

Innovation Performance Measurement in Developing Countries: A Case Study of Sub-Saharan Africa

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Abstract. This paper analyzes the actual problems of innovation performance measurement, especially; the development of methodological tools in the assessment of innovation performance in developing countries. The paper discusses and substantiates the author's position on informal sector innovation in developing economies, and its related concepts. Using regression and correlation analysis, an assessment of innovation performance of economies was carried out using innovation development variables. Although, we found a weak correlation between innovation performance and GDP per capita income, however, we think the nature of data used plays some importance in the outcome. It could be argued that the need for an integrated approach in undertaking research surveys for the above purpose. The paper highlights the criteria used in measuring innovation performance of countries. The authors emphasize on the need for a wide spectrum of approaches, not based on only the mainstream pre-requisites, but also taking into account subjective assessment of innovation in the informal sector of developing countries, which innovates to solve local problems. The methodological research tools include the reviewing of literature, theoretical approaches and various innovation concepts in assessing innovation performance, comparative analysis of the components of innovation. The paper discussed some prospects and importance of informal innovation to the Sub-Saharan economies, especially in the informal sector as a major source of employment and provides a larger proportion of the continent's GDP. This study provides a guideline in future research and innovation surveys for policymakers, economists and business people for better inclusive assessment of innovation performance of economies.

1. Introduction

The performance of an economic is largely dependent on the ability or capacity of institutions, both at the industrial and national level, to innovate or adopt existing innovative activities (Romer, 1990; Rommer, 1994; Tebaldi and Elmslie, 2013). Although, innovation is not in itself an end result, and thus does not drive growth, however, it accelerates or facilitates rapid growth. Since the emergence of classical economic theory in the 18th century as the pioneered modern school of economic thought, different conceptions of innovation have emerged and influenced the economic discussion. Adam Smith (1776), a leading proponent of this school of thought, emphasized on the importance of savings and capital accumulation to economic growth, and the role of competitive markets in innovation [1]. This reasoning was replaced with the neo-classical theory in the 19th century. Neo-classical scholars argued that the individual rational preferences among different outcomes to which values can be attributed; individuals tend to maximize utility, while companies maximize profits and economic decisions

are taken on full information. Alfred Marshall, a leading figure in this economic theory, established a linkage between innovation and local economic development [2]. According to Alfred Marshall companies undertaking similar activities and are clustered in a particular place could be more efficient than individual producers as proximity helps third-party companies to gain from new, excludable ideas created by other firms. This becomes the foundational insight to the current discourse surrounding open, user, inclusive or community-driven innovation.

Although, Sub-Saharan Africa (SSA) can be termed as latecomer in terms of development, but the region demonstrates a great potential of accelerated economic growth and development. This can be seen in the growing strides of the African continent in other development reports or measurements, for instance Sub-Saharan Africa (SSA) has over 60% of the fastest developing economies and also amongst the fast-improving countries in terms of competitiveness and ease of doing business, however, the level of innovation performance leaves much to be desired as the region lags behind. This calls for a concern, as SSA is seen as a region with least innovative output. This brings us to a discourse on the role of innovation in classical, neo-classical and Keynesian economic theories based on which various economies are run. Also we examined the concepts of innovation presented proponents of development and modernization theory, and explored the current positions on the innovation-development nexus. Particularly, these consist of novel interpretations of existing elements of conventional innovation measures or indices. There is a considerable literature, including this paper, where various definitions of the types of innovation [3, 639–667] and analysis of the metrics that set out their similarities and differences are reviewed, hence putting them into different types, however, there are still gaps [4, pp. 59–76], especially when it comes to assessing innovation in African economies. This outlines the objective of this paper. There are a considerable number of organizations, which seek to craft new specific theories on the contemporary realities of innovation in Africa [5], and to strategize grounded scenarios about innovation on the continent [6]. The paper looks at framework of scenarios of innovation performance measurement identifying elements that could enhance the possibility of capturing African innovation activities in mainstream measurement of innovation performance of countries. There is no a well-developed literature on innovation development measurement and its effects on Sub-Saharan economies, as most of the studies related to innovation performance and economic growth or development are either country-specific or on non-African economies. The studies of Oluwatobi et al., (2016) as well as Oyelaran-Oyeyinka and Barclay, (2004) the closest to this study are more identical, where both used the human capital as the proxy for driving innovation in SSA. In trying to assess the level of innovation performance and its role on economic development in Sub-Saharan Africa, we used proxy variables such as competitive index, doing business index, GDP per capita income and data of the Global innovation index report. Since the level of competition and the ease of doing business in a country should serve as a booster of innovation or morale to innovate, the level of innovation should be one of the main components of economic growth. This study which is carried out on several of economies using more than 3 variables is the first of its kind in the African context per our knowledge. We will review and point out historical trends to buttress our argument and recommendations in measuring the scale of innovation of countries.

According to the EU and OECD literature, innovation, as a process, sets to transform an idea or opinion into usable goods and services, a novel or developed method of manufacture and distribution, and/or a new way of social service. This includes the changes in techniques, equipment, and software made to reduce the cost per unit of production and delivery, improve quality, and produce a new product. The process introduced as a result of innovations of technological process can be new or a process developed technologically. This organizational innovation is the application of a novel organizational method or commercial applications of firms, organization or external relationships of workplace, reducing the administrative and transaction expenditures of organizational innovations, enhancing the satisfaction of workplace, or reducing the costs of equipment, foreseen to increase the performance of the organization. It must, however, be noted that the definition of innovation keeps involving to include different modalities of that might not necessarily be limited to commercialization. Von Hippel et al (2017), one of the most recent of such research, notes this by taking a step further to explain that

there are innovation processes developed by individual consumers without any intent to gain a reward, simply because they are doing it for personal use or as a hobby (during free time) [7]. Generally, innovation is intricately related to knowledge creation. In some assessments such as the World Bank Knowledge Assessment Methodology, innovation is an element of knowledge metrics, whereas in others such as the Global Innovative Index (GII), knowledge in itself stands out as an innovation output metric. Our understanding of the genesis of IP regimes is that they were protective mechanisms for innovators, creators and investors, especially the firms that dedicate their resources in these fields. Thus, it is, obviously, clear that the well-established IP rights were crucial to attract external trade and investment as foreign firms doing business are often insecure about their intellectual assets and need to be guaranteed that their IP would not be tampered or misappropriated [8, pp.761-766], which contradicts the system of open IP regime in developing countries. Thus, this studies seeks to add to the existing literature the other informal innovation development activities (abundantly common in developing economies), that would expand the conventional modalities, and incorporate all the elements relevant to developing countries into the mainstream fundamentals. The informal sector, therefore, serves as a vital source of livelihood for many both directly and indirectly, to some extent intertwined with the formal sector or even some well positioned than other formal firms. Informal activities plays a very crucial role in job creation, poverty alleviation, increasing competition and the production of good and service for the low income or vulnerable majority, and thus, fosters adaptation and innovation. Yet, the dynamics under which new processes, innovation and products are produced and monetized remains a misery. Despite the numerous hurdles in this sector, innovation occurs, however the extent in which it is captured does not always reflect its true significance to developing countries.

2. Literature review

The major aspects of the concept of innovation are twofold, the renewal or modification of 1) a process and/or an output (product). Innovation is defined as the process where news ideas and knowledge created are transformed into new products or service for the benefit of individuals, groups or societies. Joseph Schumpeter (1934), one of the earliest researchers into innovation, sought to include in the process (innovation) the introduction of a new product, creating a novel way of producing the product, the access to a broader market for selling the product, the access to raw material, and the entry of the producer (in the case of a monopolist) into the market. Innovativeness is an essential concept, which determines the frequency of economic growth. The use of new and developed product and process has a direct relationship with one of the main functions of an entrepreneur [9]. Thus, innovativeness is when entrepreneurs create welfare, creating new resources or improving the utility capacity of existing resources [10, pp. 149-157]. Innovation performance measurement has attracted a lot of attention from both researchers and practitioners. This is unsurprising given the growing interest in performance management at government, industry and also firm level. Governments are mostly concerned about their policy decisions on growth focused investments and the development of communities. While at the firm level individual firms are usually concerned juxtaposing the effectiveness between companies and sectors on certain metrics such as the impact of R&D investments: the process of new product development; the effectiveness of the firm's innovation on its' overall performance. A lot of perspectives have been made in the investigation of this topic. Researchers keep attempting to demonstrate the relevance in undertaking the appropriate innovation performance measurement, for instance, various studies have been conducted on the expected relationship between R&D and government/corporate innovativeness especially, with major comprehensive papers in research and development management such as Kerssens-van Drongelen and Bilderbeek (1999) positioning the discourse after Francis (1992) and Godener & Soderquist (2004). There are numerous proposed approaches, however, the difficulty is the testing for validity and reliability. Neely (2004) opines that there usually too much data, while emphasizing on what he terms as 'measurement crisis' as a result of 'drowning data. Thus, espousing that not that the wrong things are being measured but rather too much is being measured in a fierce attempt to quantify certain features which are not easily quantifiable. Also, the impact of the various policy decisions, both at the national and firm level, taken based on the proposed measure-

ments is another major challenge. Hence, another pertinent difficulty in innovation performance measurement is the unavailability of effective models of innovation with the help of which measurement metrics could be set and sanctioned. As pointed out by Smith (2005) “Key problems in innovation indicators ... concern the underlying conceptualization of the object being measured, ... the measurement concept and the general feasibility of the different types of measurement ... although statistics are often treated as though their meanings are transparent. They always rest on some kind of (usually implicit) conceptual foundation ... R&D data has a complex background in the scientification of innovation These conceptual conditions are rarely considered when indicators are used.”

The lack of generally accepted frameworks in innovation measurement, which can largely be attributed to the absence of precision in the definition of innovation, comes with countless implications. Thus, measurement indicators could be set out of false assumptions and consequently leading to poor interpretation of data and outputs. The influential OECD’s Innovation Manual (1992) which laid the basis of governmental measurement had one of its’ underlying assumptions about innovation process challenged by Rosenberg (one those responsible for the manual), precisely on the concept of research-based discovery as precursory step of innovation. Notwithstanding the complexity of R&D measurement used at national levels, there exist some weaknesses with regard to innovation performance as certain crude input measure (expenditure on R&D) are being used by policy analysts (OECD, 1992). Dooley et al. (2002) stated, after their study of industrial sectors, that benchmarking was problematic as a result of the minimal use of common measurement systems across the industries and sectors. Also, previous studies (Birchall et al., 2004; Birchall & Tovstiga, 2005a) indicated that the ultimate reason of measurement, at the industry level, is intended to guide decision or policy making, to facilitate auditing and adequacy of corporate governance, thus the absence of a common framework across a particular firm, makes the decision making process prone to being flawed. Hence the inconsistency and/or confusion in the measurement of innovation performance are attributable to the unavailability of a common and generalized theory of innovation. Birchall and Tovstiga (2005a) concluded, therefore, that measurement of innovation performance can be subdivided according to the scope and nature of the measures or indicators, which supports Andriessen’s (2004) position that the categorization be done based on the measurement and evaluation approaches that are used. On the one hand, while at the firm level, some of the subdivisions used include: intellectual Capital Frameworks (Kerssens-van Drogelen & Bilderbeek, 1999) and the balanced Score Card (Bremster & Barsky, 2004). On the other hand, others are centered on the innovation process such as measures on the inputs and outcomes of the innovation process as well as the effectiveness of the process itself (Cooper, 1999; Birchall and Tovstiga, 2005a). However, another group with extreme interest in indicators, capable of serenity-driven innovation (Van de Ven et al., 1999), and valuation approaches consists of real options (Andriessen, 2004; Copeland & Antikarov, 2001; Lint, 2002; Paxson, 2001) and the model of value creation championed by Lucent (Birchall et al., 2004). But populating with specified metrics is required in the application or adoption of whichever approach.

3. Conventional innovation prerequisites

Mainstream definitions of innovation include those provided in the formal indices and recognized worldwide. The definition of innovation contained in the Oslo Manual, a key document of the Organization of Economic Cooperation and Development (OECD) and Eurostat, is “the implementation of a new or significantly improved product (goods or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations...” . Thus, product could be a good or a service, produced for use by potential consumers, that is new or significantly enhanced either in terms of its features or proposed uses or both. This, therefore, consists of “significant improvements in the technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics...” . As defined by the Oslo Manual; product is the commercialization of a product with considerable improvement in quality and provides significant improved satisfaction to the user . Process in the Oslo Manual definition comprises of production, distribution or organization as well as the marketing processes that come with considerable

changes or development in techniques and equipment. Like product innovation, process innovation is referred as “new or significant changed processes are implemented when they are brought into actual use in the operation of the institutional unit, including the making of product available to potential users” [11, p. 23]. Generally, conventional definitions see innovation as a system which consists of agents such as firms, education/research institutions and government, each of which engages in some sort of research and development, implementation of technologies, design and practices as well as human resource development [12]. These actors engage in various activities, potential in achieving or solving some socio-economic problems such as the creation of jobs to reduce unemployment, equality to eradicate or breach the gap of poverty, to increase productivity or industrialization for economic growth. Hence, innovation activities must involve the acquisition of machinery, equipment, software, engineering, design, research and development, training, licensing and marketing undertaken or implemented to develop a product or process [13, pp. 332-362]. Based on the above conventional definitions, the following are findings on innovation performance measurement. The pre-requisite factors in measuring innovation practices are that the product, process or marketing method must be new or seek to bring a meaningful improvement to the organization. Thus, product innovation is a key factor in determining how organizations innovate. The subsequent part of the definition stresses on the fact that the product must to be accessible on the market. Thus, commercialization can be emphasized as an important element either within the organization unit or with the consumer. Also, we deduced three important components of process innovation from the definitions, they are: It is important to note that process innovation is made up of three components, they include: 1) production or distribution innovation (changes in equipment, techniques, technology or software), 2) organizational innovation (changes in both internal and external activities of the bank) and 3) marketing innovation (changes in advertisement or selling out the product) [14, pp. 68-74]. These are captured in the conventional definitions, which seem to cover only the formal sector both at the micro or macro level. Thus, this helps to adduce that the parameters guiding the measurement of innovation activities are narrowly limited to advanced economies, hence failing to capture developing countries especially those in Sub-Saharan Africa region [15, pp. 74–151]. There are two main approaches (depending on the level) in measuring innovation. They are; 1) micro approach and 2) macro approach. Micro approach, on the one hand, involves the collection, analysis and study of innovation data picked from individual organizations and firms in determining the extent of their innovation performance level, macro approach, on the other hand, is the use of statistical data of countries to assess their scale of innovation performance. Innovation, as stated before, keeps evolving over time, with different or additional innovation metrics being set out constantly [16], which make them differ in various perspectives [17, pp. 1399 -1417]. Thus, this leads to the classification in fig.1, which depicts the different historical perspectives or evolutions of innovation into four main phases.

4. Paradigms and types of innovation

Innovation, during the first period, which existed right from the early emergence until 1960s, was centered on research and development, on the inputs such as capital, expenditures and level of technology. As intellectual property rights were gaining grounds, publications, patents and products became the major focus during second phase (around 1970s to 1980s). The third generation (the 1990s) focused on a much more comprehensive approach as compared to the first two phases by undertaking innovation survey, indexing and benchmarking. While the fourth phase (beginning from the last decade) centers more on intellectual property (knowledge-based-capital), management skills and networking [18, pp. 88–265] as well as free or open innovation [19, pp. 221-235]. The current phase combines various essential inputs (intangible assets, knowledge, demand and supply risk or return as well as system dynamics) some of which were not considered in the previous phases.

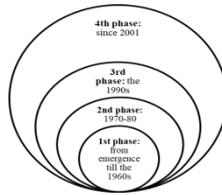


Figure 1. Historical evolutions of innovation.
Source: Compiled by author.

Whereas, the micro indexes used in assessing the scale of innovation performance of a country are those contained in the Oslo Manual Blueprint and regional manual such as NEPAD STI of African Union, National Experts on Science and Technology Indicators (NESTI) [12, p. 484]. Although, there are some inconsistencies that exist in the African innovation surveys, however, some general conclusions can be drawn from these surveys. Innovation is a dynamic and very pervasive, and has certain distinct features depending on the model or paradigm. It is an undeniable fact that some formal and informal innovation activities in African economies over the years have been largely overlooked, since most literature concentrate on formal innovation in the formal sector and few studies highlight informal innovation. Informal sector or shadow economy is defined by International Labor Organization as “units engaged in the production of goods or services with the objective of generating employment and incomes to the persons concerned. These units typically operate at low level of organization, with little or no division between labor and capital as factors of production and on a small scale. Labor relations - where they exist – are based mostly on casual employment, kinship or personal and social relations rather than contractual arrangements with formal guarantees.” Another peculiar characteristic of the informal sector is that, it consists of unregistered self-employed enterprises, according to the African Development Bank the larger size of this sector is as a result of “the opportunities it offers to the most vulnerable populations,” coupled with institutional weakness in the following areas: regulation, taxation, private property right etc. Their activities are not formalized due to bureaucratic requirements for registration, licensing, high taxes, fiscal processes and inspection and son on, that tend to hinder the formalization and registration processes, which all cast the traits of underdevelopment (system, economic, institution etc). Thus, owing to the lack of database on them makes it difficult to capture or track accurate data of their output, let alone their innovation activities. However, the informal sector remains a major source of jobs in Africa, accounting for 70% of employment in Sub-Saharan Africa and contributes about 55% of GDP of the region . Measuring innovation in the informal sector is daunting, and demands investment of a lot of resource. And although, their innovations still play important role in their efficiency and productivity, but they sometimes go unaccounted for due to their non-conventional nature. Hartmann and Hartmann (2016) define informal innovation happening in the formal sector [20] “as the development and putting-into-use of novel solutions by non-R&D employees without prior formal approval from or subsequent revealing to superiors.” Bogers and Lhuillery (2011) also think such innovation, which comes as embodied efforts of individuals or firms (the cost hardly traceable), has the following components; marketing, training or learning through practice, design and engineering, monitoring external innovation, creating or acquiring new technologies, know-how and change which all bear the informal attributes [21, pp. 581-610].

5. Data and methodology

The data used was collected from secondary source such as Global Innovation Index (GII), Doing Business report of the World Bank, Competitive Index report and per capita income as a ratio of GDP extracted from the World Bank development indicators for the 35 Sub-Saharan economies. These data sources are very well recognized as they have proven in previous studies to be unbiased and with high level of reliability. The data collection areas and policy framework of Global Innovation Index is illustrated in fig. 2 The importance of the Global Innovation Index data cannot be overemphasized as it sets out to measure the performance of innovation in economies using very recent and modern methods of techniques in the collection of data based on the parameters as contained in the Oslo Manual.

Assessing regional innovation performance per the average scores of the GII data show that amongst the regional economic blocks Sub-Saharan Africa is at the bottom, while Northern America is the top performer. The ranking is as follows: 1) Northern America, 2) Europe, 3) South East Asia, East Asia and Oceania, 4) Northern Africa and Western Asia, 5) Latin and the Caribbean, 6) Central and South-eastern Asia, and followed by 7) Sub-Saharan Africa.

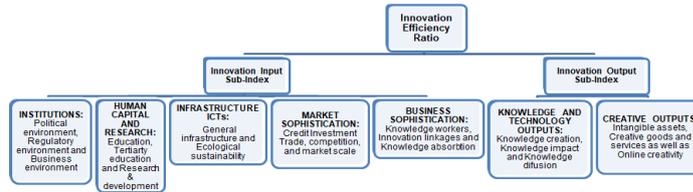


Figure 2. Conceptual framework of the Global Innovation Index 2018.

Source: Author’s compilation.

The data collected from the above institutions were analyzed using stata/SE version 14. Prior to the application of exploratory factor and regression analyses the data compiled was examined in order to ensure that they were amenable to the use of these techniques and relevance to this study. To analyze the relation between innovation performance and its relationship with factors or variables listed above one model has been used where average score is the dependent variables. The other variables have been included as independent variables in the analysis.

We think, this is a good proxy for assessing innovation performance as per the conventional definitions. Innovation Efficiency Index (IEI) which measures the innovation potential an economy; Doing business Index (DBI) gives an overview of the ease in carrying out business and its related activities with a high potentiality of influencing innovation activities; Output Sub-Index (OSI) shows the outcome of previous implemented innovation ideas and so on; Gross expenditure on Research and Development per GDP (GERD) measure the spending of governments on innovation; GDP per capita (GDPpc) measures the standard of living in an economy and plays a major role in the patronage of innovation activities; and finally Competitive Index (CI) which defines the level playing field for all firms and their readiness to undertake or implement new ideas or technology to survive the competitive economic environment. All these variables are good proxy variable for innovation and, thus should have significant positive as they are a ‘backbone’ of innovation performance in any economy. Multi regression analysis was used in this paper in order to achieve the research objective and proposed model. The model is as follows: $Score = \beta_0 + \beta_1 (IEI)_i + \beta_2 (DBI)_i + \beta_3 (OSI)_i + \beta_4 (GDPpc)_i + \beta_5 (CI)_i + \epsilon_i$

6. Results and Discussion

To understand the multi-collinearity among the variables, a multi-collinearity test was carried out using correlation. The correlation matrix for the variables is contained in table 1. This explains the multi-collinearity between two-independent variable.

The matrix below shows there is a strong positive correlation between Innovation performance and Innovation Output Sub-Index (OSI), Competitive Index (CI), Innovation Efficiency Index (IEI) and Doing Business Index (DBI) and expenditure on R&D, while surprisingly we found a weak negative correlation between GDP per capita and innovation. Although, we think that, all things being equal, an increase in per capita growth would motivate firms to innovate more.

Table 1. Correlation matrix of variables.

	CI	DBI	IEI	GDP.pc	GERD	OSI	Inn.Scor
CI	1	0.596	0.146	0.249	0.251	0.419	0.599
DBI	0.596	1	-0.191	-0.003	0.046	0.149	0.428
IEI	0.146	0.191	1	0.032	0.327	0.856	0.531
GDP.pc	0.249	0.003	0.032	1	0.032	0.012	-0.018
GERD	0.251	0.046	0.327	0.032	1	0.370	0.323
OSI	0.419	0.149	0.856	0.012	0.370	1	0.887
Inn.Scor	0.599	0.428	0.531	-0.018	0.323	0.887	1

Source: Authors' own calculations.

This emphasizes the need for more research in this field. We also noticed a strong positive correlation between IEI and OSI (0.86), CI and DBI (0.59) as well as CI and OSI (0.42), whereas that IEI and GDPpc is positive but weak. Fig. 2 depicts the model results.

Table 2. Model parameters.

Source	Value	Stand. error	T	Pr > t	Lower bound (95%)	Upper bound (95%)
C	14.132	1.259	11.228	< 0.0001	11.553	16.710
CI	0.862	0.351	2.458	0.020	0.144	1.580
DBI	0.001	0.017	0.079	0.937	-0.034	0.037
IEI	-29.464	2.048	-14.385	< 0.0001	-33.659	-25.268
GDP/p c	-0.061	0.045	-1.345	0.189	-0.153	0.032
GERD	-0.064	0.305	-0.212	0.834	-0.688	0.559
OSI	1.356	0.051	26.836	< 0.0001	1.253	1.460

This model has been adequately evaluated using regression statistical analysis. The multiple R and R squared determine the correlation and coefficient of determination respectively, and thus, the R value 0.99 is a proof of significant relationship between economic growth and the other independent finance-induced innovation proxy variables used in this study. This can be found in Table 3 and 4. The R value and lower P-value proves the reliability of the model and must be accepted.

Table 3. Analysis of variance of Innovation score.

Source	DF	Sum of squares	of Mean squares	F	Pr > F
Model	6	671.010	111.835	346.143	< 0.0001
Error	28	9.046	0.323		
Cor-rected	34	680.056			

A graphical representation of the correlation between GERD and GDPpc, the proxy variables for innovation and growth, respectively, are presented in a of scatterplot in fig. 3.

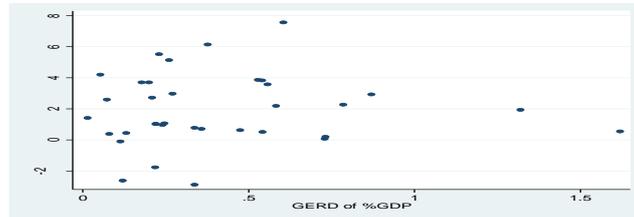


Figure 3. Graphical representation (scatterplot) of correlation between innovation level and GERD of GDP.

Following our analysis of the data, we got the following model

$$\text{Score} = 14.156 - 29.464 * \text{IEI} + 0.002 * \text{DBI} + 1.355 * \text{OSI} - 0.060 * \text{GDPpc} + 0.850 * \text{CI}$$

To control for heteroscedasticity, we undertook a robust standard error test. The linear regression test of the robust standard error is presented in table 2 below.

Table 4. Regression results.

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. regress InnScore IEI DBI OSI GDPpc CI GERDofGDP, robust

Linear regression                               Number of obs   =       35
                                                F(6, 28)        =     214.88
                                                Prob > F         =     0.0000
                                                R-squared       =     0.9867
                                                Root MSE      =     .56841
    
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Using the robust standard error test, we can test the confidence level of results, thus to accept or reject the hypotheses. The t-values must not be greater than 1.96 (at 0.05 confidence in order to reject a hypothesis, and as such they show the importance of each variable in the model. In this case only IEI and OSI are most important variables in our model. Also, the two-tail p-values test is used to test the impact of proxy variables on the dependent variable. In our case, DBI, CI and GDPpc are not statistically significant in explaining innovation performance in an economy as per the results since they are not be lower than the required value of 0.05.

7. Conclusion and Recommendations

Innovation is a crucial driver of economic growth and development, however the interval between socio-economic factors that facilitate innovation in developed and developing economies [22, pp. 21–42], specifically the Sub-Saharan economies, is large (Innovation is determined by many indicators, intellectual property (IP) being one of the most important metrics. Whereas intellectual property plays a vital role in the formal sector of the economy, its relevance in the informal sector is gaining grounds to be fully explored [23]. There is a distortion in the existing literature on the function of intellectual property in entrepreneurship, innovation, the informal economy and economic development, as it fails to provide enough grounds to substantiate how intellectual property influences or benefits socio-economic progress, as the results of this study shows (an insignificant correlation between GERD and GDP per capita). Many policymakers rely on the definition of the Oslo manual. The citation of the

Manual as well as the theoretical concepts and the methods it contains are trite for many scholars and policymakers. However, very few experts and lawyers of intellectual property are abreast with this established framework. Innovation is more a field of study. Also, the concept of entrepreneurship is intuitively linked to intellectual property, however, the laws, policies and practice generally under IP are inadequately connected to theoretical models on the reasons why and how entrepreneurship takes place [24, pp. 61–76]. Table 5 gives the ideological models under the various forms of innovation. The paper sought to strike and weave the linkages of these fields together, which would make it relevant to the theoretical and practical realities of developing countries. Unlike the formal Schumpeterian producer form of innovation, there is lack of official statistical data on free innovation and the informal type of innovation in Sub-Sahara region, statistical data collected are based on ad hoc empirical data on their activities, and which verification can be very problematic [25, pp. 608–619]. Thus, although, all the forms of innovation have some major components or indicators as outlined in the Oslo Manual namely the implementation of novel or improved product, methods and business practices, however, the scale or absence of statistical of data on IP rights and expenditure on R&D on informal innovation draws a different picture and often being underestimated in most cases.

Table 5. Comparative analysis of the forms of innovation.

Ideological features	Formal (Producer) innovation	Free/Open innovation	African informal sector innovation
Cause of innovation	Profit-rewarding motive	Desire to innovate for private or group use	To solve local problems for minimal profit.
Form of protection	Great interest in Intellectual Property Rights (IPR) protection	No IP rights protection (non-IP-based modalities)	Non-IP-based modalities. Protection based on moral rights on excludable knowledge and trade
Funding source	Finance indirectly by consumers	Private or group funding	Private and shared-funding with little (or no) information on the costs of innovation
Production type	Capital-intensive production	Labor-intensive	Labor-intensive
Economics of scale	Production based on market information (opportunities)	Small units for self-consumption	Small scale in order to avoid being administered
Method of diffusion	Market diffusion of products	Open diffusion (peer-to-peer) and peer-to-producer diffusion	Informal diffusion (peer-to-peer) and informal-formal relations.

Despite, continuous demands of domestic and international corporations insisting on reasonable financial returns on their research and development, there are various other approaches of achieving this. A great number of medium-sized local firms and multinational corporations in Africa have achieved great successes even with open innovation. This discourse brings out the limitations of the various researches of innovation performance, especially in the context of Sub-Saharan region, where informal economic activities are predominant. These organizations believe over-protected IP rights could bring about economic gridlock and thereby impede returns on investment and trade [27, pp. 611-

635]. Thus, they rely on platforms of open-source technologies by encouraging their suppliers and customers to engage with and help improve their products and services. But, there is a degree of uncertainty with regards to the platform, whether providers are free riders on user innovation or assist in the creation of shared value [28, pp. 62-77]. It must be noted that the links between technological innovation and socio-economic growth has evolved significantly over the years. Although, there is a complex understanding of development, at the backdrop of human freedom [29] or abilities [30], economic growth remains a major metric in measuring success or performance. The results indicate that the all the independent variables except GDPpc have positive and significant effect on innovation development. Thus, the findings help understand that the proxy variables used for this study positively influence the innovation performance an economy, however, the negative relationship of GDPpc opens and calls for further research. This study concludes with the call for broader and efficient innovation performance measurement.

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