunter (2004) argued based on empirical evidence that failure to pay proper attention to education in a democratic society may result in the replacement of political decision makers through periodic elections. In a similar fashion, Ali Muhammad et.al (2015) affirms that countries with low level of development in their governance institutions neither properly utilize their human capital nor makes appropriate investment into human capital development. One possible counter argument to this theoretical and empirical explanation is that in the case of governance institutions the role is more likely to promote private initiatives. However, promoting private institutions presupposes for example, appropriate regulations, rule of law, corruption control, private property protection and quality government services. For instance, a governance system in which corruption is prevalent neither properly invests into Human capital development nor exploits existing human capital for productive purposes. Transparency international's report shows that sub Saharan Africa is the lowest-scoring region on the Corruption perception index (CPI); with an average of 32 out of 100 – the lowest score represents the most corrupt. That means development of quality governance institutions is primordial to the promotion of private interests. Concerning human capital development, the 2018 Mo Ibrahim index of African governance indicates that in Sub-Saharan Africa, there is a progress in education over the last decade. However, education quality remains poor in Sub-Saharan Africa despite the growth in enrolment (Bashir Sajitha et.al, 2018). Current education quality is not matched to the growing demand for education and jobs. Mo Ibrahim index shows that half of the Continent's countries (27) registered deteriorated education scores in the last five years, meaning that for over half of Africa's citizens (51.5%) education outcomes are worsening. The poor quality of education if further deteriorates would have significant repercussions on improvement in innovative capacity. As result, the improvement of the education quality is critical. This could be done by creating industry – university linkages so that industry operators are involved in the design of

educational curriculum, which could avoid mismatch between skills needed and the skills developed by educational institutions.

Development of innovative capability of Sub-Saharan African economies has a very good prospect if: 1) improvement in political and governance institutions are sustained (discussed above); 2) focus on comparative advantage of Africa guides innovation policy in the continent; and 3) the financial and infrastructural challenges are addressed. Effective rule of law and institutions that guarantee protection for intellectual and private property rights are critical for innovation (Gillian K. Hadfield, 2008; Mason et al, 2012; Ngatat, 2016; Papageorgiadis & Sharma, 2016). This is because in countries where the rule of law is strong, the incentive to innovate is high due to the fact that proper rule and the protection of intellectual property imply maximum rent to innovators. That means, guarantee for protection of private property such as patent rights, copy rights and trademarks serve as incentives to invest into research and development, which spurs innovation. Makhtar Diop (2017) suggests that Africa's innovation system needs to be built on sectors where it had a comparative advantage, which at least initially consisted of natural resource sectors. He further argues that Sub-Saharan Africa needs to invest into three steps of innovation policy to improve its innovation capability. These are: first include managerial and organizational capabilities to adopt existing innovations and piggyback on the advances that rich countries make, capturing exactly the returns that the economist Schumpeter (1934) predicted. Second, start collaborative projects with higher performing countries (like China). And, third step involves investing longer term in technological programs. This means long term evolutionary process approach to absorptive capacity development is adaptable to the context of Sub-Saharan African economies if they were to grow based on their natural resource endowment. Gustavo Crespi et.al (2018) offer strong empirical evidence to the idea that growing on the basis of natural resource-based activities should be understood as a long-term evolutionary process, from inception of the industry to maturity and internationalization. Ndubuisi Ekekwe (2015) offers evidence that innovation in Africa remains challenged by factors that indirectly stymie access to capital, including property rights, poor technical manpower, and inadequate infrastructure. That means, absorptive capacity development requires the intervention of the state through government policy instruments in areas of protection for intellectual property, education provision, and funding for research and development among others. However, state intervention may generate

government failure. Therefore, interventions such as these require systematic introduction in order to avoid possible government failure (M. G. Ukpabio et.al, 2016).

Given that institutional development and progress in innovation capacity has good prospect in Sub-Saharan Africa, the Continent has a potential to maintain its economic growth record. African economies were described as hopeless in the early 2000s because of poor level of economic performance and rampant poverty (Hopeless Africa, 2002). Nevertheless, many African economies have been able to move from vicious cycle of poverty into virtuous cycle of unprecedented economic growth in just a decade (Africa rising, 2011). Radelet (2010) argues that large number of sub Saharan African economies exhibit the basic features of emerging economies. Moreover, Kathleen et al. (2016) provide strong evidence that Africa has enjoyed robust economic growth over the last decade. However, evidences show that the growth is not uniform across Sub-Saharan Africa and country level differences are significant. About seventeen countries in Sub-Saharan Africa (e.g., Angola, Chad, Equatorial Guinea, Ethiopia, Ghana, Liberia, Sierra Leone, Tanzania, Uganda, and Zambia) have experienced sustained high level of economic growth, rivaling those of rapid-growth, emerging economies in Asia (Kiertisak Toh, 2016). However, in countries such as Burundi, Central African Republic, Eritrea, Zimbabwe, Gabon, and many oil-exporting countries not only low growth rate is experienced, but also these economies remain fragile. Also evidences suggest that emerging economies in Sub-Saharan Africa are different in terms of economic fundamentals and quality of institutions and governance from none emerging slow-growth group (Kiertisak Toh, 2016; Garner Phillip, 2006; Cornell University et al., 2018). Sub-Saharan African region has become one of the fastest growing economies in the world, albeit the need to work for structural transformation. The economic growth record is driven principally by primary exports such as fossil fuel, minerals, and unprocessed agricultural commodities and forest products.

The Global Economic Prospects report recently released by the World Bank for Sub-Saharan Africa asserts that the Continent will maintain its growth momentum at the rate of 3.4% in 2019. Economic growth across Sub-Saharan region varies significantly. The three largest economies of the region (i.e. Nigeria, South Africa, and Angola) are expected to grow below the regional average. Nevertheless, there are large numbers of economies which are expected to grow at over 6 percent (e.g. Ethiopia, Rwanda, Burkina Faso, Cote d'Ivoire, Ghana, Niger, Tanzania, Senegal, and Uganda. Also, the predicted economic growth for Sub-Saharan African

economies is below the average of other emerging markets. This is because large sized and commodity-driven economies such as South Africa, Nigeria, Angola, and Zambia—are overwhelmed by a combination of macro-economic forces that inhibit progress and domestic challenges like unemployment, political instability, and corruption. But, countries like Ethiopia are in the spotlight. Ethiopia is on path to have nearly the highest GDP growth rate in the world, and a number of smaller economies like Tanzania, Kenya, Rwanda, and Ghana are growing at rates over 6 percent, a number on par or higher than China's expected growth. Moreover, these countries are also effectively attracting global capital through progressive policies aimed at diversifying their economies and growing the middle class. It is evident that Sub-Saharan African economies are growing and they are expected to grow in the near future too. However, the economic growth in sub Saharan Africa failed to result in significant progress in poverty reduction in the region (Kathleen et al., 2016; Sabina Alkire et al., 2017). Workers productivity is still low, while the population is growing above the economic growth rate. Sluggish progress towards key business needs such as power and rail infrastructure may also hurts investor confidence. Heidhues Franz (2009) argues that many of the strategies and approaches pursued to foster development in Sub-Saharan Africa since independence in the early 1960s have failed. Heidhues Franz points to two basic factors for the failure. The first is related to faulty strategies and policies propelled to Africa by international donors and development partners, and the second has to do with Africa's difficult geography and socio-cultural and institutional history; which cannot be changed in the short-run and need to be recognized as the given context within which development has to take place. Hence, for Sub-Saharan African region to maintain its growth record these bottlenecks need to be addressed. To this end, Sub-Saharan African region needs to focus on policies that tackle corruption, invest in infrastructure development, and enhance workers' productivity if it were to maintain its growth record.

5.4. Limitations

Every research - in spite of how well investigated or constructed – faces some limitations. As a result this thesis acknowledges some drawbacks, which by no account undermine the investigation or the findings. The primary limitation with the research is related to the issue of

data availability particularly on good proxy measures of innovation. While patent registration or patent application is considered the best proxy indicator of innovativeness at country level, it is not available for sub Saharan African economies. As a result the research uses scientific and technical journal publications index as a proxy indicator for innovation. Also it is impossible to find research and development spending for sub Saharan African economies. Although research and development spending is not considered better indicator of innovation than scientific and technical journal publications index, it would have been used for robustness analysis had it not been for data availability. However, the study is able to use the available data with different estimation methods to check for robustness. Second, in measuring the impact of institutions and innovation on economic growth, cross-country study of sub Saharan African countries is conducted using panel data. These countries are at variant level of institutional development and innovativeness, which implies that there might be better results in case countries within a specific sub-region or in a country-specific investigation were conducted, but owing to poor quality data, this was impractical to attain.

Bibliography

A. Kanitkar(1994). "Entrepreneurs and micro enterprises in rural India." *Economic and Political Weekly*, 29(9):25-30.

Abu-Bader, S., Abu-Qarn, A.M. (2008). "Financial development and economic growth: Empirical evidence from MENA countries." *Review of Development Economics*, 12(4):803–817.

Ace, Z. J., L. Anselin, and A. Varga(2002). "Patents and Innovation Counts as Measures of Regional Production of New Knowledge." *Research Policy, 31*(10): 69–85.

Acemoglu D., Suresh Naidu, Pascual Restrepo, and James A. Robinson (2019). "Democracy Does Cause Growth." *Journal of Political Economy*, 127(1): 47-100.

Acemoglu, D., and J. A. Robinson (2006). *Economic Origins of Dictatorship and Democracy*. New York: Cambridge University Press.

Acemoglu, D., and S. Johnson(2005). "Unbundling Institutions." *Journal of Political Economy,* 113(5): 949–995. doi:10.1086/432166.

Acemoglu, D., Johnson, S., Robinson, J. A., &Yared, P. (2005). "From education to

democracy?" *American Economic Review*, 95(2): 44–49.

Acemoglu, D., Z.J., L. Anselin and A. Varga (2002), Patents and Innovation Counts as Measures of Regional Production of New Knowledge, *Research Policy,* 31(10):69–85.

Acemoglu, Daron, and James Robinson. (2013). *Why Nations Fail*. New York: Crown Business.

Acemoglu, Daron, Simon Johnson and James A. Robinson(2005). "Institutions as the fundamental cause of long-run growth." In: *Handbook of Economic Growth.* Amsterdam: North Holland.

Acemoglu, Daron, Simon Johnson, and James A. Robinson (2001). "The colonial origins of comparative development: An empirical investigation." *American Economic Review*, 91(5):1369-1401.

Acemoglu, Daron, Simon Johnson, and James A. Robinson(2002). "An African success story: Botswana." *CEPR Discussion Paper 3219*. London: Centre for Economic Policy Research.

Acs, Z.J., L. Anselin and A. Varga (2002). "Patents and Innovation Counts as Measures of Regional Production of New Knowledge." Research Policy, 31(7):1069–85.

Africa rising (2011). "The Economist." (December 3). Retrieved from http://www.economist.com/ node/21541015

African Union (2014a). "On the Wings of Innovation: Science, Technology and Innovation strategy for Africa 2024." Addis Ababa: African Union Commission.

African union (2014b). "The Africa We Want: Agenda 2063, A Shared Strategic Framework for Inclusive Growth and Sustainable Development." Addis Ababa: African Union Commission.

Aghion, P., R. Veugelers, and C. Serre(2009). "Cold Start for the Green Innovation Machine." *Bruegel Policy Contribution* 12: 1–12.

Aghion, Philippe and Peter Howitt(1992). "A Model of Growth through Creative Destruction," *Econometrica*, 60(2): 323-351.

Albert, Michael, and Robin Hahnel (1999). *The Political Economy of Participatory Economics*. Princeton: Princeton University Press.

Albu and Bell (1999). "Knowledge Systems and Technological Dynamism in Industrial Clusters in Developing Countries." *World Development,* 27(9): 1715–1734.

Alcala, Francisco and Antonio Ciccone (2004). "Trade and Productivity." *Quarterly Journal of Economics,* 119 (2):613-46

Alence, R.(2004). "Political institutions and developmental governance in sub-Saharan Africa." *Journal of Modern African Studies,* 42(2): 163-187.

Alesina, A., Stelios M., E. Papaioannou(2016). "Ethnic Inequality." *Journal of Political Economy*, 124: 428-488.

Alesina, Alberto & Özler, Sule & Roubini, Nouriel & Swagel, Phillip (1996). "Political instability and economic growth." *Journal of Economic Growth*, 1(2):189-211.

Ali Muhammad et al., (2015). "Human Capital and Economic Growth: The Role of Governance." *The Pakistan Development Review*, 54(4):529–549.

Ames, Barry (1987). *Political Survival: Politicians and public policy in Latin America*. Berkeley: University of California Press.

Amman, E., & Cantwell, J.(2012). *Innovative firms in emerging market countries* (1st Ed.). Oxford: Oxford University Press.

Andrew Ruis and Nicolas Van de Walle (2003). "political and Cultural Institutions and Economic Policy Reform." Conference Paper presented at the Understanding Reforms Workshop Cairo January 16-17 2003.

Angelopoulos, K., G, Economides and V. Vassilatos (2011). "Do institutions matter for economic fluctuations? Weak property rights in a business cycle model for Mexico" *Review of Economic Dynamics*, 14(3): 511-531.

Annelies van Uden, Joris Knoben & Patrick Vermeulen(2016). "Human capital and innovation in Sub-Saharan countries: a firm-level study." *Innovation: Organization & Management,* 19(2):103-124.

Anokhin, S. and Schulze, W.S. (2009), Entrepreneurship, innovation, and corruption. *Journal of business venturing,* 24 (5): 465–476.

Arellano, M. (2003). *Panel Data Econometrics.* New York: Oxford University Press: Advanced Texts in Econometrics.

Arellano, M. and S. Bond (1991). "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations." *Review of Economic Studies,* 58(2): 277–97.

Argentino Pessoa(2007). "Innovation and Economic Growth: What is the actual importance of

R&D?" FEP Working Papers *254*, Universidade do Porto, Faculdade de Economia do Porto.

Aslund, P. Boone and S. Johnson (2001). "Escaping the Under Reform Trap." *IMF Staff Papers*, 48(SI):88-108.

Asongu, Simplice (2017a). Does Globalization Promote Governance Quality in Sub-Saharan Africa? An Empirical Study across 37 Countries. *World Affairs,* 180(2):105–141.

Asongu, Simplice, and Jacinta Nwachukwu (2016). "Revolution Empirics: Predicting the Arab Spring." *Empirical Economics*, 51(2): 439–82.

Asongu, Simplice, and Jacinta Nwachukwu(2017b). "The Impact of Terrorism on Governance in African Countries." *World Development*, 99(c):253-270. doi:10.1016/j.worlddev.2017.05.023

Aubert, Jean-Eric(2005). "Promoting Innovation in Developing Countries: A Conceptual Framework." *Policy Research Working Paper*; no. 3554. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/8965 License: CC BY 3.0 IGO."

Ayyagari, M., Demirgu¨c¸-Kunt, A. and Maksimovic, V.(2007). "Firm innovation in emerging markets." *World Bank policy research paper*, no. 4157. Washington, DC: World Bank.

Babajide, Adedoyin(2019). "Conflict and Economic Growth in Sub-saharan Africa." figshare.

Baldacci, E., B. Clements, S. Gupta, and Q. Cui (2008). "Social Spending, Human Capital, and Growth in Developing Countries." *World Development,* 36(8): 1317–1341.

Barney, J. (1991). "Firm resources and sustained competitive advantage." *Journal of Management,* 17(1): 99–120.

Baron, R. M., and D. A. Kenny (1986). "The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic and Statistical Considerations." *Journal of Personality and Social Psychology,* 51 (6): 1173–1182.

Barro, R.(1999). "Human capital and growth in cross-country regressions." *Swedish Economic Policy Review,* 6(2): 237–277.

Barro, Robert (1991). "Economic Growth in a Cross Section of Countries." *Quarterly Journal of Economics*, 106(2): 407-43.

Barro, Robert J. (1996). "Democracy and Growth," *Journal of Economic Growth*, 1(1):1–27.

Barro, Robert J. (1997). *Getting it Right: Markets and Choices in a Free Society*. Cambridge:

IT Press.

Barro, Robert J., and Jong-Wha Lee (2013). "A new Data set of Educational Attainment in the World, 1950- 2010." *Journal of Development Economics,* 104: 184–198.

Barry R. Weingast and Donald Wittman (2006). *The Oxford Handbook of Political Economy*. New York: Oxford University Press.

Bashir, Sajitha, Marlaine Lockheed, Elizabeth Ninan, and Jee-Peng Tan(2018). "Facing Forward: Schooling for Learning in Africa." *Africa Development Forum series*. Washington, DC: World Bank. Doi: 10.1596/978-1-46481260-6.

Baum, Matthew A., and David A. Lake (2003). "The Political Economy of Growth: Democracy and Human Capital." *American Journal of Political Science,* 47(2):333–347.

Baumol, W.J. (1990). "Entrepreneurship: Productive, unproductive, and destructive." *The Journal of Political Economy*, 98(5): 893-921.

Bell and Albu (1999). "Knowledge systems and technological dynamism in industrial clusters in developing countries." *World Development,* 27(9): 1715-1734.

Bell, M., & Pavitt, K. (1993). "Technological accumulation and industrial growth: Contrasts between developed and developing countries." *Industrial and Corporate Change,* 2(2):157–210.

Belton R.(2005). "Competing definitions of the rule of law: implications for practitioners." *Carnegie. Rule of Law Ser. #55* .Washington, DC: Carnegie Endow. Int. Peace.

Benhabib, J. and Spiegel, M. M. (1994). "The role of human capital in economic development: evidence from aggregate cross-country data." *Journal of Monetary Economics*, 34(2): 143–173.

Bertelsmann Foundation, Bertelsmann Transformation Index (BTI). Berlin: Germany. http://www.bertelsmann-stiftung.de/.

Black B, Kraakman R, Tarassova A. (2000). Russian privatization and corporate governance: What went wrong? *Stanford Law Review*, 52:1731–1808

Blackburn, K., Bose, N., Haque E.M.(2006). "The incidence and persistence of corruption in economic development." *Journal of Economic Dynamics and Control*, 30(12):2447-2467.

Bluhm, R., M. Wong (2017). "Neighborhood disputes? Spatial inequalities and civil conflict in

Africa." Mimeo.

Blundell, R. and S. Bond (1998). "Initial conditions and moment restrictions in dynamic panel data models." *Journal of Econometrics*, 87(1):115–143.

Bogliacino, F., Pianta, M.(20110. "Engines of growth. Innovation and productivity in industry groups." *Structural Change and Economic Dynamics*, 22(1):41-53.

Bollen, K. A. & Jackman, R. W. (1985). "Economic and noneconomic determinants of political democracy in the 1960s. "*Research in Political Sociology,* 1(1):27-48.

Bornstein D. (2003). *How to Change the World: Social Entrepreneurs and the Power of New Ideas.* New York: Oxford University Press.

Bossuroy, T., and D. Cogneau(2013). "Social Mobility in Five African Countries." *Review of Income and Wealth,* 59: S84–S110. doi:10.1111/roiw.12037.

Bourdieu, D. (1986). "The forms of capital." in *Handbook of Theory and Research for the Sociology of Education,* edited by Richardson, J., 241–258, New York: Greenwood.

Brown, D., & Hunter, W. (2004). "Democracy and human capital formation." *Comparative Political Studies*, 33(1):113–143.

Brown, D., and W. Hunter(2004). "Democracy and Human Capital Formation." *Comparative Political Studies,* 33:113–143.

Bueno de Mesquita, Bruce, Alastair Smith, Randolph M. Siverson, & James D. Morrow (2003). *The Logic of Political Survival*. Cambridge: The MIT Press.

Busenitz, L.W., C. Gomez, J.W. Spencer (2000). "Country institutional profiles: Unlocking entrepreneurial phenomena." *Academy of Management Journal,* 43(5): 994-1003.

Calderon, Cesar, and Lin Liu (2003). "The Direction of Causality between Financial Development and Economic Growth." *Journal of Development Economics,* 72(1):321–334.

Caselli, F. and Coleman II, W.J., (2001). "Cross-country technology diffusion: the case of computers." *American Economic Review*, 91 (2):328–335

Casson, M.C., M.D. Giusta, and U.S. Kambhampati (2010). "Formal and Informal Institutions and Development." *World Development*, 38(2):137-141.

Castello-Climent, A.(2008). "On the distribution of education and democracy." *Journal of Development Economics,* 87(2):179–190.

Chabal, P., & Daloz, J.-P. (1999). *Africa Works—Disorder as Political Instrument*. Oxford: James Currey.

Charles H. Matthews, Ralph Brueggemann (2015). *Innovation and Entrepreneurship: A Competency Framework*. London; New York: Routledge.

Cheeseman Nic (2018). *Institutions and Democracy in Africa: How the Rules of the Game Shape Political Developments.* Cambridge: Cambridge University Press.

Cheeseman Nic and Klaas Brian (2018). *How to Rig an Election*. London: Yale University Press.

Cheeseman, Nic (2015). *Democracy in Africa: Successes, Failures, and the Struggle for Political Reform*. New York: Cambridge University Press.

Cheibub, J.A., Ghandhi, J., Vreeland, J.(2010). "Democracy and dictatorship revisited." *Public Choice,* 143(1-2): 67–101.

Chester A. Crocker (January 14, 2019). "African Governance: Challenges and Their Implications." *Governance in emerging new world*, 19: Hoover institution.

Christensen, Clayton M.(1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Boston, MA: Harvard Business School Press.

Chu, A. C.(2010). "Effects of Patent Policy on Income and Consumption Inequality in a R&D Growth Model." *Southern Economic Journal,* 77(2):336-350.

Claude Diebolt & Ralph Hippe (2019). "The long-run impact of human capital on innovation and economic development in the regions of Europe." *Applied Economics*, 51(5):542-563, DOI: 10.1080/00036846.2018.1495820

Cockshott, W. Paul, and Allin Cottrell (1993). *Towards a New Socialism*. Nottingham: Spokesman.

Cohen, D., & Soto, M. (2007). "Growth and human capital: good data, good results." *Journal of economic growth*, *12*(1):51-76.

Cohen, W. M., &Levinthal, D. A. (1990). "Absorptive capacity: A new perspective on learning and innovation." *Administrative Science Quarterly*, 35(1): 128–152.

Collier, Paul (2007). *The Bottom Billion*. Oxford: Oxford University Press.

Collin Crouch (2005). *Capitalist Diversity and Change: Recombinant Governance and Institutional Entrepreneurs.* Oxford: Oxford University Press.

Cornell University et. al. (2018). *The Global Innovation Index 2018: Energizing the World with*

Innovation. Ithaca, Fontainebleau, and Geneva.

Cornell University, INSEAD and WIPO (2015). *"Global Innovation Index Report 2015" (PDF)*. www.globalinnovationindex.org/. Fontainebleau, Ithaca, and Geneva. *Retrieved 31 December 2019*.

Cornia, A., R.Jolly and F. Stewart (eds)(1987). *Adjustment with a Human Face, Vol. 1: Protecting the Vulnerable and Promoting Growth*. Oxford: Clarendon Press.

Covin, J. G. and D. P. Slevin (1991). "'A conceptual model of entrepreneurship as firm behavior'." *Entrepreneurship Theory and Practice,* 16(1):7-25.

CPI (2019). "Corruption Perceptions Index 2019." Transparency International. Retrieved 05 January 2020.

Crespi, G., & Zuniga, P. (2011). "Innovation and productivity: Evidence from six Latin American countries." *World Development,* 40(2): 273–290.

Crespi, G., and P. Zuniga(2012). "Innovation and Productivity: Evidence From six Latin American Countries." *World Development, 40*(2): 273–290.

d'Agostino, Giorgio & Scarlato, Margherita(2016). "Institutions, Innovation and Economic Growth in European Countries," MPRA Paper 72427, University Library of Munich, Germany.

Dakhli, M., and D. De Clercq (2004). "Human Capital, Social Capital, and Innovation: A Multi-Country Study." *Entrepreneurship & Regional Development,* 16(2): 107–128.

David, P. (2004). "The tale of two traverses. Innovation and accumulation in the first two centuries of U.S. economic growth." *SIEPR Discussion Paper No 03*-24, Stanford University.

Davin Patt(1988). *Democracy and Economic Planning: The Political Economy of a Self-Governing Society*. Boulder: Westview Press.

Davis, L.S.and Sener,M.F.(2010). "Scientists and lawyers: innovation, limitation and growth with endogenous patent protection." *Manuscript*, Union College.

Dawson, J.W.(1998). "Institutions, investment and growth: new cross-country and panel data evidence." *Economic Inquiry,* 36(4): 603–619.

Dawson, John W.(1998). "Institutions, investment, and growth: New cross-country and panel data evidence." *Economic Inquiry*, 36:603-619.

De Haan, J., Lundstrom, S., Sturm, J. E. (2006). "Market-oriented institutions and policies and

economic growth: a critical survey." *Journal of Economic Surveys,* 20(2):157–191.

De Macedo, J. B. (2003). "Development redux: reflections for a new paradigm." OECD Development Centre, *OECD Working Paper,* No. 215.

De Mesquita, Bueno, Alastair Smith Bruce, M. Randolph Siverson, and James D. Morrow (2003). *The Logic of Political Survival*. Cambridge: The MIT Press.

De Meur, G., & Berg-Schlosser, D. (1996). "Conditions of authoritarianism, fascism, and democracy in interwar Europe." *Comparative Political Studies,* 29(4):423-468.

De Winne, S., & Sels, L. (2010). "Interrelationships between human capital, HRM and innovation in Belgian start-ups aiming at an innovation strategy." *The International Journal of Human Resource Management*, 21(11):1863–1883.

Democracy Index (2017). *Free Speech under Attack*. A report by The Economist Intelligence Unit.

Democracy Index (2018). *Free Speech under Attack*. A report by The Economist Intelligence Unit.

Democracy Index (2019). *Free Speech under Attack*. A report by The Economist Intelligence Unit.

Dewatripont M. and G. Roland (1992). "The Virtues of Gradualism and Legitimacy in the Transition to a Market Economy." *the Economic Journal,* 102(411): 291-300.

Dinopoulos and Syropoulos (2007). "Rent Protection as a Barrier to Innovation and Growth." *Economic Theory, 3*2(2):309–332

Domar, E.D. (1946). "Capital Expansion, Rate of Growth and Employment." *Econometrica*, 14(2):137-147.

Doris, A., D. O'Neill, and O. Sweetman (2011). "GMM Estimation of the Covariance Structure of Longitudinal Data on Earnings." *The Stata Journal: Promoting Communications on Statistics and Stata,* 11(3): 439–459.

Drezner, Daniel (2002). "State Structure, technological leadership and the maintenance of hegemony." *Review of International Studies*, 27(1): 3-25.

Driscoll, J., and A. C. Kraay(1998). "Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data." *Review of Economics and Statistics,* 80(4): 549–560.

Drucker, P.F. (1985). *Innovation and Entrepreneurship:* Practice and principles, New York: Harper and Row.

E Flachaire, C García-Peñalosa, M Konte(2014). "Political versus economic institutions in growth process." *Journal of Comparative Economics,* 42(1):212-229

Easterly William(2001). *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics.* Cambridge MA: MIT Press.

Easterly, W. and Levine R. (1997). "Africa's growth tragedy: Policies and ethnic divisions." *Quarterly Journal of Economics,* 112(4):1203-1250.

Easterly, W. and Levine, R.(2003). "Tropics, germs and crops: how endowments influence economic development." *Journal of Monetary Economics,* 50(1): 3-39.

Eliana Cardoso and Ahmed Galal (2003). "External Environment Globalization and reform." Conference Paper presented at the Workshop on Understanding Reforms, Cairo January 16-17.

Elkins, Z.(2000). "Gradations of Democracy: Empirical Tests of Alternative Conceptualizations." *American Journal of Political Science,* 44(2): 293–300.

Engerman, S. L. and Sokoloff, K. L.(1997). "Factor endowments, institutions and differential paths of growth among new world economies: a view from economic historians of the United States." in *How Latin America Fell Behind, edited by* S. Haber, 260–304. Stanford, CA: Stanford University Press.

Esty, D. C., and M. E. Porter(2002). "Ranking National Environmental Regulation and Performance: A Leading Indicator of Future Competitiveness?" In *The Global Competitiveness Report* 2001–2002, edited by M. E. Porter, J. D. Sachs, P. K. Cornelius, J. W. McArthur, and K. Schwab, 78–100. New York: Oxford University Press.

Esty, D.C. and M.E. Porter (2000). "Measuring national environmental performance and its determinants." in M.E. Porter and J. Sachs (eds), *The Global Competitiveness Report*, New York: Oxford University Press.

Fagerberg, J. (1994). "Technology and International Differences in Growth Rates." *Journal of Economic Literature,* 32(3): 1147–1175.

Favara, Giovanni(2003). "An Empirical Reassessment of the Relationship between Finance and Growth." *IMF Working Paper 03/123* (Washington: International Monetary Fund).

Fedderke, Johannes (2001). "Growth and Institutions." *Journal of International Development*,

13(6): 645-670.

Feng, Y. (2003). *Democracy, Governance, and Economic Performance: Theory and Evidence*. Cambridge, MA: MIT Press.

Ferguson, J. (2006). *Global Shadows: Africa in the Neoliberal World Order*. London: Duke University Press.

Filippetti, A., Archibugi, D.(2011). "Innovation in times of crisis: National Systems of Innovation structure and demand." *Research Policy,* 40(2):179-192.

Firmin-Sellers, Kathryn (2000). "Institutions, Context, and Outcomes: Explaining French and British Rule in West Africa." *Comparative Politics,* 32(3): 253–272.

Fisher, R.A., (1930). *The Genetical Theory of Natural Selection.* Oxford: Clarendon Press.

Flachaire, E., C. García-Peñalosa, and M. Konte(2014). "Political Versus Economic Institutions in the Growth Process." *Journal of Comparative Economics,* 42(1): 212–229.

Fosu, Augustin K. (2015). Growth, Inequality and Poverty in Sub-Saharan Africa: Recent Progress in a Global Context. *Oxford Development Studies,* 43 (1): 44–59.

Freedom House (2017). "Freedom in the World 2017." www.freedomhouse.org/report/freedom-world/ freedom-world-2017.

Freedom House (2019)."Freedom in the World 2017." www.freedomhouse.org/report/freedom-world/ freedom-world-2017.

Freeman, C. (1987). *Technology Policy and Economic Performance*, London: Pinter.

Frunza, R. (2011). "Formal institutions and regional development: Considerations regarding Romania." *Theoretical and Applied Economics,* (4)(557):141–158.

Fry, Maxwell J. (1995). *Money, Interest, and Banking in Economic Development.* Baltimore: Johns Hopkins, 2d. ed.

Furman, J., Porter, M. E., & Stern, S. (2002). "The determinants of national innovative capacity." *Research Policy, 31:* 899–933.

Furubotn, E. G. and Richter, R. (205). *Institutions and Economic Growth.* Ann Arbor: The University of Michigan Press.

G. D. Bruton and D. J. Ketchen Jr.(2013). "Entrepreneurship as a solution to poverty." *Journal of Business Venturing*, 28:683–689.

Gareth Austin (2010). "African Economic Development and Colonial Legacies." *International Development Policy / Revue internationale de politique de développement*, 1: 11-32.

Garner Phillip(2006). "Economic Growth in Sub-Saharan Africa." (January 2006). Available at SSRN: https://ssrn.com/abstract=853184 or http://dx.doi.org/10.2139/ssrn.853184

Gary King, Robert O. Keohane, and Sidney Verba(1994). *Designing Social Inquiry: Scientific Inference in Qualitative Research*. Princeton: Princeton University Press.

Gates, Scott, Håvard Hegre, Mark P. Jones and Håvard Strand(2006). "Institutional Inconsistency and Political Instability: Polity Duration, 1800-2000." *American Journal of Political Science,* 50(4):893-908.

George, G., Corbishley, C., Khayesi, J., Haas, M., &Tihanyi, L.(2016). "Bringing Africa in: Promising directions for management research." *Academy of Management Journal,* 59(2): 377–393.

Gillian K. Hadfield (2008). "Legal Barriers to Innovation: The Growing Economic Cost of Professional Control over Corporate Legal Markets." *Stanford Law Review,* 60 (6): 1689-1732.

Glaeser, Edward L., Rafael La Porta, Florencio Lopes-de-Silanes and Andrei Shleifer(2004). "Do Institutions Cause Growth?" *Journal of Economic Growth*, 9(1):271-303.

Gradstein, M. (2004). "Governance and growth." *Journal of Development Economics,* 73(2): 505–518.

Greene, W. H.(2012). *Econometric Analysis*. 7th ed. Upper Saddle River, NJ: Prentice Hall.

Griliches, Z. (1990). "Patent Statistics as Economic Indicators: A Survey." *Journal of Economic Literature,* 28(4): 1661–1707.

Grossman, Gene M. and Elhanan Helpman (2001 [1991]). *Innovation and Growth in the Global Economy.* Cambridge, MA: The MIT Press.

Gustavo Crespi, Jorge Katz & Jocelyn Olivari (2018). "Innovation, natural resource-based activities and growth in emerging economies: the formation and role of knowledge-intensive service firms." *Innovation and Development*, 8(1): 79-101. DOI: 10.1080/2157930X.2017.1377387

Gwartney, J., and R. Lawson(2008). "Economic Freedom of the World: 2008 Annual Report." Economic Freedom Network, Fraser Institute. http://www.freetheworld.org/.

Hadenius, A., and J. Teorell(2005). "Assessing Alternative Indices of Democracy, Concepts

and Methods." *Working Papers* 6, (IPSA).

Hadfield, Gillian K.(2008). "Legal Barriers to Innovation: The Growing Economic Cost of Professional Control over Corporate Legal Markets." *Stanford Law Review,* 60 (6): 1689–1732.

Hagedoorn, J., &Cloodt, M. (2003). "Measuring innovative performance: Is there an advantage in using multiple indicators?" *Research Policy,* 32(8): 1365–1379.

Haggard, S., & Tiede, L.B.(2011). "The rule of law and economic growth: where are we?" *World Development*, 39(5): 673-685.

Hall, A. R.(2005). *Generalized Method of Moments*. Oxford: Oxford University Press.

Hall, Robert E. and Charles Jones (1999). "Why Do Some Countries Produce So Much More Output Per Worker Than Others?" *Quarterly Journal of Economics*, 114(1): 83-116.

Harrod, R F. (1939). "An Essay in Dynamic Theory." *The Economic Journal*, 49(193):14-33

Hasan, I. P. Wachtel, and M.Zhou(2009). "Institutional development, financial deepening and economic growth: Evidence from China." *Journal of Banking and Finance,* 33(1):157-170.

Hassan, I., & Tucci, C. L. (2010). "The innovation-economic growth nexus: global evidence." *Research Policy*, 39(10): 1264–1276.

Hausmann, R., and C. A. Hidalgo(2011). "The Network Structure of Economic Output." *Journal of Economic Growth,* 16(4): 309–342.

Heckman, James J, Alan B Krueger, and Benjamin M Friedman (2003). *Inequality in America: What Role for Human Capital Policies?* Cambridge, Mass.: MIT Press.

Heidhues, Franz (2009). "Why is Development in Sub-Saharan Africa so Difficult? Challenges and Lessons Learned." *Review of Business and Economics*, 54(3):398-409.

Helliwell, J. F. (1994). "Empirical linkages between democracy and economic growth." *British Journal of Political Science,* 24(2): 225–248.

Helpman, E. and G.M. Grossman (1991). *Innovation and Growth in the Global Economy*. Cambridge MA: MIT Press.

Hodges, T. (2004). *Angola: Anatomy of an Oil State*. 2nd Edition. Oxford: Indiana University Press.

Hoechle, D. (2007). "Robust Standard Errors for Panel Regressions with Cross-Sectional Dependence." *The Stata Journal: Promoting Communications on Statistics and Stata, 7*(3): 281–312.

Hopeless Africa (2000). "The Economist." (May 11). Retrieved from http://www.economist.com/node/333429

Howells C. (2000). "Innovation and regional economic development: A matter of perspective?" *Research Policy,* 34(8):1220-1234.

https://hdl.handle.net/2134/36256.

Huang, Haizhou and Chenggang Xu (1999). "Institutions, Innovations and Growth." *American Economic Review,* 89(2): 438-443.

Huang, Y. (2010). "Political Institutions and Financial Development: An Empirical Study." *World Development*, 38(12):1667–1677.

Huntington, S.(1991). *The third wave: Democratization in the late twentieth century*. Norman: University of Oklahoma Press.

Hymer, Stephen Herber (1976). *The International Operations of National Firms: A Study of Direct Foreign Investment*. Cambridge MA: M.I.T Press.

Ibeanu, O.(2008). "Nigerian state and the economy, 1999 – 2004." in E. Amucheazi & O. Ibeanu (eds). *Between theory and practice of democracy in Nigeria: an assessment of Obasanjo's first term in office by academics and practitioners.* London: Adonis & Abbey Publishers Ltd.

IMF (International Monetary Fund) (2009). *Regional economic outlook: Sub-Saharan Africa - Weathering the storm*. Washington: IMF.

Ivo Bicanic, Vladimir Glogorov and Ivan Krastev (2003). "state Public Sector and development." Conference Paper presented at the Understanding Reforms Workshop, January 16-17, 2003.

Jaffe, A. B., and K. Palmer(1997). "Environmental Regulation and Innovation: A Panel Data Study." *Review of Economics and Statistics,* 79(4): 610–619.

Jakkie Cilliers (2016). "The Future of Democracy in Africa". Institute for Security Studies (Pretoria) and Frederick S. Pardee Center for International Studies (Denver).

Jalilian Hossein, Kirkpatrick Colin and Parker David (2007). "The Impact of Regulation on Economic Growth in Developing Countries: A Cross-Country Analysis." *World*

Development, 35(1):87–103

Jean-Eric Aubert (editor) (2010). *Innovation Policy: A Guide for Developing Countries*. Washington, DC: World Bank.

Jean-Germain Gros(1998). *Democratization in the Late Twentieth Century in Africa: Coping with Uncertainty*. Westport, Conn: Greenwood.

Jeroen Klomp and Jakob de Haan(2013). "Political Regime and Human Capital: A Cross-Country Analysis." *Social Indices Research,* 111(1):45–73. DOI 10.1007/s11205-011-9983-6

Jerven, Morten (2011). "The quest for the African dummy: Explaining African post-colonial economic performance revisited." *Journal of International Development,* 23(*2*)*:*288-307. DOI: 10.1002/jid.1603.

John Stremlau (2016). *Africa's Democracies: Promises, Progress and Prospects.* Electoral Institute for Sustainable Democracy in Africa. Johannesburg, South Africa.

John Temnin (2018). "Democratic Governance in Africa: Three Key Trends" (May 10)https://freedomhouse.org/blog/democratic-governance-africa-three-key-trends

Jolliffe, Ian(2002). *Principal Component Analysis*. 2nd ed. New York: Springer.

Jonathon Adams-Kane & Jamus Jerome Lim(2016). "Institutional Quality Mediates the Effect of Human Capital on Economic Performance," *Review of Development Economics,* 20(2):426-442.

Jones, Charles(1995). "R&D-Based Models of Economic Growth." *Journal of Political Economy,* 103(4): 759-784.

Jong-a-Pin, R.(2009). "On the measurement of political instability and its impact on economic growth." *European Journal of Political Economy,* 25(1):15–29.

Josse Maria Fenelli and Vladimir Popov (2003). "On the Philosophical, Political and Methodological Underpinnings of Reforms." Conference Paper Presented at the Understanding Reforms Workshop, Cairo January 16-17.

Kaiser, Henry (1974). "An Index of Factorial Simplicity." *Psychometrika,* 39(1):31–36.

Kangoye, Thierry (2013). "Does Aid Unpredictability Weaken Governance? Evidence from Developing Countries." *The Developing Economies,* 51(2):121–44.

Kathleen et.al.(2016). *Poverty in a Rising Africa.* Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/22575 License: CC BY 3.0

IGO.

Katz, M. (1986). "An analysis of cooperative research and development." *Rand Journal of Economics,* 17(4): 527–543.

Kauffman, D., A. Kraay, and M. Mastruzzi(2005). *Governance Matters IV: Governance Indicators for 1996– 2004*. World Bank Policy Research.

Kaufman, Daniel, Aart Kraay, and Massimo Mastruzzi(2003). "Governance Matters III: Governance Indicators for 1996-2002." *PR Working Paper* 2196, Washington DC: World Bank.

Kaufmann, D., and A. Kraay (2007). "Governance Indicators: Where Are We, Where Should We Be Going?" *The World Bank Research Observer,* 23(1): 1–30.

Kaufmann, D., Kraay, A. (2008). "Governance indicators: where are we, and where should we be going?" *World Bank Research Observer*, 23(1): 1–30.

Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi (2011). "The Worldwide Governance Indicators: Methodology and Analytical Issues." *Hague Journal on the Rule of Law,* 3(2):220–246.

Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi(2007a). "Growth and Governance: A Rejoinder." *Journal of Politics,* 69 (2): 570–72.

Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi(2007b). "Growth and Governance: A Reply." *Journal of Politics,* 69 (2): 555–62.

Kaufmann, Daniel, and Aart Kraay(2002). "Growth without Governance." *Economia,* 3(1): 169-229.

Kiertisak Toh(2016). "Emerging Growth Economies in Sub-Saharan Africa." *The American Economist,* 61(2): 229–244 DOI: 10.1177/0569434516652041.

Kim, W.(1998). "Democracy and economic development in South Korea." *International Journal on Korean Studies,* 2(1): 69-99.

King, Robert G., and Ross Levine (1993). "Finance, Entrepreneurship, and Growth: Theory and Evidence." *Journal of Monetary Economics*, 32(3):513–542.

Klasen, S., (2003). "What can Africa learn from Asian Development Successes and Failures?" *Review of Income and Wealth,* 49(3): 441-451.

Klausd E. and Stephen L. P. (2010). "Bigger is better: market size, demand elasticity, and innovation." *International Economic Review*, 51(2):319-333.

Klomp, Jeroen, and Jakob de Haan (2013). "Political Regime and Human Capital: A Cross-

Country Analysis."*Social Indicators Research,* 111(1): 45–73. Doi:10.1007/s11205-011-9983-6.

Knack, Stephen (2002). "Social Capital and the Quality of Government: Evidence from the U.S. States." *American Journal of Political Science,* 46(4): 772-785.

Knox, Simon (2002). "The Boardroom Agenda: Developing the Innovative Organization." *Corporate Governance: The International Journal of Business in Society,* 2(1): 27–36. doi:10.1108/14720700210418698.

Knutsen, C. H.(2010). *Africa's growth tragedy revisited: weak states, strong rulers.* Department of Political Science, University of Oslo Centre for the Study of Civil War, PRIO

Kogut, B., & Zander, U. (1992). "Knowledge of the firm, combinative capabilities, and the replication of technology." *Organization Science,* 3(3):383–397.

Kopstein, J. S. & Wittenberg, J. (2010). "Beyond dictatorship and democracy: rethinking national minority inclusion and regime type in interwar Eastern Europe." *Comparative Political Studies,* 43(8): 1089–1118.

Kremer, M., (1993). "Population Growth and Technological Change: One Million B.C. to 1990." *Quarterly Journal of Economics,* 108(3):681–716.

Krugman, P.(1994). "The myth of Asia's miracles." *Foreign Affairs,* 63(6): 62-78.

Lake, D., &Baum, D. (2001). "The Invisible hand of democracy: Political control and the provision of public services." *Comparative Political Studies,* 34(6):587–621.

Lee Weng Chang and Siong Hook Law(2017). "Roles of Formal Institutions and Social Capital in Innovation Activities: A Cross-Country Analysis." *Global Economic Review*, 46(3): 203-231,DOI: 10.1080/1226508X.2017.1292859

Lee, K., & Kang, S.M. (2007). "Innovation types and productivity growth: Evidence from Korean manufacturing firms." *Global Economic Review,* 36(4): 343–359.

Licht, A.N., J.I. Siegel.(2006). "The social dimensions of entrepreneurship." M. Casson, B. Yeung, eds. *Oxford Handbook of Entrepreneurship.* Oxford: Oxford University Press.

Likwelile, Servacius (1998). "Private Investment, Macroeconomic Environment and Economic Growth in Tanzania 1967-1995." Nairobi: African Economic Research Consortium, mimeo.

Lipset, S. M. (1959). "Some social requisites of democracy: Economic development and

political legitimacy." *American Political Science Review,* 53(1): 69–105.

Lipset, S. M. (1981). *Political man: The social bases of politics*. Baltimore: Johns Hopkins University Press.

López-Claros, A. and Yasmina Mata (2009). "Innovation Capacity Index: Factors, Policies, and Institutions Driving Country Innovation." Innovation for Development Report 2009–2010, 3–65.Palgrave Macmillan.

Lucas, R.E.J. (1988). "On the Mechanics of Economic Development." *Journal of monetary Economics,* 22(1):3-42.

Lucas, Robert(1998). "On the mechanisms of development planning." *Journal of Monetary Economics,* 22(1): 3-42.

Luebbert, G. M.(1991). *Liberalism, fascism, or social democracy: Social classes and the political origins of regimes in interwar Europe.* Oxford: Oxford University Press.

Lumpkin, G.T., and Dess, G.G. (1996). "Clarifying the entrepreneurial orientation construct and linking it to performance." *Academy of Management Review,* 21(1):135–172.

Lundvall, B.-A. (ed.) (1992). *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter.MA: MIT Press.

M. G. Ukpabio, A. D. Adeyeye & O. B. Oluwatope (2016). "Absorptive capacity and product innovation: new evidence from Nigeria." *Innovation and Development*, 6(2):213-233. DOI: 10.1080/2157930X.2016.1215801

Mairesse, J. and Mohnen, P.(2010). "Using innovation surveys for econometric analysis." In *Handbook of the economics of innovation*. Edited by B.H. Hall and N. Rosenberg, 1130-1155. Amsterdam: Elsevier.

Makhtar Diop (November 30, 2017). "Innovation in Africa Institute of South – South Cooperation and Development (ISSCAD)." Peking University, Beijing, China

Malcolm Gladwell (December 17, 2001). "Examined Life: What Stanley H. Kaplan Taught Us About the S.A.T." The New Yorker.

Manacorda, M., A. Tesei(2016). "Liberation Technology: Mobile Phones and Political Mobilization in Africa." CEPR Discussion Paper 11278.

Mankiw, N., Romer, D. and Weil, D. (1992). "A contribution to the empirics of economic growth." *Quarterly Journal of Economics,* 107(2): 407–437.

Mansfield, Edward D. and Jack Snyder (2007*)*. *Electing to Fight: Why Emerging Democracies go to War*. Cambridge: MIT Press.

Maskell, P. and Malmberg, A. (1999). "Localized learning and industrial competitiveness." *Cambridge Journal of Economics,* 23(2): 167–185.

Mason, G., O'Leary, B., & Vecchi, M. (2012). "Certified and uncertified skills and productivity growth performance: Cross-country evidence at industry level." *Labour Economics,* 19(3):351-360.

Massa Coulibaly, Kaphalo Ségorbah Silwé,and Carolyn Logan(2019). "Taking Stock: Citizen Priorities and Assessments Three Years into the SDGs." *Afrobarometer Policy Paper* #51 (November 2018) accessed at http://afrobarometer.org/sites/default/files/publications/Dispatches/ab_r7_policypapern o51_africans_priorities_the_sdgs_and_govt_performance.pdf, May 2019

Mauro, Paola (1995). "Corruption and Growth." *Quarterly Journal of Economics*, 110(3): 681-712.

Mauro, Paolo (1997). "The Effects of Corruption on Growth, Investment, and Government Expenditure: A Cross-country Analysis." In *Corruption and the Global Economy*, edited by Kimberly Ann Elliott, 83–108. Washington: Institute for International Economics.

McMillan, G. Steven, and Robert D. Hamilton (2000). "Using Bibliometrics to Measure Firm Knowledge: An Analysis of the U.S. Pharmaceutical Industry." *Technology Analysis & Strategic Management,* 12 (4):465–75.

Méon Pierre-Guillaume and Sekkat, K.(2004). "Does the Quality of Institutions Limit the MENA‟s Integration in the World Economy?" *The World Economy*, 27:1475-1498.

Michalopoulos, S., E. Papaioannou(2014). "National Institutions and Sub national Development in Africa." *Quarterly Journal of Economics*, 129(1): 151–213.

Michalopoulos, S., E. Papaioannou(2013). "Pre-Colonial Ethnic Institutions and Contemporary African Development." *Econometrica*, 81(1): 113-152

Michalopoulos, S., E. Papaioannou(2016). The Long-Run Effects of the Scramble for Africa." *American Economic Review*, 106(7): 1802–1848.

Miller, T., Holmes Kim, R., Kim Anthony, B., Markheim, D., Roberts James, M., Walsh, C. (2009). *Index of Economic Freedom.* The Heritage Foundation and Dow Jones &

Company,Inc.

Miller, W., M. Reisinger, and V. L. Hesli(1996). "Understanding Political Change in Post-Soviet Societies: a Further Commentary on Finifter and Mickiewicz." *American Political Science Review,* 90(1): 153–166.

Mohamed A. El-Khawas (2001). "Democracy in Africa: Problems and Solutions." *Mediterranean Quarterly*, 12(3):85-97.

Moore, B., Jr.(1966). *Social origins of dictatorship and democracy: Lord and peasant in the making of the modern world*. Boston: Beacon.

Morck, R., et al. (2001). *the economic determinants of innovation*. Industry Canada Research Publications Program.

Moyo D. (2012).*Winner Take All: China's Race for Resources and What It Means for Us*. London: Allen Lane.

Mtatifikolo, F. (1998). *The Content and Challenges of Reform Programmes in Africa-the Case of Tanzania.* Bremen: University of Bremen.

Mungiu-Pippidi, A. (2015). "Good governance powers innovation." *Nature*, 518: 195-297.

Narayan D, Patel R, Schafft K, Rademacher A, Koch-Schulte S. (2000). *Voices of the Poor*. New York: Oxford Univ. Press.

Ndubuisi Ekekwe (2015). "Improving Innovation in Africa." *Harvard Business Review*. February 18.

Nee, V.(1996). "The emergence of a market society: Changing mechanisms of stratification in china." *The American Journal of Sociology,* 101(4): 908-949.

Ngatat, Elvis Tankwa (2016). "Intra-BRICS Human Capital Development and the Rule of Law." *South East Asia Journal of Contemporary Business, Economics and Law* 9 (2): 1–9.

Norman v. Louyza and Raimundo Sotto (2003). "On the measurement of Market oriented Reforms." Paper Presented at the Workshop on Understanding Reforms, Cairo January 16-17.

North, D. C. (1981). *Structure and change in economic history*. New York: W. W. Norton.

North, D. C. (1990). *Institutional Change and Economic Performance*. New York: Cambridge Press.

North, D. C., Wallis, J. J., & Weingast, B. R (2013). *Violence and Social Orders: A Conceptual Framework for Interpreting Recorded Human History.* New York: Cambridge University Press.

North, Douglass Cecil and Robert Paul Thomas (1973). *The Rise of the Western World: A New Economic History***.** New York**:** Cambridge University Press.

OECD (2010a). "The OECD innovation strategy: innovation to strengthen growth and address global and social challenges." Paris: OECD.

OECD (2010b). "Innovation and growth, chasing a moving frontier." Paris: OECD.

Oliver Reynolds (December 10, 2018). "Ethiopia and Rwanda: From Destruction to Development." *Focus Economics S.L.U*

Olson M., Sarna N., and Swamy A. V.(1998). "Governance and growth: A simple hypothesis explaining cross-country differences in productivity." *Mimeo*: Centre for Institutional Reform and Informal Sector (IRIS), University of Maryland.

Olson, M. (1993). "Dictatorship, democracy, and development." *The American Political Science Review,* 87(3):567-576.

Olson, M. (1996). "Big Bills Left on the Sidewalk: Why Some Nations Are Rich and Others Poor." *Journal of Economic Perspectives.* 10(2):3-24.

O'Muircheartaigh. C., and Campanelli, P. (1998). "The Relative Impact of Interviewer Effects and Sample Design Effects on Survey Precision." *Journal of the Royal Statistical Society Series*, 161(1): 63-77.

Ostrom, E. (2005). *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press.

P. J. Robson and H. M. Haugh (2009). "Entrepreneurship and innovation in Ghana: Enterprising Africa," *Small Business Economics*, 32(3):331-350.

P. J. Robson and H. M. Haugh (2009). "Entrepreneurship and innovation in Ghana: Enterprising Africa." *Small Business Economics,* 32(3):331-350.

Papageorgiadis N. and Sharma A. (2016). "Intellectual property rights and innovation: a panel analysis." *Economics Letters*, 141: 70-72.

Park, D., and J. Park (2010). "Drivers of Developing Asia's Growth: Past and Future." *ADB Economics Working Paper Series No. 235*, Manila: Economics and Research Department, Asian Development Bank.

Park, J.(2010). “Projection of Long-term TFP Growth for 12 Asian Economies.” Manila: Asian Development Bank Mimeo.

Patrick J.Murphy(2009). “Entrepreneurship Theory and the Poverty of Histroricism.” *Journal of Management History*, 15(2):109-133.

Paulin Grosjan and Claudio Senik (2007). “Should market liberalization precede democracy? Casual relations between political preference and development.” Paris: Institute Of Labor Study.

Pauline Grosjean and Claudia Senik (2011). “Democracy, Market Liberalization and Political Preferences.” *Review of Economics and Statistics*, 93(1):365-381.

Plumper, Thomas, and Eric Neumayer(2010). “The Level of Democracy during Interregnum Periods: Recoding the polity2 Score.” *Political Analysis,* 18: 206–226.

Prodan, I.(2005). “Influence of research and development expenditures on number of patent applications: Selected Case Studies in OECD Countries and Central Europe, 1981-2001.” *Applied Econometrics and International Development*, 5(4)*:* 5-22.

Przeworski, A., Alvarez, M.E., Cheibub, J., Limongi, F. (2000). *Democracy and Development.* Cambridge University Press: Press Syndicate of the University of Cambridge.

Psacharopoulos, George (1994). “Returns to investment in education: A global update.” *World Development*, 22(9): 1325–1343.

Radelet S. (2010). “Emerging Africa.” Washington, DC: Center for Global Development.

Rebelo S (1991). “Long-run Policy Analysis and Long-run Growth.” *Journal of Political Economy,* 99(3):500-521.

Regini, M.(2014). “Models of capitalism and the crisis.” *Stato e Mercato, no. 100 Vs.*

Rivera-Batiz, F. (2002), Democracy, governance, and economic growth: Theory and evidence. *Review of Development Economics, 6*(2):225-247.

Robert M. Solow(1957). “Technical Change and the Aggregate Production Function.” *Review of Economics and Statistics,* 39(3): 312–20.

Robinson Ken (2001). “Mind the gap: The creative conundrum.” *Critical Quarterly,* 43(1):41–45

Rodriguez-Pose, Andres and Riccardo Crescenzi (2008). “Research and Development, Spillovers, Innovation Systems, and the Genesis of Regional Growth in Europe.” *Regional Studies*, 42(1):51–67.

Rodrik, D. (2000) “Institutions for high-quality growth: what they are and how to acquire them.” *NBER Working Paper No. 7540*, NBER, Cambridge, MA.

Rodrik, D. (2003). *In Search of Prosperity. Analytic Narratives on Economic Growth***.** New Jersey: Princeton University Press.

Rodrik, D. (2007). *One Economics Many Recipes: Globalization, Institutions, and Economic Growth.* Princeton: Princeton University Press.

Rodrik, D., A. Subramanian, and F. Trebbi (2004). “Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development.” *Journal of Economic Growth*, 9(2): 131–165.

Rodrik, Dani, Arvind Subramanian and Francesco Trebbi (2004). "Institutions Rule: The Primacy Of Institutions Over Geography And Integration In Economic Development." *Journal of Economic Growth*, 2004, 9(2):131-165.

Roland G. (2001). “The Political Economy of Transition.” *the Journal of Economic Perspectives,* 16(1): 29-50.

Roland Morck, et. al.(2001). *The economic determinants of innovation*. Industry Canada Research Publications Program.

Roland, G. (2002). “The Political Economy of Transition.” *Journal of Economic Perspectives,* 16(1): 29–50.

Romer, P. (1986). “Increasing Returns and Long-term Growth,” *Journal of Political Economy*, 94 (5):1002-1037.

Romer, P. (1990). “Endogenous Technological Change.” *Journal of Political Economy,* 98(5): S71–S102.

Rose-Ackerman, S.(2001). “Trust, honesty, and corruption: reflection of the state-building process.” *European journal of sociology*, 42 (3):27–71.

Ross, M.(2006). “Does democracy reduce infant mortality?” *American Journal of Political Science,* 50(4): 860–874.

Rudolf Sivak , Anetta Caplanova & John Hudson(2011). “The impact of governance and infrastructure on innovation.” *Post-Communist Economies,* 23(2):203-217.

Sabina Alkire, Christoph Jindra, Gisela Robles Aguilar & Ana Vaz (2017). “Multidimensional Poverty Reduction among Countries in sub-Saharan Africa.” *Forum for Social Economics,* 46(2):178-191.

Sala-i-Martin, X.(2002). “15 years of new growth economics: what have we learnt?” *Central Bank of Chile Working Paper No.172*, Central Bank of Chile, 2002.

Schumpeter, J. A. (1934). *The theory of economic development*. Cambridge MA: Harvard University Press.

Segerstrom, Paul S. (1998). “Endogenous Growth without Scale Effects.” *American Economic Review,* 88(5): 1290-1310.

Sen, A.(1981).*Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford: Clarendon Press.

Sender, John, and Sheila Smith (1986). *The development of capitalism in Africa*. London: Methuen.

Siddiqui, Danish Ahmed & Ahmed, Qazi Masood, 2009. "Institutions and Economic Growth: A Cross country Evidence," MPRA Paper 19747, University Library of Munich, Germany.

Siegle, Joseph T., Michael W. Weinstein, and Morton H. Halperin(2004). “Why Democracies Excel” *Foreign Affairs,* 83(5): 57–71.

Silve, Florent and Plekhanov, Alexander(2015). “Institutions, Innovation and Growth: Cross-Country Evidence.” *EBRD Working Paper No. 177*. Available at SSRN: https://ssrn.com/abstract=3119688 or http://dx.doi.org/10.2139/ssrn.3119688

Sivak, Rudolf, Anetta Caplanova, and John Hudson (2011). “The Impact of Governance and Infrastructure on Innovation.” *Post-Communist Economies,* 23 (2): 203–217.

Solow, R. (1956). “A Contribution to the Theory of Economic Growth.” *The Quarterly Journal of Economics,* 70(1): 65–94.

Solow, R. (1957). “Technical Change and the Aggregate Production Function.” *Review of Economics and Statistics,* 39(3): 312–20.

Streeck W and Thelen K. (2005). “Institutional change in advanced political economics.” In: Streeck W and Thelen K (eds) *Beyond Continuity. Institutional Change in Advanced Political Economics*, Oxford: Oxford University Press, pp. 1–39

Streeck W. (2011). “The Crisis in Context. Democratic Capitalism and Its Contradictions.” Cologne: MPIfG Discussion Paper 11/15.

Tansuğ Ok (2015). “Science, technology and innovation for sustainable urbanization, urban planning and local governance.” Presented at the sixteenth session of the United

Nations Commission on Science and Technology for Development. Geneva. 5 June . Available at http://unctad.org/en/pages/MeetingDetails.aspx?meetingid=213 (accessed 30 December 2017).

Tanzi, V., and H. R. Davoodi(2002). "Corruption, Growth, and Public Finances." In *Governance, Corruption, and Economic Performance*, edited by G. T. Abed, and S. Gupta, 197–222. Washington: IMF.

Taylor, M. (2004). "Empirical Evidence Against Varieties of Capitalism's Theory of Technological Innovation." *International Organization*, 58(3):601-631. Doi: 10.1017/S0020818304583066.

Tebaldi, Edinaldo, and Bruce Elmslie (2008). "Institutions, Innovation and Economic Growth." *Journal of Economic Development,* 33(2): 27–53.

Tebaldi, Edinaldo, and Bruce Elmslie (2013). "Does Institutional Quality Impact Innovation? Evidence from Cross-Country Patent Grant Data." *Applied Economics,* 45(7): 887–900. doi:10.1080/00036846.2011.613777.

Temnin, John. (May 10 2018). "Democratic Governance in Africa: Three Key Trends." https:// freedomhouse.org/blog/democratic-governance-africa-three-key-trends

Thomson, A. (2010). *An Introduction to African Politics*. 3rd Edition. New York: Taylor & Francis.

Todaro, M. P. & Smith, S. C.(2009). *Economic development*. England: Pearson Education Limited.

Ulimwengu, Jenerali (1 August 2015). "More surprises in store as we head towards an unpredictable election". *The East African*. Retrieved 20 August 2019.

Ulku, H. (2004). "R&D, innovation, and economic growth: an empirical analysis." *IMF Working Paper WP/04/185*. Washington, DC: the International Monetary Fund.

Ulku, Hulya (2007). "R&D, Innovation, and Growth: Evidence from Four Manufacturing Sectors in OECD Countries." *Oxford Economic Papers*, 59(3):513-535.

Van de Walle, S. (2005). "Measuring bureaucratic quality in governance indicators." *Working paper*, InstituutVoor De Overheid, Katholieke Universiteit Leuven.

Van Uden, Annelies, Joris Knoben, and Patrick Vermeulen(2016). "Human Capital and Innovation in Sub-Saharan Countries: a Firm-Level Study." *Innovation: Organization & Management,* 19(2): 103–124.

Williams, G. (2007). "Why Structural Adjustment Is Necessary And Why It Doesn't Work." *Review of African Political Economy*, 21(60):214-225. DOI: 10.1080/03056249408704057

Williamson, J. (1990). "What Washington means by policy reform." In J. Williamson (Ed.), *Latin American readjustment: How much has happened* (pp. 5–20). Washington, DC: Institute for International Economics.

World Bank (1981). *Accelerated Development in Sub-Saharan Africa: An Agenda for Action*. Washington, D.C.

World Bank (2008). *Global economic prospects 2008: technology diffusion in the developing world.* Washington, DC: World Bank.

Yang ChihHai (2006). "Is innovation the story of Taiwan's economic growth?" *Journal of Asian Economics,* 17(5): 867–878.

Yao, Y. and L. Yueh L. (2009). "Law, Finance and Economic Growth in China: An Introduction." *World Development*, 37(4): 753-762

Young, Alwyn(1998). "Growth without scale effects." *Journal of Political Economy* 106(1): 41-63.

Zahra, S. A., & George, G.(2002). "Absorptive capacity: A review, reconceptualization, and extension." *Academy of Management Journal*, 27(2):185–203.

Appendix –A:

Appendix Table A1: Lists of Countries And Mean Values Of The Key Variables

Country	ID	Polity2	lnSJA	DEMO	ATR	HC
Angola	AGO	-2.2381	2.130582	1.714286	3.952381	1.361142
Benin	BEN	6.52381	4.214989	6.52381	0	1.523739
Botswana	BWA	7.952381	4.657352	7.952381	0	2.607398
Burkinafaso	BFA	-0.38095	4.436408	2	2.380952	1.131863
Burundi	BDI	2.619048	1.602067	4.333333	1.714286	1.264374
Cameron	CMR	-4	5.461935	1	5	1.803056
Central African Republic	CAF	1.190476	2.101296	-12.5238	-13.7143	1.43828
Congo Republic	COG	-4	3.85501	0.285714	4.285714	2.000335
Dem. Republic Congo	ZAR	3	2.081521	3.714286	0.714286	1.590991
Cote D'voire	CIV	0.619048	4.71709	2.238095	1.619048	1.492009
Ethiopia	ETH	-1.28571	5.647005	1.857143	3.142857	1.250761
Gabon	GAB	-1.33333	3.563768	1.52381	2.857143	2.332142
Gambia	GMB	-5.04762	3.538028	0	5.047619	1.402539
Ghana	GHA	6.285714	5.39069	6.666667	0.380952	2.210005
Kenya	KEN	5.047619	6.228357	6.238095	1.190476	2.06716
Lesotho	LSO	7.047619	1.92472	7.857143	0.714286	2.036762
Madagascar	MDG	5.714286	4.005382	6.190476	0.428571	1.594221
Malawi	MWI	5.761905	4.520296	5.952381	0.190476	1.662526
Mali	MLI	6.047619	3.655342	2.571429	-3.47619	1.196794
Mauritania	MRT	21	-3.76191	1.930861	0.190476	3.952381
Mauritius	MUS	10	3.790405	10	0	2.395448
Mozambique	MOZ	5	3.494667	5.190476	0.190476	1.161901
Namibia	NAM	6	3.606275	6	0	2.092194
Niger	NER	3.47619	3.350271	5.285714	1.809524	1.147668
Nigeria	NGA	3	7.43206	-0.38095	-3.52381	1.633099
Rwanda	RWA	-3.85714	2.755321	0	3.857143	1.508193
Senegal	SEN	5.809524	5.039578	6.380952	0.571429	1.398857
Sierra Leone	SLE	4.809524	1.937011	2	4	1.447756
South Africa	ZAF	9	8.536566	9	0	2.342954
Sudan	SDN	-4.38095	4.886726	0.333333	4.809524	1.467113
Swaziland	SWZ	-9	2.88311	0	9	1.697869
Tanzania	TZA	-0.61905	5.3801	2.190476	2.809524	1.554498
Togo	TGO	-2.47619	3.31371	1	3.47619	1.735146
Uganda	UGA	-2.28571	5.30845	0.571429	2.857143	1.863473
Zimbabwe	ZWE	-1.71429	5.03896	2	3.714286	2.276592

Appendix Table A2: Summary Statistics (1995–2015).

Variable	Obs	Mean	Std. Dev.	Min	Max	Source	Description
lnSJA	723	3.8884	1.7514	-.91629	9.1777	World Bank and Science Web Citation	Measured by the citation index of Scientific and Technical Journal Articles
POL	724	1.669	5.3035	-9	10	Polity IV Project	A codified measure of a country's political regime based on (Jaggers and Gurr 1995; Marshall and Jaggers 2002). Scores can range from -10 to 10, with 10 representing a full democracy
DEM	720	3.7111	3.2512	0	10	Polity IV Project	A codified measure of a country's level of democratization based on (Jaggers and Gurr 1995; Marshall and Jaggers 2002). Scores can range from 0 to 10, with 10 representing a full democracy
ATR	720	2.2056	2.3638	0	9	Polity IV Project	A codified measure of a country's level of democratization based on (Jaggers and Gurr 1995; Marshall and Jaggers 2002). Scores can range from -10 to 10, with 10 representing a full Autocracy
HC	724	1.692	.4022	1.0493	2.8336	Pen World Tables	A codified index of a country's level of human capital development based on (Barro, Robert J. and Jong-Wha Lee,2013) data set of educational attainment
lnGDPPC	717	6.8956	1.0298	5.1295	9.3848	Pen World Tables	the national income per person
lnPOP	724	16.099	1.1602	13.879	18.994	Pen World Tables	The total population of a country
lnEMP	724	14.993	1.293	12.207	17.855	Pen World Tables	The total number of people engaged in productive economic activities
lnCK	724	24.778	1.2917	21.889	28.435	Pen World Tables	The level of accumulated capital due to saving and investment
lnFCF	724	2.8968	.51648	-1.2280	4.3151	World Bank	Gross fixed capital formation as a percentage of GGDP
lnUPOP	724	3.4989	.48462	1.9756	4.4677	World Bank	The total size of the urban population
lnTRD	720	4.1989	.47799	2.6928	5.77341	World Bank	The ratio of the total trade(i.e. import plus export) to national GDP
MID	724	.29282	.45537	0	1	World Bank	Middle income dummy which assumes a value of 1 if the country is in the middle category as classified by the world bank , otherwise 0

Appendix Table A3: Correlation Matrix

Pair-Wise Correlation Matrix

Variable	lnSJA	POL	DEM	ATR	HC	lnGDPPC	lnPOP	lnEMP	lnCK	lnFCF	lnUPOP	lnTRD	MID
lnSJA	1.00												
POL	0.19	1.00											
DEM	0.21	0.94	1.00										
ATR	-0.21	-0.89	-0.78	1.00									
HC	0.38	0.24	0.33	-0.18	1.00								
lnGDPPC	0.34	0.06	0.16	0.03	0.69	1.00							
lnPOP	0.54	0.01	-0.03	-0.10	-0.25	-0.26	1.00						
lnEMP	0.53	0.13	0.05	-0.26	-0.23	-0.35	0.94	1.00					
lnCK	0.75	0.13	0.16	-0.15	0.32	0.50	0.65	0.59	1.00				
lnFCF	0.07	0.14	0.22	-0.07	0.25	0.30	-0.19	-0.22	0.08	1.00			
lnUPOP	0.20	0.05	0.04	-0.03	0.40	0.56	-0.25	-0.23	0.21	0.11	1.00		
lnTRD	-0.15	0.12	0.21	-0.03	0.42	0.46	-0.41	-0.47	0.00	0.39	0.40	1.00	
MID	0.254	0.118	0.20	-0.04	0.562	0.801	-0.23	-0.32	0.36	0.23	0.39	0.36	1.00

Table 1A: Regression With Lagged Values

Table 2: Dependent Variable: Scientific Journal Articles; Political Institution: Polity2									
	General Methods of Moments(GMM)								
	Lagged Polity2			Lagged HC			Lagged Both HC and Polity2		
Variable	*(1)*	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*	*(1)*	*(3)*	*(4)*
POL				0.033***	0.019***	0.0296			
				(0.014)	(0.0077)	(0.0368)			
HC-1				1.201***	1.208***	1.222***	1.149***	1.203***	1.3178***
				(0.1341)	(0.1756)	(0.195)	(0.149)	(0.1764)	(0.19584)
POL* HC-1						-0.0057			
						(0.0202)			
POL-1	0.0226**	0.017 **	0.0395				-0.0128	0.0146**	.0742**
	(0.0104)	(0.0069)	(0.0334)				(0.047)	(0.0072)	(0.0378)
HC	1.364***	1.429***	1.469***						
	(0.131)	(0.188)	(0.2038)						
POL-1* HC			-0.01323						
			(0.0178)						
POL-1* HC-1									-0.0343*
									(0.0204)
lnGDPPC		-0.015	-0.0128		0.10573	0.1057		0.09199	0.1032
		(0.127)	(0.12744)		(0.12513)	(0.125)		(0. 1248)	(0.1258)
lnPOP		0.327**	0.3161**		0.29462*	0.2946*		0.25689	0.2394
		(0.1629)	(0.1621)		(0.16701)	(0.167)		(0.1634)	(0. 1602)
LnEMP		0.1258	0.1261		0.18478	0.1848		0.2144*	0.213*
		(0. 1223)	(0.1221)		(0.11781)	(0.1178)		(0.1636)	(0.1155)
LnUPOP		0.4848***	0.4772***		0.473***	0.4731***		0.472***	0.4517***
		(0.1288)	(0.1314)		(0.128)	(0.1283)		(0.128)	(0.1302)
lnTRD		-0.947***	-0.958***		-0.907***	-0.907***		-0.89***	-0.926***
		(0.1309)	(0.1317)		(0.1338)	(0.1338)		(0.1339)	(0.1343)
lnFCF		0.351***	0.351***		0.364***	0.3644***		0.369***	0.3703***
		(0.095)	(0.0945)		(0.0951)	(0.09504)		(0.095)	(0.0941)
lnCK		0.559***	0.568***		0.533***	0.5332***		0.545***	0.558***
		(0. 118)	(0.117)		(0.1248)	(0.1248)		(0.1236)	(0.121)
MID		0.0549	0.057		0.0308	0.0308		0.0524	0.0528
		(0.142)	(0.141)		(0.1444)	(0.1444)		(0.147)	(0.1437)
_cons	1.57***	-18.22***	-18.3***	1.829***	-18.54**	-18.536**	1.80***	-18.6***	-18.68***
	(0.227)	(1.176)	(1.179)	(0.2323)	(1.1895)	(1.1895)	(0.23228)	(1.185)	(1.181)
Wald chi2(1)	110.64	2066.2	2308.9	86.53	1969.18	1969.18	86.25	1944.3	1950.08
(Prob> chi2)	0.000	0.0000	0.000	0.0000	0.0000	0.0000	0.0000	0.000	0.0000
R-squared	0.1143	0.6854	0.6856	0.1003	0.6793	0.6793	0.0954	0.678	0.6795
Root MSE	1.653	0.9876	0.9873	1.6663	0.99714	0.99714	1.6709	0.9989	0.9969
	713	654	654	713	754	654	713	654	654

, , *** indicate significance at 10%, 5% and 1% levels respectively; robust standard errors in brackets*
INTR is equal to the interaction of terms of human capital with polity2

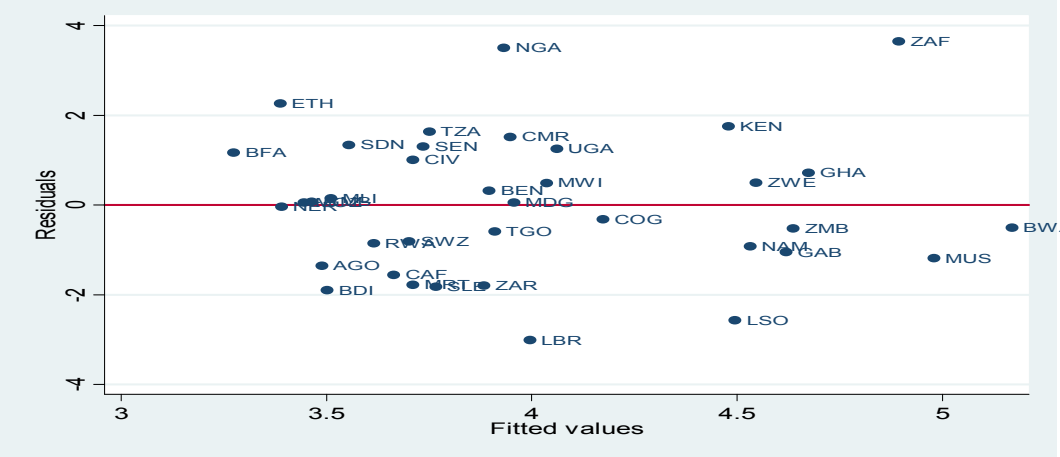

Fig. 5. Scatter plot of residual for impact of Polity2 on Innovation.

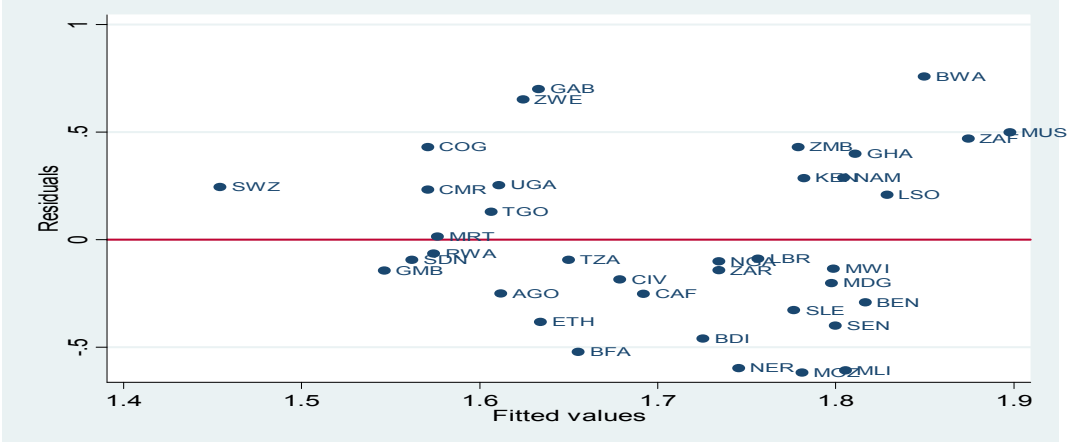

Fig. 6. Scatter plot of residual for impact of Polity2 on Human Capital.

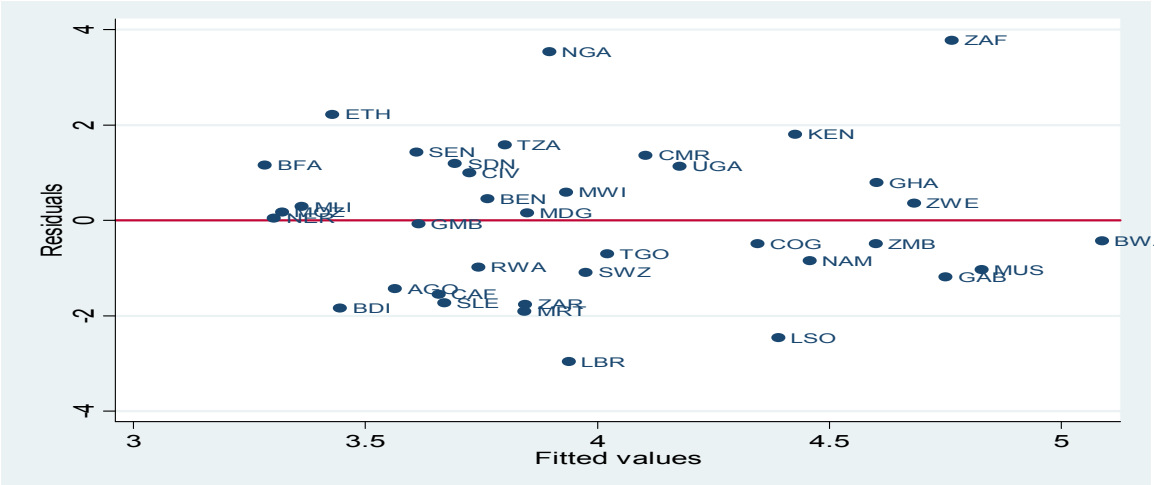

Fig. 7. Scatter plot of residual for impact of human capital on innovation.

Appendix Table A4: Dependent Variable: Scientific Journal Articles; Political Institution: Polity2

	Fixed Effects					
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
POL	0.09***		-0.001	-0.021**	0.161**	-0.010
	(0.018)		(0.015)	(0.009)	(0.054)	(0.031)
HC		4.48***	4.48***	1.29***	5.02***	1.36***
		(0.360)	(0.401)	(0.344)	(0.335)	(0.309)
POL* HC					-0.11**	-.007
					(0.044)	(0.019)
lnGDPPC				1.324***		1.330***
				(0.205)		(0.202)
lnPOP				1.530***		1.534**
				(0.310)		(0.303)
LnEMP				0.650**		0.634**
				(0.232)		(0.238)
LnUPOP				-0.058		-0.081
				(0.447)		(0.488)
lnTRD				0.273*		(0.274*
				(0.151)		(0.129)
lnFCF				-0.083		-0.084
				(0.061)		(0.060)
lnCK				-0.121		-0.126
				(0.083)		(0.083)
MID				0.244***		0.244**
				(0.076)		(0.075)
_cons	3.73***	-3.69***	-3.70***	-39.58***	-4.51***	-39.34***
	(0.180)	(0.646)	(0.704)	(3.051)	(0.579)	(3.525)
Hetroced(χ^2)	2552.1	2301.57	2274.5	1345.5	5748.9	1377.5
(Prob>chi2)	0.000	0.000	0.000	0.000	0.000	0.000
Auto-corr(F)	2.324	1.560	1.55	1.045	1.601	1.071
(Prob>F)	0.137	0.2202	0.22	0.314	0.214	0.308
Pesaran(χ^2)	15.748	22.320	22.352	19.581	20.523	18.813
(Prob>chi2)	0.000	0.000	0.000	0.000	0.000	0.000
[a]Hausman(χ^2)	0.39	29.98	20.69	46.20	28.53	35.27
(Prob>chi2)	0.537	0.0000	0.000	0.000	0.000	0.0002
N(Obs)	723	723	723	712	723	712

*,** , *** indicate significance at 10%, 5% and 1% levels respectively; standard errors in brackets

[a]Note: the Hausman test suggests that the fixed effect models are more efficient estimators than the random effect models

Appendix Table A5: Dependent Variable: Scientific Journal Articles; Political Institution: Democracy Score

	General Methods of Moments(GMM)											
	Lagged DEM				Lagged HC				Lagged Both HC and DEM			
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
DEMO					0.0554***	-0.0499	0.0435***	0.0727				
					(0.0187)	(0.0769)	(0.0123)	(0.0573)				
HC-1					1.169***	0.883***	1.183***	1.252***	0.0341*	1.107***	1.159***	1.457***
					(0.1308)	(0.2324)	(0.1748)	(0.245)	(0.0187)	(0.2362)	(0.1783)	(0.2471)
DEMO* HC-1						0.0591		-0.0163				
						(0.0434)		(0.0302)				
DEMO-1	0.0339*	-0.115**	0.0202***	0.0898*					1.216***	-0.0037	0.0362***	0.148**
	(0.0184)	(0.0478)	(0.0572)	(0.0531)					(0.1296)	(0.0781)	(0.0118)	(0.0397)
HC	1.359***	1.014***	1.315***	1.523***								
	(0.1274)	(0.189)	(0.189)	(0.2429)								
DEMO-1* HC		0.0756**		-0.0275								
		(0.037)		(0.0273)								
DEMO-1* HC-1										0.02135		-0.062**
										(0.0442)		(0.0314)
lnGDPPC			-0.01372	0.0015			0.10004	0.1052			0.10509	0.1251
			(0.1293)	(0.1309)			(0.1293)	(0.131)			(0.1273)	(0.1292)
lnPOP			0.333**	0.3216**			0.2931*	0.2841*			0.2624*	0.2416
			(0.1566)	(0.155)			(0.1584)	(0.1578)			(0.1566)	(0.1534)
LnEMP			0.1278	0.1645			0.1829	0.1855*			0.2121*	0.2272**
			(0. 181)	(0.1172)			(0.1134)	(0.1139)			(0.1119)	(0.1117)
LnUPOP			0.5174***	0.502***			0.5017***	0.496***			0.4988***	.4786***
			(0.1304)	(0.1309)			(0.1304)	(0.1333)			(0.1286)	(0.1302)
lnTRD			-0.953***	-0.919***			-0.936***	-0.944***			-.9107***	-0.952***
			(0.1304)	(0.1291)			(0.1337)	(0.1351)			(0.1345)	(0.1341)
lnFCF			0.3462***	0.353***			0.349***	0.3464***			0.3597***	0.3524***
			(0.0943)	(0.0944)			(0.0951)	(0.0949)			(0.0943)	(0.0934)
lnCK			0.5495***	0.5593***			0.533***	0.536***			0.5369***	0.5436***
			(0.1188)	(0.1187)			(0.1248)	(0.1249)			(0.1241)	(0.1221)
MID			0.0292	0.0573			0.175	0.0191			0.0259	0.02702
			(0.1443)	(0.1457)			(0.1444)	(0.1437)			(0.1482)	(0.1441)
_cons	1.495***	2.124***	-18.08***	-18.3***	1.737***	2.09***	-18.536**	-18.508**	1.8005***	1.919***	-18.59***	-18.87***
	(0.233)	(0.305)	(1.182)	(1.179)	(0.2367)	(0.255)	(1.1895)	(1.1201)	(0.23228)	(0.4106)	(1.183)	(1.181)
Wald chi2(1)	114.81	119.46	2209.06	2376.67	86.86	89.25	2056.02	2334.69	86.25	92.09	1981.79	1953.35
(Prob> chi2)	0.000	0.0000	0.0000	0.000	0.0000	0.00	0.0000	0.0000	0.0000	0.0000	0.000	0.0000
R-squared	0.1142	0.1157	0.6871	0.6848	0.1001	0.103	0.6793	0.6813	0.0954	0.0945	0.6796	0.6814
Root MSE	1.6569	1.6521	.9857	.98863	1.6685	1.664	0.99714	.9953	1.6709	1.6728	.99748	.99465
	707	708	650	650	707	707	650	650	709	707	650	650

****,** , *** indicate significance at 10%, 5% and 1% levels respectively; robust standard errors in brackets***

Appendix Table A6: Dependent Variable: Scientific Journal Articles; Political Institution: Autocracy Score

	General Methods of Moments(GMM)											
	Lagged ATR				Lagged HC				Lagged Both HC and ATR			
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
ATR					-0.108***	-.0135	-0.044***	-0.0727				
					(0.0225)	(0.1055)	(0.0123)	(0.0573)				
HC-1					1.198***	1.28***	1.183***	1.252***	1.211***	1.205***	1.221***	1.037***
					(0.1379)	(0.1758)	(0.1748)	(0.245)	(0.1389)	(0.1771)	(0.1779)	(0.1741)
ATR* HC-1						0.0591		-0.0163				
						(0.0434)		(0.0302)				
ATR-1	-0.082***	-0.0335	-0.0278**	-0.2052**					-0.083***	-0.0891	-0.0246	-0.233**
	(0.0222)	(0.1076)	(0.0189)	(0.088)					(0.0224)	(0.1104)	(0.0192)	(0.0933)
HC	1.354***	1.392***	1.453***	1.288***								
	(0.1349)	(0.171)	(0.189)	(0.1867)								
ATR-1* HC		-0.0293		0.091**								
		(0.0637)		(0.0459)								
ATR-1* HC-1										0.00404		-0.1242**
										(0.0652)		(0.0515)
lnGDPPC			-0.0193	-0.02768			0.10004	0.1052			0.0894	0.08591
			(0.1278)	(0.1272)			(0.1293)	(0.131)			(0.1259)	(0.1256)
lnPOP			0.31447*	0.28172			0.2931*	0.2841*			0.2460	0.2145
			(0.1794)	(0.1768)			(0.1584)	(0.1578)			(0.1785)	(0.1739)
LnEMP			0.13087	0.1284			0.1829	0.1855*			0.2196*	0.2099
			(0.1384)	(0.1374)			(0.1134)	(0.1139)			(0.1313)	(0.1299)
LnUPOP			0.479***	0.464***			0.5017***	0.496***			0.466***	0.446***
			(0.1306)	(0.1325)			(0.1304)	(0.1333)			(0.1289)	(0.1309)
lnTRD			-0.934***	-0.966***			-0.936***	-0.944***			-0.879***	-0.931***
			(0.1339)	(0.1347)			(0.1337)	(0.1351)			(0.1359)	(0.1375
lnFCF			0.3567***	0.3642***			0.349***	0.3464***			0.374***	0.384***
			(0.0949)	(0.0949)			(0.0951)	(0.0949)			(0.0949)	(0.0944)
lnCK			0.5635***	0.593***			0.533***	0.536***			0.549***	0.579***
			(0.1181)	(0.1159)			(0.1248)	(0.1249)			(0.1238)	(0.1198)
MID			0.0536	0.0593			0.175	0.0191			0.0532	0.0531
			(0.1426)	(0.1398)			(0.1444)	(0.1437)			(0.1487)	(0.1441)
_cons	1.809***	1.742***	-18.15***	-17.85***	1.737***	2.09***	-18.536**	-18.508**	2.055***	2.064***	-18.59***	-18.1***
	(0.2355)	(0.2916)	(1.192)	(1.201)	(0.2367)	(0.255)	(1.1895)	(1.1201)	(0.2434)	(0.3041)	(1.204)	(1.223)
Wald chi2(1)	109.22	111.91	2055.92	2128.55	86.86	89.25	2056.02	2334.69	86.27	90.20	1941.02	1918.65
(Prob> chi2)	0.000	0.0000	0.0000	0.000	0.0000	0.00	0.0000	0.0000	0.0000	0.0000	0.000	0.0000
R-squared	0.1222	0.1223	0.6845	0.6859	0.1001	0.103	0.6793	0.6813	0.1022	0.1022	0.6770	0.6795
Root MSE	1.6471	1.6469	.9898	.98765	1.6685	1.664	0.99714	.9953	1.6657	1.6657	1.0015	.99763
	707	707	650	650	707	707	650	713	707	707	650	650

****,** , *** indicate significance at 10%, 5% and 1% levels respectively; robust standard errors in brackets***

Appendix Table A7

Dependent Variable: Scientific Journal Articles; Political Institution Polity 2												
Estimates of Structural Equation Models												
	HC Lagged				Polity2 Lagged				Both HC and polity2 lagged			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
HC-1 <-					HC <-				HC-1 <-			
POL	0.0201***	0.0201***	.0187 ***	0.0187***								
	(0.00275)	(0.00276)	(0.0028)	(0.0028)								
Pol-1					0.0201***	0.021***	0.0193***	0.0193***	0.022***	0.023***	0.022***	0.0212***
					(0.0027)	(0.0027)	(0.00279)	(0.00279)	(0.0028)	(0.0027)	(0.0028)	(0.00276)
_cons	1.658***	1.658***	1.663***	1.663***	0.659***	1.66***	1.665***	1.665***	1.655***	1.655***	1.659***	1.659***
	(0.0136)	(0.0136)	(0.0139)	(0.0139)	(0.0132)	(0.0132)	(0.01349)	(0.0135)	(0. 0131)	(0.0131))	(0.0134)	(0.0134)
lnSJA <-					lnSJA <-				lnSJA <-			
HC					1.364***	1.193***	1.429***	1.469***				
					(0.13024)	(0.14671)	(0.1881)	(0.2039)				
HC-1	1.201***	1.035***	1.208***	1.221***					1.229***	1.148***	1.203***	1.318***
	(0.1342)	(0.1467)	(0.1757)	(0.1949)					(0.1338)	(0.1496)	(0.1765)	(0.1959)
POL	0.0334***	-0.0498	0.0196***	0.0296								
	(0.0106)	(0.0459)	(0.00769)	(0.0368)								
POL-1					0.0226**	-0.0529	0.0166**	0.0395	0.0227**	-0.0128	0.015**	0.074**
					(0.0104)	(0.0457)	(0.0069)	(0.0334)	(0.0105)	(0.0471)	(0.0072)	(0.0378)
POL* HC-1		0.0478*		-0.0057								
		(0.0263)		(0.0201)								
POL-1* HC						0.0438*		-0.0132				
						(0.0264)		(0.0178)				
POL-1* HC-1										0.0206		-0.0342*
										(0.0273)		(0.0204)
lnGDPPC			0.1057	0.1075			-0.0151	-0.0128			0.092	0.1032
			(0.1253)	(0.1264)			(0.1271)	(1.1275)			(0.125)	(0.1259)
lnPOP			0.295*	0.2899*			0.3265**	0.3161**			0.2569	0.2391
			(0.1672)	(0.1667)			(0.16297)	(0.1522)			(0.1635)	(0.1603)
lnEMP			0.1848	0.1851			0.1258	0.1261			0.2144*	0.2125*
			(0.1179)	(0.1179)			(0.1224)	(0.1222)			(0.1164)	(0.1155)
lnCK			0.533***	0.537***			0.5598***	0.568***			0.545***	0.558***
			(0.1249)	(0.1238)			(0.1179)	(0.1168)			(0.1237)	(0.1211)
lnFCF			0.364***	0.364***			0.3505***	0.3507***			0.369***	0.371***
			(0.0951)	(0.0949)			(0.0947)	(0.0945)			(0.095)	(0.0941)
lnUPOP			0.473***	0.469***			0.485***	0.477***			0.473***	0.452***
			(0.1283)	(0.1323)			(0.1289)	(0.1315)			(0.128)	(0.1302)
lnTRD			-.907***	-0.911***			-0.947***	-0.958 ***			-0.89***	-0.926***
			(0.1339)	(0.1354)			(0.1311)	(0.1317)			(0.134)	(0.1345)
MID			0.0308	0.0318			0.0549	0.0568			0.0524	0.0527
			(0.1445)	(0.1441)			(0.1421)	(0.1412)			(0.147)	(0.1438)
_cons	1.829***		-18.54***	-18.6***	1.569***	1.838***	-18.21***	--18.25***	1.801***	1.925***	-18.6***	-18.68***
	(0.2327)		(1.191)	(1.1943)	(0.2267)	(0.2563)	(1.1768)	(1.1808)	(0.2324)	(0.2603)	(1.186)	(1.182)
R2(HC)	0.0673	.0673	.0608281	.06083	0.0666	0.0667	0.06498	0.0649	0.0821	0.0821	0.0786	0.0786
R2(lnSJA)	0.1612	.0878	.6739036	.6744	0.1143	0.0984	0.6826	0.6845	0.09536	0.0877	0.6721	0.6776
log likelihood	-4240.46	-6021.77	-7430.4	-8957.02	-4236.64	-6033.38	-7435.89	-8963.19	-4236.54	-6025.33	-7438.97	-8963.19
Wald χ^2(HC)	53.37***	53.37***	43.34***	43.34***	54.40***	54.40***	47.67***	47.67***	68.83***	68.83***	59.1***	59.12***
Wald χ^2(lnSJA)	86.42***	89.13***	1966.4***	2300.27***	110.5***	113.3***	2063.3***	2305.7***	86.14***	89.18***	1941.6***	1947.4***
N(Obs)	713	713	654	654	713	713	717	717	713	713	654	654

, , *** indicate significance at 10%, 5% and 1% levels respectively; robust standard errors in brackets*

Appendix Table A8: Dependent Variable: Scientific Journal Articles

Fixed Effects												
	Political Institution: Democracy						**Political Institution: Autocracy**					
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
DEM	0.004		-0.0006	-0.003	0.088**	0.023	-0.007*		-0.001	-0.001	-0.150***	-0.002
	(0.007)		(0.002)	(0.002)	(0.036)	(0.015)	(0.004)		(0.002)	(0.002)	(0.036)	(0.018)
HC		4.48***	4.480***	1.163***	4.862***	1.331***		4.478***	4.477***	1.135***	4.456***	1.136***
		(0.615)	(0.360)	(0.303)	(0.338)	(0.317)		(0.3594)	(0.363)	(0.300)	(0.358)	(0.294)
DEM*HC					-0.062**	-0.019					0.103***	0.001
					(0.024)	(0.011)					(0.025)	(0.012)
lnGDPPC				1.368 ***		1.397***				1.346***		1.345***
				(0.208)		(0.211)				(0.198)		(0.202)
lnPOP				1.36 ***		1.356***				1.351***		1.351***
				(0.312)		(0.317)				(0.326)		(0.325)
LnEMP				0.737***		0.716***				0.757***		0.756***
				(0.234)		(0.232)				(0.233)		(0.2411)
LnUPOP				-0.0579		-0.091				-0.065		-0.0653
				(0.474)		(0.471)				(0.481)		(0.4790)
lnTRD				0.245		0.249				0.241		0.2414
				(0.149)		(0.152)				(0.148)		(0.1479)
lnFCF				-0.093		-0.095				-0.096		-0.0962
				(0.066)		(0.065)				(0.067)		(0.0675)
lnCK				-0.106		-0.122				-0.097		-0.09689
				(0.085)		(0.083)				(0.089)		(0.0890)
MID				0.227***		0.226***				0.223 ***		0.223***
				(0.0664)		(0.0660)				(0.0645)		(0.064)
_cons	3.88***	-3.69***	-3.72***	-38.4***	-4.30***	-38.1***	3.90***	-3.69***	-3.69***	-38.6***	-3.69***	-38.6***
	(0.228)	(1.042)	(0.647)	(3.086)	(0.614)	(3.264)	(0.224)	(0.646)	(0.653)	(3.181)	(0.648)	(3.233)
Hetroced(χ^2)	4058.24	2301.57	2253.8	1642.34	3524.38	1671.51	4204.21	2301.6	2295.54	1792.95	2787.68	1762.77
(Prob>chi2)	0.000	0.0000	0.000	0.000	0.000	0.000	0.00	0.000	0.00	0.00	0.00	0.00
Auto-corr(F)	2.389	1.560	1.571	1.048	1.561	1.039	2.39	1.560	1.57	1.048	1.566	1.045
(Prob>F)	0.132	0.2202	0.219	0.313	0.220	0.315	0.132	0.22	0.219	0.313	0.219	0.3138
Pesaran(χ^2)	85.51	22.320	22.32	19.03	21.21	19.33	84.14	22.320	22.31	18.75	20.89	18.738
(Prob>chi2)	0.000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
[b]Hausman(χ^2)	0.01	29.98	27.98	53.64	30.20	49.85	0.08	29.98	27.23	34.02	31.65	28.80
(Prob>chi2)	0.9194	0.0000	0.0000	0.0000	0.0000	0.0000	0.7839	0.00	0.00	0.0002	0.0000	0.0024
N(Obs)	719	723	719	708	719	708	719	723	719	708	719	708

*, **, *** indicate significance at 10%, 5% and 1% levels respectively; robust standard errors in brackets.

[b]Note: the Hausman test suggests that the fixed effect models are more efficient estimators than the random effect models

Appendix Table A9: Dependent Variable: Scientific Journal Articles; Political Institution: Democracy Score

Estimates of Structural Equation Models												
	HC Lagged				Democracy Lagged				Both HC and Democracy lagged			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
HC-1 <-					HC <-				HC-1 <-			

DEM	0.0409***	0.0412***	0.0391***	0.039***								
	(0.00443)	(0.0044)	(0.0046)	(0.0046)								
DEM-1					0.039***	0.039***	0.039***	0.039***	.0438***	0.044***	0.043***	0.0427***
					(0.0046)	(0.0046)	(0.0047)	(0.0047)	(0.0044)	(0.0044)	(0.0046)	(0.0046)
_cons	1.541***	1.541***	1.551***	1.551***	1.548***	1.548***	1.556***	1.56***	1.531***	1.531***	1.54***	1.54***
	(0.0186)	(0.0186)	(0.0189)	(0.0189)	(0.0179)	(0.0179)	(0.0181)	(0.0181)	(0. 0176)	(0.0176)	(0.0177)	(0.0177)
lnSJA <-					lnSJA <-				lnSJA <-			
HC					1.359***	1.084***	1.397***	1.53***				
					(0.1275)	(0.2339)	(0.1886)	(0.2432)				
HC-1	1.1693***	1.167***	1.184***	1.162***					1.216***	1.11***	1.159***	1.46***
	(0.1309)	(0.1826)	(0.1749)	(0.1928)					(0.1297)	(0.2364)	(0.1784)	(0.2472)
DEM	0.0554***	0.0559	0.0435***	0.0397								
	(0.0187)	(0.0516)	(0.0124)	(0.0275)								
DEM-1					0.0339**	-0.0616	0.041***	0.0898*	0.0341*	-0.0037	0.0362***	.1477**
					(0.0182)	(0.0763)	(0.0113)	(0.0531)	(0.0187)	(0.0781)	(0.0118)	(0.0598)
DEM* HC-1		-0.000041		0.0027								
		(0.0288)		(0.0137)								
DEM-1* HC						0.054		-0.0275				
						(0.0431)		(0.0273)				
DEM-1* HC-1										0.0214		-0.062**
										(0.0242)		(0.0314)
lnGDPPC			0.10004	0.11294			-0.0047	0.00147			0.1051	0.1251
			(0.1293)	(0.1294)			(0.1299)	(0.11311)			(0.1274)	(0.1292)
lnPOP			0.2931*	0.2936*			0.335**	0.322**			0.262*	0.2416
			(0.1585)	(0.1586)			(0.1557)	(0.155)			(0.1567)	(0.1535)
lnEMP			0.1829	0.18759*			0.1196	0.1227			0.2121*	0.2172**
			(0.1134)	(0.1139)			(0.1176)	(0.1177)			(0.1121)	(0.1115)
lnCK			0.5316***	0.5252***			0.552***	0.559***			0.537 ***	0.544***
			(0.1261)	(0.1258)			(0.1183)	(0.1173)			(0.1242)	(0.1222)
lnFCF			0.349***	0.3524***			0.341***	0.338***			0.359***	0.352***
			(0.0951)	(0.0951)			(0.0942)	(0.0937)			(0.0944)	(0.0934)
lnUPOP			0.5017***	0.5027***			0.517***	0.508***			0.499***	0.479***
			(0.1305)	(0.1314)			(0.1296)	(0.1313)			(0.1287)	(0.1302)
lnTRD			-0.936***	-0.931***			-0.972***	-0.987***			-0.911***	-0.952***
			(0.1338)	(0.1342)			(0.1309)	(0.1314)			(0.1346)	(0.1342)
MID			0.01758	0.00291			0.0217	0.0238			0.0259	0.0271
			(0.1446)	(0.1456)			(0.1428)	(0.1414)			(0.1483)	(0.1442)
_cons	1.737***	1.726***	-18.42***	-18.42***	1.495***	1.954***	-18.18***	-18.33***	1.739***	1.919***	-18.59***	-18.87***
	(0.2367)	(0.2351)	(1.19)	(1.1943)	(0.2334)	(0.4079)	(1.1702)	(1.183)	(0.2367)	(0.4109)	(1.184)	(1.181)
R2(HC)	0.0673	.10596	.09954	0.10087	.09635	0.0964	0.0971	0.0971	0.1200	0.1200	0.1189	0.1189
R2(lnSJA)	0.1612	.100312	.67664	0.67606	.11424	0.0896	0.6845	0.6902	0.09425	0.0842	0.6734	0.6863
log likelihood	-4240.46	-6021.77	-7038.87	-8957.02	-3827.9	-5573.8	-7045.3	-8440.99	-3824.5	-6025.33	-7046.21	-8963.19
Wald χ^2(HC)	53.37***	86.51***	71.9***	72.85***	74.68***	74.68***	67.11***	67.11***	99.63***	99.63***	87.84***	87.84***
Wald χ^2(lnSJA)	86.42***	88.83***	2053.1***	2087.74***	114.66***	117.59***	2142.8***	2373.6***	89.22***	91.98***	1979.0***	1950.6***
N(Obs)	707	706	650	650	707	707	650	650	707	707	650	650

,, *** indicate significance at 10%, 5% and 1% levels respectively; robust standard errors in brackets*

Appendix Table A10: Dependent Variable: Scientific Journal Articles, Political Institution: Autocracy Score 7

Estimates of Structural Equation Models												
	HC Lagged				Autocracy Lagged				Both HC and Autocracy lagged			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
HC-1 <-					HC <-				HC-1 <-			

ATR	-0.0318***	-0.032***	-0.029***	-0.0285***								
	(0.0059)	(0.0059)	(0.0059)	(0.0059)								
ATR-1					-0.033***	-0.033***	-0.031***	-0.031***	-.036***	-.036***	-.0334***	-0.034***
					(0.0056)	(0.0056)	(0.0057)	(0.0057)	(0.0056)	(0.0056)	(0.0057)	(0.0057)
_cons	1.763***	1.763***	1.757***	1.757***	1.766***	1.766***	1.764***		1.773***	1.77***	1.769***	1.769***
	(0.0218)	(0.0218)	(0.0227)	(0.0227)	(0.0223)	(0.0223)	(0.0232)	1.764***	(0.0222)	(0.0222)	(0.0232)	(0.0232)
lnSJA <-					lnSJA <-			(0.0232)	lnSJA <-			
HC					1.354***	1.392***	1.45***	1.31***				
					(0.1350)	(0.1711)	(0.1891)	(0.1878)				
HC-1	1.198***	1.281***	1.233***	1.128***					1.211***	1.205***	1.22***	1.037***
	(0.1381)	(0.1759)	(0.1772)	(0.1759)					(0.1389)	(0.1772)	(0.1780)	(0.1743)
ATR	-0.108***	-0.0147	-0.041**	-0.1334								
	(0.0225)	(0.1056)	(0.0208)	(0.0927)								
ATR-1					-0.0821**	-0.0335	-0.0278	-0.179**	-.082***	-0.0891	-0.0246	-0.232**
					(0.0222)	(0.1077)	(0.0189)	(0.0836)	(0.0224)	(0.1104)	(0.0192)	(0.0934)
ATR* HC-1		-0.0561		0.05469								
		(0.0617)		(0.0535)								
ATR-1* HC						-0.0293		0.091**				
						(0.0638)		(0.046)				
ATR-1* HC-1										0.0041		0.124***
										(0.0653)		(0.0515)
lnGDPPC			0.0878	0.0836			-0.0193	0.02771			0.0894	0.08591
			(0.1275)	(0.1268)			(0.1279)	(0.1273)			(0.1261)	(0.1256)
lnPOP			0.3017*	0.2817			0.314*	0.2817			0.2460	0.2145
			(0.1845)	(0.1834)			(0.1795)	(0.1769)			(0.1786)	(0.1740)
lnEMP			0.16144	0.15764			0.1309	0.1284			0.2196*	0.2099
			(0.1359)	(0.1353)			(0.1385)	(0.138)			(0.1313)	(0.1296)
lnCK			0.5452***	0.566***			0.564***	0.593***			0.548***	0.579***
			(0.1254)	(0.1238)			(0.1182)	(0.1159)			(0.1239)	(0.1199)
lnFCF			0.3676***	0.37156***			0.357***	0.364***			0.374***	0.384***
			(0.0950)	(0.0959)			(0.0950)	(0.0949)			(0.0949)	(0.0945)
lnUPOP			0.4693***	0.459***			0.479***	0.464***			0.466***	0.446***
			(0.1302)	(0.1327)			(0.1307)	(0.1326)			(0.1291)	(0.1309)
lnTRD			-0.904***	-0.9185***			-0.934***	-0.966***			-0.879***	-0.931***
			(0.1372)	(0.1399)			(0.1339)	(0.1348)			(0.1361)	(0.1375)
MID			0.0414	0.04669			0.0536	0.0593			0.0532	0.0531
			(0.1448)	(0.1432)			(0.1427)	(0.1399)			(0.1489)	(0.1442)
_cons	2.13***	1.981***	-18.42***	-18.24***	1.809***	1.742***	-18.15***	-17.85***	2.055***	2.064***	-18.59 ***	-18.1***
	(0.22415)	(0.3024)	(1.19)	(1.231)	(0.2357)	(0.2918)	(1.1965)	(1.102)	(0.2436)	(0.3043)	(1.205)	(1.224)
R2(HC)	0.0333943	0.0334	0.0283	0.0283	0.0349	0.03491	0.0318	0.0318	0.0433	0.0433	0.0388	0.03877
R2(lnSJA)	.1105838	0.1208	0.673439	0.67047	0.1222	0.1271	0.6823	0.6778	0.1022	0.1016	0.6712	0.6683
log likelihood	-3606.99	-4699.09	-6792.58	-7769.97	-3602.79	-4617.42	-6801.93	-7681.19	-3606.26	-6025.33	-7046.21	-8963.19
Wald χ^2(HC)	29.37***	29.36***	22.98***	22.98***	34.02***	44.02***	28.45***	28.45***	41.56***	41.56***	34.18***	34.18***
Wald χ^2(lnSJA)	93.66 ***	94.54***	1926.5***	2134.88 ***	109.08 ***	111.77***	2053.0***	2125.6***	86.16***	90.08***	1938.3***	1915.9***
N(Obs)	707	707	650	650	707	707	650	650	707	707	650	650

, ** , * indicate significance at 10%, 5% and 1% levels respectively; robust standard errors in brackets*

Appendix-B:

Appendix Table B1: Lists of countries and mean values of the key variables

Country	ID	lnSJA	GQ	VA	PSNV	GE	RQ	RL	CC	HC

Angola	AGO	2.130582	-1.26017	-1.25558	-1.13361	-1.17193	-1.25373	-1.41228	-1.33392	1.361142
Benin	BEN	4.214989	-0.1689	0.266396	0.533017	-0.44335	-0.37875	-0.39678	-0.59394	1.523739
Botswana	BWA	4.657352	0.723487	0.588086	1.067835	0.530219	0.59729	0.63274	0.924742	2.607398
Burkinafaso	BFA	4.436408	-0.36244	-0.31251	-0.24021	-0.63527	-0.24929	-0.53166	-0.20567	1.131863
Burundi	BDI	1.602067	-1.29301	-1.11427	-1.93918	-1.2981	-1.16966	-1.21238	-1.02444	1.264374
Cameron	CMR	5.461935	-0.93888	-1.02985	-0.67136	-0.8415	-0.81743	-1.12904	-1.14412	1.803056
Central African Republic	CAF	2.101296	-1.31848	-1.03554	-1.72003	-1.48014	-1.13732	-1.40755	-1.13026	1.43828
Congo Republic	COG	3.85501	-1.13691	-1.1287	-0.93726	-1.1915	-1.20148	-1.24896	-1.11355	2.000335
Dem. Republic Congo	ZAR	2.081521	-1.72009	-1.50325	-2.40868	-1.66925	-1.5958	-1.70729	-1.43628	1.590991
Cote D'voire	CIV	4.71709	-0.94059	-0.89785	-1.28052	-0.89253	-0.65405	-1.11339	-0.80522	1.492009
Ethiopia	ETH	5.647005	-0.96154	-1.20963	-1.39262	-0.71713	-1.07369	-0.76243	-0.61375	1.250761
Gabon	GAB	3.563768	-0.45534	-0.72001	0.300543	-0.64961	-0.35653	-0.47674	-0.82968	2.332142
Gambia	GMB	3.538028	-0.46045	-1.02689	0.255773	-0.62091	-0.43171	-0.36929	-0.5697	1.402539
Ghana	GHA	5.39069	-0.03231	0.256717	-0.07195	-0.08106	-0.11428	-0.01895	-0.16433	2.210005
Kenya	KEN	6.228357	-0.70681	-0.40414	-1.19455	-0.52851	-0.25103	-0.85219	-1.01045	2.06716
Lesotho	LSO	1.92472	-0.14688	-0.10831	0.04302	-0.29953	-0.47992	-0.0799	0.043368	2.036762
Liberia	LBR	0.976679	-1.17278	-0.60418	-1.38274	-1.42458	-1.37997	-1.27451	-0.97067	1.667688
Madagascar	MDG	4.005382	-0.44848	-0.28006	-0.16402	-0.74452	-0.50479	-0.53208	-0.46539	1.594221
Malawi	MWI	4.520296	-0.35261	-0.20994	-0.06919	-0.53327	-0.49951	-0.26395	-0.5398	1.662526
Mali	MLI	3.655342	-0.4222	0.03993	-0.23984	-0.83272	-0.42011	-0.39116	-0.68927	1.220031
Mauritania	MRT	1.930861	-0.56742	-0.8362	-0.25649	-0.54938	-0.47002	-0.71303	-0.57941	1.589824
Mauritius	MUS	3.790405	0.749581	0.879562	0.965336	0.672197	0.66345	0.95671	0.360229	2.395448
Mozambique	MOZ	3.494667	-0.38291	-0.17179	0.069617	-0.52182	-0.43413	-0.70026	-0.53907	1.161901
Namibia	NAM	3.606275	0.330316	0.39087	0.674327	0.160789	0.14902	0.21320	0.393687	2.092194
Niger	NER	3.350271	-0.64128	-0.48319	-0.56984	-0.79688	-0.60777	-0.60747	-0.78254	1.147668
Nigeria	NGA	7.43206	-1.12578	-0.754	-1.71861	-1.02699	-0.8927	-1.18812	-1.17425	1.633099
Rwanda	RWA	2.755321	-0.68168	-1.33888	-0.99761	-0.42858	-0.54874	-0.68335	-0.09291	1.508193
Senegal	SEN	5.039578	-0.18429	0.076099	-0.38081	-0.27051	-0.19377	-0.14564	-0.19114	1.398857
Sierra Leone	SLE	1.937011	-0.93303	-0.49856	-0.84635	-1.269	-1.04609	-1.05658	-0.88162	1.447756
South Africa	ZAF	8.536566	0.330437	0.675996	-0.18655	0.554749	0.47065	0.14678	0.320986	2.342954
Sudan	SDN	4.886726	-1.5656	-1.73068	-2.35859	-1.26173	-1.3652	-1.43474	-1.24265	1.467113
Swaziland	SWZ	2.88311	-0.58437	-1.35801	-0.17518	-0.66557	-0.46464	-0.57719	-0.26563	1.697869
Tanzania	TZA	5.3801	-0.44388	-0.32305	-0.40839	-0.5229	-0.41359	-0.36132	-0.63402	1.554498
Togo	TGO	3.313712	-0.85459	-1.03103	-0.36321	-1.24999	-0.74342	-0.85099	-0.88889	1.735146
Uganda	UGA	5.308445	-0.64169	-0.68399	-1.18079	-0.50251	-0.10947	-0.47792	-0.89547	1.863473
Zambia	ZMB	4.109119	-0.37523	-0.28665	0.227111	-0.77672	-0.45509	-0.41265	-0.5474	2.208529
Zimbabwe	ZWE	5.038958	-1.27833	-1.28128	-1.00652	-1.04894	-1.71193	-1.47532	-1.14601	2.276592

Appendix Table B2. Definitions of Variables

Variables	Sign	Definitions of variables (measurement)	Source e
General Governance	GG	First principal component of the six world governance indicators.	PCA
Control of Corruption	CC	Control of corruption (estimate): captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the state by elites and private interests."	World Bank
Voice and Accountability	VA	Reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	World Bank
Political Stability	PS	Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism	World Bank
Government Effectiveness	GE	Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	World Bank
Regulatory Quality	RQ	Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	World Bank
Rule of Law	RL	Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence	World Bank
Economic Growth	GDPG	Rate of annual growth in domestics physical product	World Bank
Human Capital	HC	Human capital is measured by the human capital development index	Pen World Tables
Fixed capital formation	FCF	Measured by investment in to fixed capital facility as a percentage of the national GDP	World Bank
Trade	TRD	Measured by the ratio of the total trade(i.e. import plus export) to national GDP	World Bank
Employment	EMP	Measured by the total number of people engaged in productive economic activities	Pen World Tables
Capital; Stock	CK	Measured by the level of accumulated capital due to saving and investment	Pen World Tables
Middle Income	MID	Middle income dummy which assumes a value of 1 if the country is in the middle category as classified by the world bank , otherwise 0	World Bank
Urban Population	UPOP	Measured by the total size of the urban population	World Bank
Percapita Income	GDP	Measured by the national income per person	World Bank
Population size	POP	Measured by the total population	World Bank
Scientific Publication	SJA	Measured by the citation index of scientific and technical journal articles	World Bank & Web Of Science
Total Factor Productivity	TFP	Measured by the total factor productivity index	Pen World Tables
Global Innovation Index	GIO	Measured by the global innovation output sub index	

Appendix Table B3. Summary Statistics (1996–2016).

Variables	Obs	Mean	Std. Dev.	Min	Max
Scientific and Technical Journal Articles(lnSJA)	775	3.994	1.753634	-1.20397	9.177724
Total Factor Productivity(TFP)	525	0.97707	0.1589825	0.54649	2.87904
Global Innovation Output Sub Index(GIO)	252	20.47	5.306145	1.81	34.99
General Governance Quality (GQ)	777	-0.60737	0.6037891	-2.44516	0.9104884
Voice and Accountability(VA)	777	-0.55356	0.683491	-1.8587	1.007172
Political Stability and Non Violence(PS)	777	-0.57318	0.9907496	-5.52657	2.056143
Government Effectiveness(GE)	777	-0.67743	0.580799	-1.88489	1.049441
Regulation Quality(RQ)	777	-0.58338	0.5966134	-2.29754	1.12727
Rule of Law (RL)	777	-0.64821	0.6247567	-2.12999	1.07713
Control of Corruption(CC)	777	-0.60847	0.5683565	-1.72293	1.216737
GDP growth(GDPG)	758	4.7055	6.516985	-36.6999	106.2798
Human Capital Development Index(HC)	777	1.7069	0.4091225	1.05333	2.833614
Fixed Capital Formation as % of GDP (FCF)	752	20.111	9.20625	-2.42436	74.82057
Trade as % GDP (TRD)	771	73.628	38.10227	0	321.6317
Engaged Labour Force (lnEMP)	777	15.067	1.320976	12.2068	17.88267
Accumulated Capital Stock(lnCK)	777	24.865	1.302973	21.9487	28.43539
Middle Income Dummy(MID)	777	0.29858	0.4579319	0	1
Urban Population as % of Total Population(lnUPOP)	777	3.4981	0.4810486	2.0031	4.4677
GDP Per Capita (lnGDPPC)	771	6.8705	1.028889	4.80799	9.384846
Total Population Size (lnPOP)	777	16.169	1.186216	13.907	19.02063

Appendix Table B4. Pairewise Correlation Matrix.

Dependent Variables			Institutional Variables								Control variables								
lnSJA	TFP	GIO	GQ	VA	PS	GE	RQ	RL	CC	GDPG	HC	FCF	TRD	lnEMP	lnCK	MID	lnUPO	lnGDP	lnPOP
1																			
0.267	1																		
0.326	0.093	1																	
0.137	0.266	0.357	1																
0.257	0.218	0.381	0.877	1															
-0.032	0.257	0.267	0.861	0.681	1														
0.249	0.252	0.413	0.933	0.791	0.703	1													
0.217	0.309	0.402	0.928	0.794	0.71	0.896	1												
0.104	0.229	0.306	0.964	0.828	0.781	0.904	0.897	1											
0.025	0.17	0.221	0.89	0.694	0.674	0.861	0.82	0.873	1										
0.026	0.104	0.046	0.084	0.101	0.063	0.085	0.078	0.07	0.065	1									
0.345	0.24	0.375	0.484	0.383	0.431	0.521	0.41	0.493	0.397	0.119	1								
-0.073	0.166	0.155	0.409	0.282	0.406	0.35	0.374	0.444	0.349	0.112	0.181	1							
-0.185	0.059	0.391	0.439	0.268	0.524	0.353	0.331	0.448	0.394	0.063	0.458	0.442	1						
0.641	0.044	0.239	-0.374	-0.127	-0.487	-0.253	-0.28	-0.408	-0.414	0.14	0.302	-0.313	-0.619	1					
0.916	0.23	0.327	0.111	0.209	-0.067	0.241	0.203	0.101	0.001	0.022	0.345	-0.038	-0.104	0.576	1				
0.283	0.228	0.148	0.44	0.314	0.335	0.443	0.446	0.481	0.417	0.065	0.611	0.205	0.408	0.354	0.357	1			
0.358	0.427	0.152	0.308	0.305	0.359	0.272	0.29	0.247	0.144	-0.05	0.488	0.065	0.217	0.144	0.39	0.452	1		
0.384	0.337	0.281	0.576	0.42	0.477	0.612	0.581	0.585	0.49	0.073	**0.776**	0.222	**0.471**	0.378	**0.489**	**0.812**	**0.63**	1	
0.666	0.013	0.362	-0.406	-0.227	-0.502	-0.27	-0.285	-0.436	-0.416	0.118	0.326	-0.272	**-0.508**	**0.925**	**0.658**	-0.241	-0.17	-0.27	1

Note: Bold values indicate correlation with a high degree of substitution

Table 3C. Innovation and Voice and Accountability(VA).

Dependent Variables: lnSJA, TFP and GIO

	Foxed Effect			GLS-Random Effect			GMM(IV)		
Variable	lnSJA	TFP	GIO	lnSJA	TFP	GIO	lnSJA	TFP	GIO
GQ	0.1336	0.198**	-3.2309	0.1829	0.082**	0.082**	0.4352***	0.0205**	2.189***
	(-0.1202)	(-0.0812)	(-2.2671)	(-0.1205)	(-0.04031)	(-0.04031)	(-0.0556)	(-0.0096)	(-0.6009)
GDPG	-0.00384	0.0022	0.10207**	-0.0046	0.0031*	0.0031*	-0.00189	0.0026*	0.0656
	(-0.0027)	(-0.0015)	(-0.0434)	(-0.0032)	(-0.00167)	(-0.00167)	(-0.007)	(-0.0016)	(-0.1438)
HC	0.8035**	0.265	-3.0389	1.365***	0.0703	0.0703	1.116***	0.0328	0.4037
	(-0.3763)	(-0.2228)	(98.2657)	(-0.3193)	(-0.0981)	(-0.0981)	(-0.1182)	(-0.0247)	(-0.8045)
FCF	-0.0062	0.0016	0.03976	-0.0025	0.002	0.002	0.0037	0.0032***	-0.147***
	(-0.0038)	(-0.0016)	(-0.0508)	(-0.0033)	(-0.0018)	(-0.0018)	(-0.00430	(-0.00086)	(-0.0415)
TRD	-0.0008	-0.0009	0.02875*	-0.0009	-0.00093*	-0.00093*	-0.0109***	-0.0009 ***	0.0295*
	(-0.0012)	(-0.0007)	(-0.01602)	(-0.0012)	(-0.00054)	(-0.000540	(-0.00120	(-0.00024)	(-0.0173)
MID	0.188*	-0.0432	4.0994***	0 .274***	-0.0328	-0.0328	0.1462	-0.0024	0.12176
	(-0.06640	(-0.03960	(-0.64879)	(-0.1031)	(-0.0374)	(9-0.0374)	(-0.1237)	(-0.0151)	(-0.9663)
lnEMP	1.774***	-0.0773	0.64648	1.043***	0.0167	0.0167	0.3894***	-0.0076	0.04703
	(-0.4582)	(-0.1506)	(-8.5899)	(-0.1619)	(-0.0405)	(-0.0405)	(-0.0696)	(-0.0092)	(-0.5505)
lnCK	0.4765 ***	-0.0684	-0.5303	0.473***	-0.02051	-0.02051	0.591***	0.0221**	0.50084
	(-0.1688)	(-0.0586)	(-3.8055)	(-0.1559)	(-0.0383)	(-0.0383)	(-0.0739)	(-0.0097)	(-0.4697)
lnUPOP	0.872	0.3508**	1.7718	1.146***	0.1835***	0.1835***	0.2819***	0.1171***	0.6523
	(-0.6032)	(-0.1629)	9-10.724)	(-0.3116)	(-0.0619)	(-0.0619)	(-0.09540	(-0.0139)	(-0.8912)
_cons	-38.782***	2.275	16.8147	-29.661***	0.5375*	0.5375*	-18.464***	0.0812	6.2239
	(-4.5198)	(-2.2815)	(-81.614)	(-2.5292)	(-0.4287)	(-0.4287)	(-1.0151)	(-0.1734)	(-6.8393)
Wald chi2	57.24	9.24	10.16	503.47	58.07	58.07	261.72	158.94	77.86
(Prob> chi2)	0	0	0	0	0	0	0	0	0
R^2 *within*	0.7017	0.2195	0.0775	0.6949	0.1876	0.1876	0.7172	0.2097	0.2198
R^2*between*	0.5548	0.1705	0.0832	0.6489	0.3017	0.3017	-	-	-
N(Obs)	733	506	236	733	506	506	733	482	216
Countries	37	25	30	37	25	30	37	25	30

lnSJA
TFP
GIO
GG
VA
PS
GE
RQ
RL
CC
GDPG
HC
FCF
TRD
lnEMP
lnCK
MID
lnUPOP
lnGDP
lnPOP

*,** , *** indicate significant at 10%, 5% and 1% levels respectively; robust standard errors in brackets; governance institution is instrumented with early institutions and GDP per capita for the GMM (IV) models

Table 3D. Innovation and Political Stability And Non Voilance(PS).

Dependent Variables: lnSJA, TFP and GIO

	Foxed Effect			GLS-Random Effect			GMM(IV)		
Variable	lnSJA	TFP	GIO	lnSJA	TFP	GIO	lnSJA	TFP	GIO
GQ	-0.0038	0.0567**	-1.2252	0.0225	0.0491**	-0.01319	0.412***	0.0276***	2.1055***
	(-0.0618)	(-0.0234)	(-0.7724)	(-0.0579)	(-0.0215)	(-0.86369)	(-0.0466)	(-0.0089)	(-0.60461)
GDPG	-0.0027	0.0032*	0.0941**	-0.0033	0.0034*	0.0878**	-0.0068	0.0023	0.02763
	(-0.0027)	(-0.0018)	(-0.04297)	(-0.0031)	(-0.0018)	(-0.04471)	(-0.0069)	(-0.0016)	(-0.14272)
HC	0.7617**	0.1878	-2.97368	1.3504***	0.05875	0.79143	1.150***	0.0308	0.27836
	(-0.3799)	(-0.2164)	(-8.3171)	(-0.34568)	(-0.0941)	(-1.59304)	(-0.1358)	(-0.0247)	(-0.8363)
FCF	-0.00638	0.0019	0.03576	-0.0025	0.002	0.00618	0.0022	0.0029***	-0.1307***
	(-0.004)	(-0.0021)	(-0.0546)	(-0.0036)	(-0.0019)	(-0.03588)	9-0.0047)	(-0.009)	(-0.03999)
TRD	-0.0007	-0.0011	0.03063**	-0.0008	-0.0012**	0.03144*	-0.0104***	-0.0011***	0.02357
	(-0.0012)	(-0.0007)	(-0.0138)	(0.0012)	(-0.0006)	(-0.01863)	(-0.0014)	(-0.00024)	(-0.01649)
MID	0.1964*	-0.0235	4.336***	0.288**	-0.0206	2.5802**	0.1697	-0.0038	0.71594
	(-0.1006)	(-0.0414)	(-0.8225)	(-0.1016)	(-0.0391)	(-1.3178)	(0.1215)	(-0.0156)	(-1.03471)
lnEMP	1.784***	-0.0712	-0.9854	1.026***	0.0201	0.54269	0.523***	-0.0023	0.60455
	(-0.4663)	(-0.1687)	(-8.4187)	(-0.1675)	(-0.0343)	(-0.80406)	(-0.0654)	(-0.0093)	(-0.59302)
lnCK	0.474***	-0.0634	-0.96439	0.477***	-0.0114	0.048383	0.575***	0.0244**	0.60533
	(-0.1683)	(-0.0677)	(-4.0416)	(-0.1569)	(-0.0347)	(-0.83548)	-0.071	-0.0098	-0.46405
lnUPOP	0.9496	0.435**	3.0697	1.198***	0.172***	1.2318	0.240***	0.1086***	0.264524
	(-0.5992)	(-0.1712)	(-11.049)	(-0.3024)	(-0.0591)	(-1.7881)	(-0.0878)	(-0.0144)	(-0.90921)
_cons	-39.163***	1.821**	49.1618	-29.784***	0.380**	1.04701	-19.98***	-0.00059	-3.422
	(-4.6503)	(-2.432)	(-84.412)	(-2.5654)	(-0.4338)	(-10.312)	(-0.951)	(-0.1788)	(-6.49003)
Wald chi2	55.64	6.87	6.87	556.87	85.73	24.27	240.28	181.48	68.48
(Prob> chi2)	0	0	0	0	0	0.0039	0	0	0
R^2 *within*	0.7003	0.1832	0.0691	0.6929	0.1627	0.0507	0.7287	0.2135	0.1962
R^2*between*	0.5394	0.2144	0.0002	0.6333	0.3757	0.1548	-	-	-
N(Obs)	733	506	236	733	506	236	733	482	216
Countries	37	25	30	37	25	30	37	25	30

*,** , *** indicate significant at 10%, 5% and 1% levels respectively; robust standard errors in brackets; governance institution is instrumented with early institutions and GDP per capita for the GMM (IV) models

Table 3E. Innovation and Government Effectiveness (GE).

Dependent Variables: lnSJA, TFP and GIO

	Foxed Effect			GLS-Random Effect			GMM(IV)		
variable	lnSJA	TFP	GIO	lnSJA	TFP	GIO	lnSJA	TFP	GIO
GO	0.2856*	0.123**	-1.3824	0.287**	0.0786**	2.73154*	0.746***	0.0345***	4.4299***
	(-0.1776)	(-0.0568)	(-2.5264)	(-0.1498)	(-0.0385)	(-1.56998)	(-0.0748)	(-0.0122)	(-0.94539)
GDPG	-0.0039	0.0033*	0.0892**	-0.0044	0.0034	0.07817*	-0.0076	0.0024	0.09222
	(-0.0027)	(-0.0018)	-0.04193	(-0.003)	(-0.0018)	(-0.04739)	(-0.0069)	(-0.0016)	(-0.1312)
HC	0.8378**	0.1924	(-3.4663)	1.439***	0.0641	-0.224	0.945***	0.0271	-0.70483
	(-0.3575)	(-0.2340)	(-8.7104)	(-0.2938)	(-0.1015)	(-1.5576)	(-0.1294)	(-0.0251)	(-0.88549)
FCF	-0.0073*	0.0013	0.03525	-0.0028	0.0021	-0.02389	0.0007	0.0031***	-0.2009***
	(-0.0039)	(-0.0019)	(-0.05625)	(-0.0034)	(0.0019)	(-0.0519)	(-0.0045)	(-0.0008)	(-0.0519)
TRD	-0.00034	-0.0006	0.0347**	-0.0004	-0.0007	0.03355*	-0.0087***	-0.0009***	0.0409**
	(-0.0011)	(-0.0008)	(-0.01506)	(-0.0011)	(-0.0006)	(-0.02081)	(-0.0012)	(-0.00024)	(-0.0165)
MID	0.2209**	-0.02082	4.354***	0.326***	-0.0166	2.0493	0.1898	-0.00087	0.0802
	(-0.0936)	(-0.0424)	(-0.73701)	(-0.0955)	(-0.0394)	(-1.4429)	(-0.1242)	(-0.0152)	(-0.92904)
lnEMP	1.890***	0.0231	-1.40808	1.067***	0.0336	0.94015	0.544***	-0.00076	0.86982
	(-0.4192)	(-0.1899)	(-8.7739)	(-0.144)	(-0.0402)	(-0.8556)	(-0.0679)	(-0.0095)	(-0.59305)
lnCK	0.4774***	-0.0812	-0.61366	0.4524***	-0.0312	-0.01671	0.466***	0.0172*	0.13176
	(-0.15720	(-0.0631)	(-4.1316)	(-0.1507)	(-0.0392)	(-0.8094)	(-0.0753)	(-0.0099)	(-0.49003)
lnUPOP	0.7287	0.3899**	4.7802	1.102***	0.203***	1.4278	0.45***	0.1259***	1.43333*
	(-0.5702)	(-0.1812)	(-11.888)	(-0.2885)	(-0.0557)	(-1.6555)	(-0.0915)	(-0.0141)	(-0.85165)
_cons	-40.02***	1.024	41.3122	-29.45***	0.4725	0.13049	-17.85***	0.0918	3.97125
	(-4.644)	(-2.5670	(-95.248)	(-2.5141)	(-0.4291)	(-9.1269)	(-1.0081)	(-0.1733)	(-6.5108)
Wald chi2	67.91	7.85	6.67	733.32	57.79	41.44	297.76	165.69	96.14
(Prob> chi2)	0	0	0	0	0	0	0	0	0
R^2 *within*	0.7058	0.1784	0.0639	0.6973	0.1622	0.0341	0.7312	0.2113	0.2749
R^2*between*	0.5656	0.2929	0.0028	0.6677	0.372	0.3446	-	-	
N(Obs)	733	506	236	733	506	236	733	482	216
Countries	37	25	30	37	25	30	37	25	30

*,** , *** indicate significant at 10%, 5% and 1% levels respectively; robust standard errors in brackets; governance institution is instrumented with early institutions and GDP per capita for the GMM (IV) models

Table 3F. Innovation and Regulatory Quality (RQ).

Dependent Variables: lnSJA, TFP and GIO									
	Foxed Effect			GLS-Random Effect			GMM(IV)		
variable	lnSJA	TFP	GIO	lnSJA	TFP	GIO	lnSJA	TFP	GIO
GO	0.285*	0.185***	1.2037	0.3396**	0.1258***	3.0571**	0.7899***	0.0514***	4.0631***
	(-0.1565)	(-0.0534)	(-3.3058)	(-0.1333)	(-0.03644)	(-1.551)	(-0.0774)	(-0.013090	(-0.75098)
GDPG	-0.00396	0.0034**	0.0841*	-0.00463	0.0034**	0.07825*	-0.0074	0.002	0.1037
	(-0.00280	(-0.0016)	(-0.0432)	(-0.0032)	(-0.0016)	(-0.0479)	(-0.0071)	(-0.00153)	(-0.13375)
HC	0.909**	0.2396	-5.3726	0.483***	0.0881	0.11881	1.051***	0.0461*	0.16268
	(-0.3913)	(-0.2007)	(-8.2619)	(-0.2967)	(-0.0982)	(-1.6932)	(-0.1282)	(-0.0251)	(-0.79467)
FCF	-0.00713*	0.00081	0.027986	-0.0032	0.00152	-0.02369	-0.00272	0.0027***	-0.197***
	(-0.0039)	(-0.0018)	(-0.05071)	(-0.0036)	(-0.0018)	(-0.05192)	(-0.00452)	(-0.00081)	(-0.04513)
TRD	-0.00027	-0.0005	0.0377**	-0.00024	-0.00062	0.038623	-0.0075***	-0.0009***	0.0458***
	(-0.0012)	(-0.00065)	(-0.01836)	(-0.0012)	(-0.0005)	(-0.02105)	(-0.0011)	(-0.00023)	(-0.01709)
MID	0.2034**	-0.0222	4.326***	0.301***	-0.0204	2.2391*	0.1266	-0.0061	0.05584
	(-0.097)	(-0.0378)	(-0.8652)	(-0.0993)	(-0.0351)	(-1.329)	(-0.1197)	(-0.0151)	(-0.9302)
lnEMP	1.817***	0.0314	0.32553	1.0623***	0.0481	1.0742	0.5601***	-0.00755	0.7703
	(-0.4351)	(-0.1577)	(-8.9464)	(-0.1524)	(-0.0432)	(-0.88716)	(-0.0676)	(-0.00986)	(-0.5755)
lnCK	0.4678***	-0.0967	-0.43166	0.445***	-0.04351	-0.04465	0.4823***	0.0152	0.30747
	(-0.1495)	(-0.0615)	(-3.9142)	(-0.1436)	(-0.0411)	(-0.80348)	(-0.0712)	(-0.0102)	(-0.4831)
lnUPOP	0.7186	0.3433*	4.3259	1.032***	0.1899***	0.84836	0.4007***	0.1207***	0.53593
	(-0.5572)	(-0.1706)	(-11.2052)	(-0.2947)	(-0.0551)	(-1.6718)	(-0.0888)	(-0.014)	(-0.8534)
_cons	-38.793***	1.3911	16.0754	-29.018***	0.591	-0.4167	-18.55***	0.398**	1.4927
	(-4.621)	(-2.278)	(-86.2963)	(-2.403)	(-0.404)	(-8.9454)	(-0.9303)	(-0.1741)	(-6.6095)
Wald chi2	63.23	6.36	6.73	734.66	91.78	46.91	321.06	172.66	93.83
(Prob> chi2)	0	0.0001	0	0	0	0	0	0	0
R^2 *within*	0.707	0.2297	0.0637	0.6994	0.2163	0.0426	0.7415	0.2092	0.2929
R^2*between*	0.575	0.2677	0.0411	0.6785	0.3398	0.353	-	-	-
N(Obs)	733	506	236	733	506	236	733	482	216
Countries	37	25	30	37	25	30	37	25	30

*,** , *** indicate significant at 10%, 5% and 1% levels respectively; robust standard errors in brackets; governance institution is instrumented with early institutions and GDP per capita for the GMM (IV) models

Table 3G. Innovation and Rule of Law (RL).

Dependent Variables: lnSJA, TFP and GIO									
	Foxed Effect			GLS-Random Effect			GMM(IV)		
variable	lnSJA	TFP	GIO	lnSJA	TFP	GIO	lnSJA	TFP	GIO
GO	0.3053**	0.1414*	-1.6869	0.352***	0.0914**	1.5015	0.7763***	0.02296**	3.435***
	(-0.14852)	(-0.074)	(-1.7248)	(-0.141)	(-0.041)	(-1.3158)	(-0.0753)	(-0.0117)	(-0.7464)
GDPG	-0.0044	0.0032*	0 .0925**	-0.00497	0.0034**	0.0807*	-0.00869	0.00307**	0.05531
	(-0.0028)	(-0.0017)	(-0.04238)	(-0.00311)	(-0.00171)	(-0.04917)	(-0.00665)	(-0.00158)	(-0.14293)
HC	0.7857**	0.1857	-2.7925	1.374***	0.0606	0.24086	0.9534***	0.00749	0.0591
	(-0.37282)	(-0.2256)	(-8.7246)	(-0.3083)	(-0.09863)	(-1.5448)	(-0.12549)	(-0.0271)	(-0.8136)
FCF	-0.0069*	0.00125	0.04192	-0.00303	0.00163	-0.01313	-0.0023	0.00241***	-0.183***
	(-0.0041)	(0.0021)	(-0.0525)	(-0.0037)	(-0.0019)	(-0.04288)	(-0.00444)	(-0.00086)	(-0.0447)
TRD	-0.00052	-0.00058	0.02958*	-0.00053	-0.00074	0.0355*	-0.0087***	-0.0081***	0.045***
	(-0.0011)	(-0.00072)	(-0.01638)	(-0.0011)	(-0.00055)	(-0.0213)	(-0.0011)	(-0.00024)	(-0.0179)
MID	0.1759*	-0.04114	4.505***	0.272***	-0.0331	2.241	0.11244	-0.0115	-0.09428
	(-0.09414)	(-0.0449)	(-0.71614)	(-0.0936)	(-0.0395)	(-1.4233)	(-0.1214)	(-0.01489)	(-0.9696)
lnEMP	1.8901***	0.02159	-0.95675	1.089***	0.03582	0.8264	0.5541***	-0.01185	0.81875
	(-0.43261)	(-0.1861)	(-8.3427)	(-0.1555)	(-0.0413)	(-0.8469)	(-0.0675)	(-0.00971)	(-0.6069)
lnCK	0.4471**	-0.0939	-0.70897	0.4364***	-0.02911	0.04569	0.5195***	0.01481	0.278
	(-0.1714)	(-0.06965)	(-3.8934)	(-0.15911)	(-0.03872)	(-0.83276)	(-0.0709)	(-0.00937)	(-0.4907)
lnUPOP	0.73012	0.36869*	4.4568	1.087***	0.2008***	1.3394	0.4763***	0.1325***	1.2961
	(-0.55853)	(-0.2074)	(-10.712)	(-0.2926)	(-0.0575)	(-1.6846)	(-0.08972)	(-0.01378)	(-0.8482)
_cons	-39.155***	1.47189	36.6893	-29.151***	0.4274	-1.5229	-19.334***	0.3184*	-1.0443
	(-4.5057)	(-2.4476)	(-83.073)	(-2.4327)	(-0.41254)	(-9.7967)	(-0.89521)	(-0.1931)	(-6.4331)
Wald chi2	78.16	5.44	8.28	845.1	68.96	32.37	314.48	18.21	84.35
(Prob> chi2)	0	0.0004	0	0	0	0.0002	0	0	0
R^2 *within*	0.7067	0.1841	0.0651	0.6984	0.1695	0.0398	0.7423	0.2367	0.2408
R^2*between*	0.5585	0.221	0.0046	0.6758	0.3391	0.2426	-	-	-
N(Obs)	733	506	236	733	506	236	733	506	216
Countries	37	25	30	37	25	30	37	25	30

*,** , *** indicate significant at 10%, 5% and 1% levels respectively; robust standard errors in brackets; governance institution is instrumented with early institutions and GD per capita for the GMM (IV) models

Table 3H. Innovation and Corruption Control (CC).

Dependent Variables: lnSJA, TFP and GIO									
	Foxed Effect			GLS-Random Effect			GMM(IV)		
variable	lnSJA	TFP	GIO	lnSJA	TFP	GIO	lnSJA	TFP	GIO
GO	0.323**	0.02234	-5.4709*	0.3277**	0.03723	-0.95431	0.6482***	0.02164*	1.5523**
	(-0.1599)	(-0.05324)	(-3.0478)	(-0.1352)	(-0.03228)	(-1.4189)	(-0.06628)	(-0.01161)	(-0.71595)
GDPG	-0.00357	0.00357*	0.0974**	-0.004	0.00367**	0.0912**	-0.00379	0.00311**	0.018988
	(-0.0028)	(-0.00182)	(-0.0385)	(-0.00311)	(-0.00181)	(-0.04424)	(-0.00691)	(-0.0016)	(-0.14819)
HC	0.7927**	0.17298	-2.7859	1.386***	0.06849	1.1226	1.1007***	0.00977	0.76106
	(-0.34334)	(-0.2332)	(-7.9501)	(-0.30525)	(-0.09813)	(-1.67203)	(-0.12433)	(-0.02686)	(-0.87014)
FCF	-0.00691*	0.00187	0.0837	-0.00285	0.00223	0.01559	0.00278	0.00259***	-0.1381***
	(-0.00391)	(-0.0022)	(-0.0562)	(-0.00359)	(-0.00212)	(-0.0373)	(-0.00462)	(-0.00086)	(-0.0439)
TRD	-0.00053	-0.00091	0.0291*	-0.00055	-0.00083	0.03049	-0.00999***	-0.0008***	0.0415**
	(-0.00114)	(-0.00071)	(-0.0157)	(-0.00118)	(-0.00056)	(-0.0195)	(-0.0012)	(-0.00024)	(-0.01771)
MID	0.1991**	-0.03743	4.082***	0.2976***	-0.02859	2.5561**	0.06298	-0.01213	-0.29616
	(-0.09696)	(-0.04399)	(-0.4815)	(-0.09862)	(-0.03875)	(-1.2902)	(-0.1263)	(-0.01486)	(-1.0069)
lnEMP	1.897***	-0.03686	-3.5075	1.0859***	0.018385	0.35345	0.4895***	-0.01234	0.29099
	(-0.4189)	(-0.20045)	(-10.171)	(-0.15463)	(-0.03499)	(-0.83817)	(-0.06897)	(-0.00967)	(-0.5555)
lnCK	0.4925***	-0.07744	-2.202	0.4768***	-0.0166	0.03834	0.5748***	0.015904*	0.68014
	(-0.1621)	(-0.06404)	(-3.9369)	(-0.15335)	(-0.03397)	(-0.8541)	(-0.07365)	(-0.00928)	(-0.46469)
lnUPOP	0.70529	0.4844**	9.5311	1.0988***	0.2019***	1.3505	0.4346***	0.13398***	0.9134
	(-0.58103)	(-0.17875)	(-12.673)	(-0.29976)	(-0.05528)	(-1.6368)	(-0.09303)	(-0.01416)	(-0.85617)
_cons	-40.326***	1.48326	93.6125	30.215***	0.31463	2.5595	-19.963***	0.28278	-4.4069
	(-4.64734)	(-2.5814)	(-106.163)	(-2.4922)	(-0.41756)	(-10.0752)	(-0.95231)	(-0.19785)	(-6.4459)
Wald chi2	67.77	6.97	26.98	775.14	49.34	22.08	283.77	18.08	65.46
(Prob> chi2)	0	0	0	0	0	0.0086	0	0	0
R^2 *within*	0.7075	0.149	0.0956	0.6994	0.1275	0.0606	0.7243	0.2364	0.1819
R^2*between*	0.5571	0.2478	0.0003	0.6641	0.4141	0.1207	-	-	
N(Obs)	733	506	236	733	506	236	733	506	216
Countries	37	25	30	37	25	30	37	25	30

*,** , *** indicate significant at 10%, 5% and 1% levels respectively; robust standard errors in brackets; governance institution is instrumented with early institutions and GDP per capita for the GMM (IV) models

Appendix-C.

Appendix Table C1: Lists ofcountries and mean values of the key variables													
Country	ID	lnSJA	GQ	VA	PSNV	GE	RQ	RL	CC	Polity2	DEMO	AUTOCR	GDPG
Angola	AGO	2.130582	-1.26017	-1.25558	-1.134	-1.17193	-1.25373	-1.41228	-1.33392	-2.2381	1.7143	3.95238	7.16622
Benin	BEN	4.214989	-0.1689	0.266396	0.5330	-0.44335	-0.37875	-0.39678	-0.59394	6.52381	6.52381	0	4.3545
Botswana	BWA	4.657352	0.723487	0.588086	1.06784	0.530219	0.59729	0.63274	0.924742	7.952381	7.9524	0	4.5446
Burkinafaso	BFA	4.436408	-0.36244	-0.31251	-0.24021	-0.63527	-0.24929	-0.53166	-0.20567	-0.3809	2	2.38095	6.0104
Burundi	BDI	1.602067	-1.29301	-1.11427	-1.93918	-1.2981	-1.16966	-1.21238	-1.02444	2.61905	4.333	1.71427	1.893
Cameron	CMR	5.461935	-0.93888	-1.02985	-0.67136	-0.8415	-0.81743	-1.12904	-1.14412	-4	1	5	4.1425
Central African Republic	CAF	2.101296	-1.31848	-1.03554	-1.72003	-1.48014	-1.13732	-1.40755	-1.13026	1.19048	-12.523	-13.714	0.6654
Congo Republic	COG	3.85501	-1.13691	-1.1287	-0.93726	-1.1915	-1.20148	-1.24896	-1.11355	-4	0.2857	4.28571	3.690
Dem. Republic Congo	ZAR	2.081521	-1.72009	-1.50325	-2.40868	-1.66925	-1.5958	-1.70729	-1.43628	3	3.7143	0.71429	3.2723
Cote D'voire	CIV	4.71709	-0.94059	-0.89785	-1.28052	-0.89253	-0.65405	-1.11339	-0.80522	0.61905	2.23809	1.61905	3.2864
Ethiopia	ETH	5.647005	-0.96154	-1.20963	-1.39262	-0.71713	-1.07369	-0.76243	-0.61375	-1.2857	1.85714	3.14286	8.0684
Gabon	GAB	3.563768	-0.45534	-0.72001	0.30054	-0.64961	-0.35653	-0.47674	-0.82968	-1.333	1.52381	2.85714	2.1487
Gambia	GMB	3.538028	-0.46045	-1.02689	0.25577	-0.62091	-0.43171	-0.36929	-0.5697	-5.0476	0	5.0476	3.5738
Ghana	GHA	5.39069	-0.03231	0.256717	-0.07195	-0.08106	-0.11428	-0.01895	-0.16433	6.2857	6.6667	0.38095	5.7891
Kenya	KEN	6.228357	-0.70681	-0.40414	-1.19455	-0.52851	-0.25103	-0.85219	-1.01045	5.0476	6.2381	1.19048	4.1819
Lesotho	LSO	1.92472	-0.14688	-0.10831	0.04302	-0.29953	-0.47992	-0.0799	0.04337	7.04762	7.8571	0.71428	3.74551
Liberia	LBR	0.976679	-1.17278	-0.60418	-1.38274	-1.42458	-1.37997	-1.27451	-0.97067	3.94737	5.6316	1.6842	11.597
Madagascar	MDG	4.005382	-0.44848	-0.28006	-0.16402	-0.74452	-0.50479	-0.53208	-0.46539	5.71423	6.1905	0.42857	3.0538
Malawi	MWI	4.520296	-0.35261	-0.20994	-0.06919	-0.53327	-0.49951	-0.26395	-0.5398	5.7619	5.9524	0.19048	4.325
Mali	MLI	3.655342	-0.4222	0.03993	-0.23984	-0.83272	-0.42011	-0.39116	-0.68927	6.04762	2.5714	-3.4762	5.0895
Mauritania	MRT	1.930861	-0.56742	-0.8362	-0.25649	-0.54938	-0.47002	-0.71303	-0.57941	2.1	1.93091	0.1904	4.1558
Mauritius	MUS	3.790405	0.74958	0.879562	0.96533	0.672197	0.66345	0.95671	0.36023	10	10	0	4.4527
Mozambique	MOZ	3.494667	-0.38291	-0.17179	0.069617	-0.52182	-0.43413	-0.70026	-0.53907	5	5.1905	0.1905	8.7002
Namibia	NAM	3.606275	0.33031	0.39087	0.67433	0.16079	0.14902	0.21320	0.39369	6	6	0	4.598
Niger	NER	3.350271	-0.64128	-0.48319	-0.56984	-0.79688	-0.60777	-0.60747	-0.78254	3.47619	5.2857	1.8095	5.5039
Nigeria	NGA	7.43206	-1.12578	-0.754	-1.71861	-1.02699	-0.8927	-1.18812	-1.17425	3	-0.3809	-3.524	6.369
Rwanda	RWA	2.755321	-0.68168	-1.33888	-0.99761	-0.42858	-0.54874	-0.68335	-0.09291	-3.857	0	3.8571	8.29545
Senegal	SEN	5.039578	-0.18429	0.076099	-0.38081	-0.27051	-0.19377	-0.14564	-0.19114	5.8095	6.3809	0.5715	4.2278
Sierra Leone	SLE	1.937011	-0.93303	-0.49856	-0.84635	-1.269	-1.04609	-1.05658	-0.88162	4.8095	2	4	4.8302
South Africa	ZAF	8.536566	0.3304	0.675996	-0.18655	0.554749	0.47065	0.14678	0.32099	9	9	0	2.8614
Sudan	SDN	4.886726	-1.5656	-1.73068	-2.35859	-1.26173	-1.3652	-1.43474	-1.24265	-4.3809	0.3333	4.8095	5.8006
Swaziland	SWZ	2.88311	-0.58437	-1.35801	-0.17518	-0.66557	-0.46464	-0.57719	-0.26563	-9	0	9	1.8884
Tanzania	TZA	5.3801	-0.44388	-0.32305	-0.40839	-0.5229	-0.41359	-0.36132	-0.63402	-0.619	2.1905	2.8095	6.1536
Togo	TGO	3.313712	-0.85459	-1.03103	-0.36321	-1.24999	-0.74342	-0.85099	-0.88889	-2.4762	1	3.477	3.1506
Uganda	UGA	5.308445	-0.64169	-0.68399	-1.18079	-0.50251	-0.10947	-0.47792	-0.89547	-2.2857	0.5714	2.8571	6.4697
Zambia	ZMB	4.109119	-0.37523	-0.28665	0.2271	-0.77672	-0.45509	-0.41265	-0.5474	4.90476	5.380952	0.4762	6.1707
Zimbabwe	ZWE	5.038958	-1.27833	-1.28128	-1.00652	-1.04894	-1.71193	-1.47532	-1.14601	-1.7143	2	3.7143	0.7404

Appendix Table C2. Definitions of Variables

Variables	Sign	Definitions of variables (measurement)	Source e
General Governance	GQ	First principal component of the six world governance indicators.	PCA
Control of Corruption	CC	Control of corruption (estimate): captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the state by elites and private interests."	World Bank
Autocracy	AUTOCR	Codified measure of a country's level of democratization based on (Jaggers and Gurr 1995; Marshall and Jaggers 2002). Scores can range from -10 to 10, with 10 representing a full Autocracy	POLITY IV
Voice and Accountability	VA	Reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media	World Bank
Political Stability	PS	Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism	World Bank
Government Effectiveness	GE	Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies	World Bank
Regulatory Quality	RQ	Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development	World Bank
Rule of Law	RL	Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	World Bank
Economic	GDPG	Rate of annual growth in domestics physical product	World Bank
Human Capital	HC	Human capital is measured by the human capital development index	Pen World Tables
Gross Capital	GCF	Measured by investment as a percentage of the national GDP	World Bank
Trade	TRADE	Measured by the ratio of the total trade(i.e. import plus export) to national GDP	World Bank
Labour Force	LFP	Measured by the total number of people engaged in productive economic activities	Pen World Tables
Government	GCE	Measured by the annual government consumption spending AS % of GDP	World Bank
household	HCE	Measured by the total Household consumption spending as % of GDP	World Bank
Growth in initial	g	Measured by the one period lagged value of annual, growth in national income per person	World Bank
Domestic	DCP	Measured by the total domestic credit provided to the private sector as % of GDP (DCP)	World Bank
Innovation	SJA	Measured by the citation index of scientific and technical journal articles	World Bank & Web Of Science
Inflation	INF	Measured by the increase in annual consumer price index	World Bank

Appendix Table C3. Summary Statistics (1996–2016).

Variables	Obs	Mean	Std. Dev.	Min	Max
Scientific and Technical Journal Articles(lnSJA)	775	3.994	1.753634	-1.20397	9.177724
Polity2	777	1.810811	5.162462	-9	10
Democracy	776	3.765464	3.198652	0	10
Autocracy	776	2.131443	2.282781	0	9
General Governance Quality (GQ)	777	-0.60737	0.6037891	-2.44516	0.9104884
Voice and Accountability(VA)	777	-0.55356	0.683491	-1.8587	1.007172
Political Stability and Non Violence(PS)	777	-0.57318	0.9907496	-5.52657	2.056143
Government Effectiveness(GE)	777	-0.67743	0.580799	-1.88489	1.049441
Regulation Quality(RQ)	777	-0.58338	0.5966134	-2.29754	1.12727
Rule of Law (RL)	777	-0.64821	0.6247567	-2.12999	1.07713
Control of Corruption(CC)	777	-0.60847	0.5683565	-1.72293	1.216737
GDP growth(GDPG)	758	4.7055	6.516985	-36.6999	106.2798
Human Capital Development Index(HC)	777	1.7069	0.4091225	1.05333	2.833614
Gross Capital Formation as % of GDP (GCF)	746	20.34275	9.187498	-2.424358	61.46868
Government consumption spending % of GDP(GCE)	730	15.16523	6.063101	2.047121	59.72279
Household consumption spending % of GDP(HCE)	730	73.63497	20.27096	15.64096	28.3636
Inflation(INF)	754	52.94012	902.7758	-35.83668	24411.03
Lagged GDP Per Capita growth (GDPPCGlag)	776	2.066428	5.654828	-36.8299	91.64805
Domestic credit to the private sector as % of GDP (DCP)	738	19.88499	24.79346	.4913875	160.1248

Appendix Table C4. Pairewise Correlation Matrix.

	Dependent Variable	Innovation	Institutional Variables					Control variables								
	GDPG	lnSJA	POLIT2Y2	DEMO	AUTOCR	GQ	GDPPCGlag~g	HC	TRADE	INF	HCE	DCP	FDI	GCE	GCF	LFP
GDPG	11															
lnSJA	0.0283	1														
POLIT2Y2	0.0833	0.2186	1													
DEMO	0.0648	0.2583	**0.9364**	1												
AUTOCR	-0.073	-0.242	**-0.8870**	**-0.7784**	1											
GQ	0.0888	0.3126	**0.5298**	**0.6015**	**-0.4015**	1										
GDPPCGlag	0.1743	0.0863	0.0841	0.0867	-0.0523	0.1588	1									
HC	-0.0955	0.4153	0.2626	0.3401	-0.1734	0.4898	-0.0093	1								
TARDE	0.0104	-0.228	0.0426	0.1362	0.0532	0.1570	-0.0091	0.3099	1							
INF	-0.182	-0.1204	-0.1147	-0.1238	0.0726	-0.2609	-0.1857	-0.0062	0.0373	1						
HCE	-0.013	-0.273	0.0809	0.0430	-0.0265	-0.2076	-0.1207	-0.3163	0.0954	-0.0168	1					
DCP	-0.0747	0.4856	0.3834	0.4711	-0.2687	0.5097	0.0422	0.4914	0.0801	-0.0415	0.1364	1				
FDI	-0.0528	-0.1594	0.0345	0.0293	-0.0067	-0.0908	0.0403	-0.0277	0.4075	0.0455	0.2020	-0.0633	1			
GCE	0.0216	-0.0771	0.0991	0.1805	-0.0508	0.2404	0.0837	0.0702	0.2762	0.1515	-0.3074	0.2321	0.1057	1		
GCF	0.1316	0.1082	0.1513	0.1875	0.1398	0.3549	0.1578	0.2283	0.2387	-0.1655	-0.3107	0.0783	0.3165	0.3058	1	
LFP	0.0975	-0.1486	-0.1287	-0.1582	0.0121	-0.2613	0.0295	-0.3219	0.3179	0.1419	0.1402	-0.3307	0.0438	0.0173	-0.0395	1

Note: Bold values indicate correlation with a high degree of substitution

Table C5: Political Institutions, Innovation and Economic Growth

	IQ: Political Rights Index				IQ: Civil Liberty Index			
Variable	IV(GMM)	(FE)	(RE)	GMM (xtabond2)	IV(GMM)	(FE)	(RE)	GMM (xtabond2)
$GDPG_{-1}$				.1836**				.17235*
				(.09132)				(.09179)
GDPPCGlag	.12908***	-.0144539	.1291**	.2875***	.13508**	-.008434	.1351**	.2892***
	(.058673)	(.065679)	(.06164)	(.10757)	(.05841)	(.07056)	(.06299)	(.1081)
IQ	.4201***	1.094***	.4201***	.6311**	.52064**	1.594***	.5206**	.6297*
	(.13894)	(.2348)	(.16789)	(.26771)	(.213312)	(.42457)	(.25794)	(.35491)
SJA	.00062***	.000171	.00063**	.00082***	.00062**	.00023	.0061**	.0079**
	(.00017)	(.00029)	(.00028)	(.000253)	(.00018)	(.00026)	(.00308)	(.00254)
HC	1.958***	1.75647*	1.958***	2.4546***	1.9747**	1.9558	1.975***	2.3144**
	(.56302)	(2.0679)	(.75414)	(.6809)	(.56851)	(2.8040)	(.7378)	(.69667)
TRADE	.02068**	.03481**	.020673	.0319***	.0196**	.03134**	.0196066	.0289***
	(.00905)	(.01619)	(.01294)	(.00721)	(.00899)	(.01524)	(.01286)	(.00722)
INF	-.0173***	-.0248***	-.0173***	-.0199***	-.0163***	-.0239***	-.0163***	.0191***
	(.00555)	(.00525)	(.00642)	(.00558)	(.00566)	(.00526)	(.00681)	(.00578)
HCE	-.008027	-.012655	-.00803	-.01492	-.004045	-.01253	-.00405	-.00746
	(.01461)	(.03164)	(.02194)	(.01356)	(.01447)	(.02937)	(.02161)	(.01311)
DCP	-.03238**	-.06026	.0324***	.0458**	.030146	-.07323*	.03015**	.04067*
	(.00964)	(.03371)	(.01249)	(.01469)	(.00976)	(.03339)	(.01367)	(.02433)
FDI	-.096490	.1174***	.09649**	.149503**	-.09291	.12502**	-.09291	.1404**
	(.08613)	(.03806)	(.05201)	(.0324)	(.0864)	(.03447)	(.05095)	(.0331)
GCE	-.01916	-.0284546	-.019162	-.048840	-.02635	-.01632	-.02635	.05197
	(.03933)	(.07774)	(.05259)	(.04625)	(.03909)	(.07509)	(.05263)	(.04793)
GCF	.08047**	.060152	.08047**	.0848***	.07823**	.047321	.07823**	.0851***
	(.03715)	(.03881)	(.03844)	(.03281)	(.03737)	(.03458)	(.03762)	(.03345)
LFP	.0585***	.048669	.05851**	.06703**	.0612**	.05138	.06128**	.0667***
	(.0206)	(.05232)	(.02969)		(.0208)	(.0685)	(.02991)	(.02108)
_cons	4.1508	2.5787	4.1508	6.295**	4.1681	4.4545	4.1681	5.444*
	(2.6193)	(5.8554)	(3.7051)	92.9859)	(2.6872)	(6.6801)	(3.7082)	(3.1542)
R^2	0.1225	0.0479	0.4292		0.1199	.1179	0.4359	
Wald $\chi 2$	89.91	8.99	66.02	96.69	84.73	649	62.06	90.87
AR(1)				-9.05				-9.50
AR(2)				0.28				0.312
Sargan Oid.				231.92				237.46
N(Obs)	649	649	649	619	649	649	649	619

SJA: of scientific and technical journal articles index; GDPG-1 : lagged value of log of GDP growth IQ:

institutional quality proxy for Political Rights Index *and* Civil Liberty Index*; HC: human capita; GDPPCGlag: lagged value of GDP per capita growth; TRADE: trade as a percentage of GDP;INF: inflation rate; HCE: household consumption spending as a percentage of GDP; DCP: domestic credit to the private sector; FDI: foreign direct investment as percentage of GDP; GCE: government consumption expenditure as percentage of GDP; GCF: gross capital formation n* as a percentage of GDP; EMP: employment level as percentage of the total population.

*Notes: Regression results for the system (gmm) are obtained by Arellano-Bond dynamic panel-data estimation of first-difference equations using generalized method of moments (GMM). All available lagged values of the dependent variables in each previous time period are used as instrumental variables in first-differencing. ***, **, * indicates significance at ρ < 0.01, ρ < 0.05 & ρ < 0.1 respectively.*

Table C6: Political Institutions, Innovation and Economic Growth

Estimates of Structural Equation Models				
Variable	IQ: Political Rights Index		IQ: Civil Liberty Index	
SJA <-				
IQ	.22371***	Z	.35182***	7.03
	(.036122)	6.19	(.050018)	
_cons	5.0654***		5.5379***	26.32
	(.176784)	28.65	(.210384)	
GDPG<-				
SJA	.315498**	2.25	.29331*	1.69
	(.179978)		(.171286)	
IQ	.38226***	2.78	.452699**	2.12
	(.137525)		(.213304)	
GDPPCGlag	.12564**	2.12	.131965**	2.24
	(.059385)		(.058977)	
HC	2.24796***	3.64	2.2255***	2.11
	(.61731)		(.617763)	
TRADE	.02133**	2.23	.020095**	3.60
	(.0095698)		(.009518)	
INF	-.01679***	-2.72	-.016013***	-2.59

	(.0061631)		(.006185)	
HCE	-.0051499	-0.34	-.0015074	-0.10
	(.015046)		(.0149799)	
DCP	-.0197478	-2.42	-.017139	-1.65
	(.028156)		(.017993)	
FDI	-.090652	-1.08	-.087839	-1.04
	(.084031)		(.084706)	
GCE	-.009028	-0.23	-.015726	-0.40
	(.0391807)		(.039122)	
GCF	.069454**	1.99	.067729*	1.87
	(.035764)		(.036227)	
LFP	.05348***	2.91	.05569***	2.69
	(.020542)		(.020679)	
_cons	3.30056		3.25478	
	(2.7867)		(2.91241)	
R2(SJA)	.0560093		.0822019	
R2(GDPG)	.1383116		.1333716	
log likelihood	-27616.378		-27412.401	
Wald χ2(SJA)	38.35		49.47	
Wald χ2(GDPG)	88.63		84.62	
N(Obs)	649		649	

SJA: of scientific and technical journal articles index; GDPG-1 : lagged value of log of GDP growth IQ: institutional quality proxy for Political Rights Index *and* Civil Liberty Index*; HC: human capita; GDPPCGlag: lagged value of GDP per capita growth; TRADE: trade as a percentage of GDP;INF: inflation rate; HCE: household consumption spending as a percentage of GDP; DCP: domestic credit to the private sector; FDI: foreign direct investment as percentage of GDP; GCE: government consumption expenditure as percentage of GDP; GCF: gross capital formation n* as a percentage of GDP; EMP: employment level as percentage of the total population.

*Notes: ***, **, * indicates significance at $\rho < 0.01$, $\rho < 0.05$ & $\rho < 0.1$ respectively.*