RELATIONSHIP BETWEEN ICT EDUCATION AND KNOWLEDGE ECONOMY IN AFRICA

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Abstract

Advancement in the technology and techniques of effective transmission of information over space and time has engendered a marked improvement in the wellbeing of humans. The Internet, Computers and Telephony (both mobile and fixed) have been major drivers of this advancement. Can educating a Nation's populace adequately to become proficient and skillful in exploiting the ICTs for personal and subsequently national goals enhance that economy's preparedness for Knowledge Economy? This is the question this paper seeks to address by investigating the relationship between ICT education (ICTed), ICT Development Index (IDI), Knowledge Economy (KE) and Knowledge Economy Index (KEI) in general and particularly for African Nations. KEI and IDI data provided by the World Bank Institute and International Telecommunications Union are employed in the statistical analysis.

Keywords: Knowledge economy, KI, ICT, IDI, ICT in education, ITU, World Bank, WBI

I. INTRODUCTION

The Industrial Revolution that began in Great Britain in the late 1700s and early 1800s, quickly spread like wild fire across the world. This revolution determined the socio-economic tendencies of that era. The Information Revolution, which is a loose term used to describe the socio-economic, and socio-technological trends resulting as the aftermath of the Industrial age came next. Information and Communication Technology (ICT) greatly enhances the rate, spate, and scope of information dissemination. This has resulted in the current exponential growth in knowledge acquisition, exploitation, and dissemination. The Knowledge-based Economy (a.k.a Knowledge Economy) has emerged as a consequence of the ubiquity and ease of information acquisition. This trend in pervasiveness of information (data) and consequently knowledge is currently receiving a tremendous boost by the emerging Internet of Things (IoT) paradigm [1]. Gone are the days (and thankfully never to return) when a caucus of persons claimed monopoly of specific knowledge through the hoarding of information. The global economy is currently in a state of transition towards the Knowledge Economy. Education is a known and generally accepted catalyst of growth. Without adequate and relevant technical education, no Nation or Region can harness the benefits of the emerging Knowledge Economy. The extent to which this truth has manifested itself is apparent in the current global classification of Nations and Economies into Developed, Developing, and Underdeveloped economies. According to the Organization for Economic Cooperation and Development (OECD), the Knowledge based Economy implies those economies, which are directly based on the *production*, *distribution*, and *exploitation* of knowledge and information [2].

The rest of the paper is arranged as follows. Section II presents the aim of this paper as well as the identified objectives (presented as research questions) for achieving it. In Section III, we present the methodology for answering the questions, which should culminate in achieving the aim. Section IV presents an in-depth definition of salient terminologies from existing relevant literature of authoritative bodies. In section V, the methodology is implemented by performing statistical analyses on relevant data towards answering the questions posed in Section II. Discussions on the findings are presented in Section VI, while concluding remarks as well as salient recommendations round up the paper in Section VII.

II. AIM AND OBJECTIVES

The aim of this study is to determine the relationship between ICT Education (ICTed) and Knowledge Economy (KE) in Africa. We elicit the following research questions, answering which will fulfill the objectives towards achieving the aim.

a. Research Questions

Q1. *Is there a correlation between ICTed and ICT Development Index (IDI) in Africa?*
Q2. *Is there a correlation between IDI and Knowledge Economy Index (KEI) in Africa?*
Q3. *What is the relationship between ICTed and KEI in Africa?*

III. METHODOLOGY

The methodology adopted in answering the established research questions and subsequently fulfilling the objectives of the study with a view to achieving the aim are as given in the following steps:

- Robust literature review and concise definition of terminologies:
    - ICT Education (vs. ICT in Education),
    - ICT Development Index (IDI),
    - Knowledge Assessment Methodology (KAM),
    - Knowledge Economy (KE),
    - KE Index (KEI).
- Establish correlation (or lack thereof) between ICT Education and IDI for Africa
- Assume KEI based on World Bank Institute's (WBI) KAM as veritable measure of a region's capacity for KE.
- Establish correlation (or lack thereof) between IDI and KEI for Africa
- Infer correlation (or lack thereof) between ICT Education and KEI for Africa.
- Submit on the relationship between ICTed and KEI for Africa
- Identify means by which improved ICTed can foster increase in KEI for Africa

In the process of achieving this methodology, data from authoritative international organizations, such as The World Bank Institute (WBI) and the International Telecommunications Union (ITU) will be used.

IV. DEFINITIONS

The definitions of some terminologies necessary for adequate understanding of the topic are hereby given in bid to avoid ambiguity and misconceptions.

a. ICT Education vs. ICT *in* Education

Information and Communication Technology Education can be simply defined as the study of tools and techniques for reliable information content transmission and reception over

appropriate conduits. *ICT Education* must not be confused with *ICT **in** Education*. The two are not synonymous, and as such cannot be used interchangeably. The latter is concerned with the use of ICTs in the realisation of pedagogical objectives, while the former implies the teaching of ICT with the aim of increasing the literacy proficiency of the populace with a view enhancing its adoption and usage in everyday tasks. An understanding of this is necessary for the purposes of this study.

b. ICT Development Index (IDI)

Developed by the International Telecommunications Union (ITU) in 2008, ICT Development Index is made up of 11 separate indicators. It aims at benchmarking different measures for comparing ICT developments across countries and regions of the world. According to ITU, the main objectives of IDI are to measure [3]:

i. *"the level and evolution over time of ICT developments in countries and relative to other countries;*
ii. *progress in ICT development in both developed and developing countries: the index should be global and reflect changes taking place in countries at different levels of ICT development;*
iii. *the digital divide, i.e. differences between countries in terms of their levels of ICT development;*
iv. *the development potential of ICTs or the extent to which countries can make use of ICTs to enhance growth and development, **based on available capabilities and skills**."*

Without necessarily discountenancing the remaining measure objectives, of these four objectives of the IDI as stipulated by ITU, objective (iv) becomes the most relevant for the purposes of this study.

Table 1: The top five economies in each region and their respective 2013 GIR

Africa	GIR	Europe	GIR	Asia & Pacific	GIR	Americas	GIR	Arab States	GIR	CIS	GIR
Mauritius	**70**	**1.** Denmark	1	**Korea (Rep.)**	**2**	USA	14	Bahrain	27	Belarus	38
Seychelles	**75**	**2.** Sweden	3	Hong Kong, China	9	Canada	23	UAE	32	Russia	42
RSA	**90**	**3.** Iceland	4	Japan	11	Barbados	35	Qatar	35	Kazakhstan	53
Cape Verde	**93**	**4.** UK	5	Australia	12	Uruguay	48	S. Arabia	47	Moldova	61
Botswana	**104**	**5.** Norway	6	Singapore	16	St. Kitts & Nevis	54	Oman	52	Azerbaijan	64

Adapted from [3], GIR – Global IDI Rank

As seen from Table 1, of the six regions presented, Africa takes the rear with a best Global IDI rank of 70 by Mauritius. At the bottom of the list of top five African Economies by ICT

Development Index is Botswana. The United Kingdom breaks the monopoly of the Nordic economies in the top five for Europe, while the Republic of Korea does the same for Europe in the global top five. The largest (traditional) economy in Africa (Nigeria) is conspicuously absent from the list of regional top five in terms of IDI.

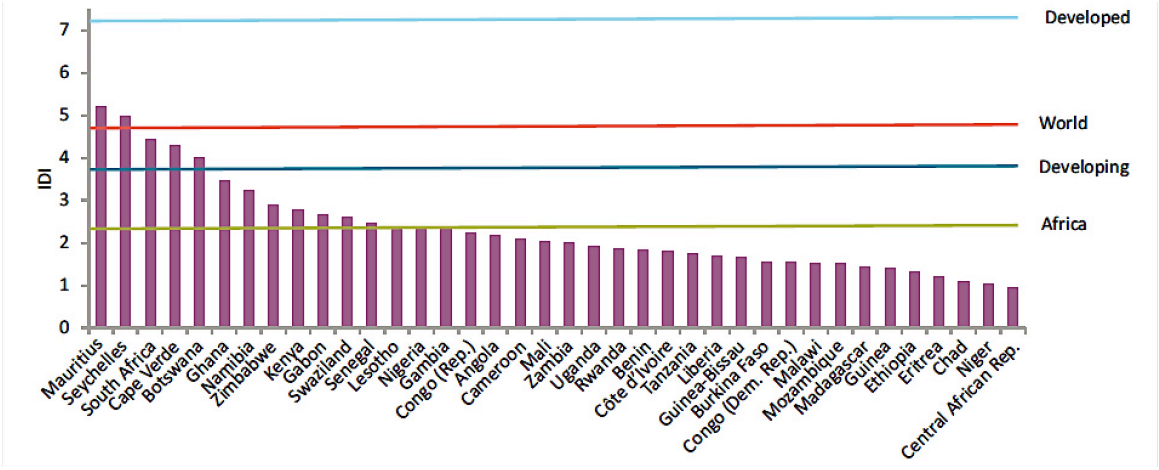

Fig.1: African 2013 IDI values in comparison with global, regional, developing|developed-country averages [3]

Figure 1 shows the performance of African economies relative to global and regional averages. It likewise depicts the outstanding performance of the top-five African economies (vis-à-vis IDI), as surpassing the global average for developing countries.

Table 2: Weights used for indicators and sub-indices included in the IDI

		Indicators	Sub-index
Access	Fixed-telephone subscriptions per 100 inhabitants	0.20	0.40
	Mobile-cellular telephone subscriptions per 100 inhabitants	0.20	
	International Internet bandwidth per Internet user	0.20	
	Percentage of households with a computer	0.20	
	Percentage of households with Internet access	0.20	
Use	Percentage of individuals using the Internet	0.33	0.40
	Fixed (wired)-broadband subscriptions per 100 inhabitants	0.33	
	Active mobile-broadband subscriptions per 100 inhabitants	0.33	
Skills	**Adult literacy rate**	**0.33**	**0.20**
	Secondary gross enrolment ratio	**0.33**	
	Tertiary gross enrolment ratio	**0.33**	

Source: ITU.

Table 2 presents the weights used by ITU for indicators and sub-indices in calculating the value of IDI. We shall adopt ICT Skills as a proxy measure of ICT literacy (and therefore ICT Education) level of economies.

c. Knowledge Economy (KE)

Powell and Snellman of Stanford University defined Knowledge Economy as: "*Production and services based on knowledge-intensive activities that contribute to an accelerated pace of*

technical and scientific advance, as well as rapid obsolescence."[4]. In the Knowledge Economy, greater emphasis is placed on intellectual capacity and the proceeds thereof, rather than on physical input and natural resources.

Unlike in the traditional economy that subsists today, Knowledge Economy is not predicated on the principle of ***scarcity***. Where economics is popularly defined as the science that studies the use of *scarce resources* to meet endless needs. On the contrary, knowledge economy celebrates the idea of ***abundance***. Knowledge shared actually grows and multiplies by finding different applications that even the knowledge creator might not have envisaged. The major paradox of a Knowledge Economy is that its most important component – *human capital* – often gets decimated as a result of automation and more efficient production processes brought about by innovations discovered by the *human capital.*

For developing countries (under which category most African Nations fall), The United Nations Commission on Science and Technology for Development (UNCSTD) noted in its 1997 report that sustainable development and successful integration of the ICTs is crucial for participation in the emerging Knowledge Economy. To achieve this, it recommended collective and strategic intervention, which in its turn presupposes the concept of knowledge sharing. [5]

d. Knowledge Assessment Methodology (KAM)

Knowledge Assessment Methodology was designed by the Knowledge for Development (K4D) program as an interactive benchmarking tool. It was developed to help countries determine necessary steps to take towards becoming knowledge-based economy compliant. It is made up of 148 variables used in determining countries' performance vis-à-vis the four Knowledge Economy pillars. These variables are normalized such that they have values ranging from zero (0) to ten (10). The KAM is employed in determining the KEI and KI of countries. The performance score of countries is presented in the KEI and KI indexes. The World Bank's Knowledge Assessment Methodology can be accessed online at: *www.worldbank.org/kam*. KAM is an interactive online tool [6].

i. KAM Pillars

KAM pillars are based on the four pillars of the Knowledge Economy Framework as given in the original World Bank document that introduced the methodology for Knowledge Assessment. They are as summarized below [7]:

1. *Economic incentive and institutional regime EIR* – for the purpose of:

a) Providing good economic policies
b) Permitting efficient mobilization and allocation of resources
c) Encouraging creativity and providing incentives for the efficient creation, dissemination, and use of existing knowledge.

2. *Educated and skilled workers:*
a) Capable of lifelong learning and skill adaptation for efficient creation and use of knowledge.

3. *Effective innovation system, made up of:*
a) Made up of firms, research centers, universities, consultants, and other organizations.
b) Capable of keeping up with revolution in knowledge
c) Able to tap into global knowledge for assimilation and adaptation to meet local needs.

4. *Modern and adequate information infrastructure*
a) Able to facilitate the effective communication, dissemination, and processing of information and knowledge.

Each of these four pillars has a set of three variable used in determining their empirical values.

ii. KAM Variables

The KAM variables help in tracking the overall performance of an economy. This is a major advantage of the KAM methodology, i.e. its holistic view of a set of factors relevant to the determination of a country's preparedness for the Knowledge Economy. They are as summarized below according to their respective pillars, noting source of data. A detailed exposition into these variables is given in [8]:

a) Education and Human Resources
   i) Average Years of Schooling (Barro and Lee – *World bank*)
   ii) Primary Enrollment (*UNESCO*)
   iii) Tertiary Enrollment (*UNESCO*)
b) The Innovation System
   iv) Royalty and License Fees Payments and Receipts (DDP[1] – *World Bank*)
   v) Patents Applications Granted by US Patent and Trade Mark Office (*USPTO*)
   vi) Scientific and Technical Journal Articles (DDP – *World Bank*)
c) Information and Telecommunication Technology
   vii) **I**nternet Users per 1000 People (*ITU*)
   viii) **C**omputers per 1000 People (*ITU*)
   ix) **T**elephones per 1000 People (*ITU*)

[1] World Bank's internal database Development Data Platform

d) Economic Incentive and Institutional Regime

x) Tariff and Nontariff Barriers (Trade policy Index – *Heritage Foundation*)

xi) Regulatory Quality (Governance Indicators – *World Bank*)

xii) Rule of Law (Governance Indicators – *World Bank*).

iii. KAM Methodology

The methodology adopted by The World Bank Institute (WBI) for Knowledge Assessment of Nation, Economies, and Regions is explicitly given in [7].

e. Knowledge Index (KI)

As earlier mentioned, the KAM determines the Knowledge Index of a country/economy. It is essentially a measure of the economy's capacity to a) generate, b) adopt, and c) disseminate knowledge for productive purposes that invariable affect its growth. It demonstrates a country's potential for knowledge development. It is calculated as the simple average of a country's normalized score on the nine key variables (Fig.2: variables 1–9) in three of the four KAM KE pillars (Fig.2: Pillar *i* - *iii*)[9].

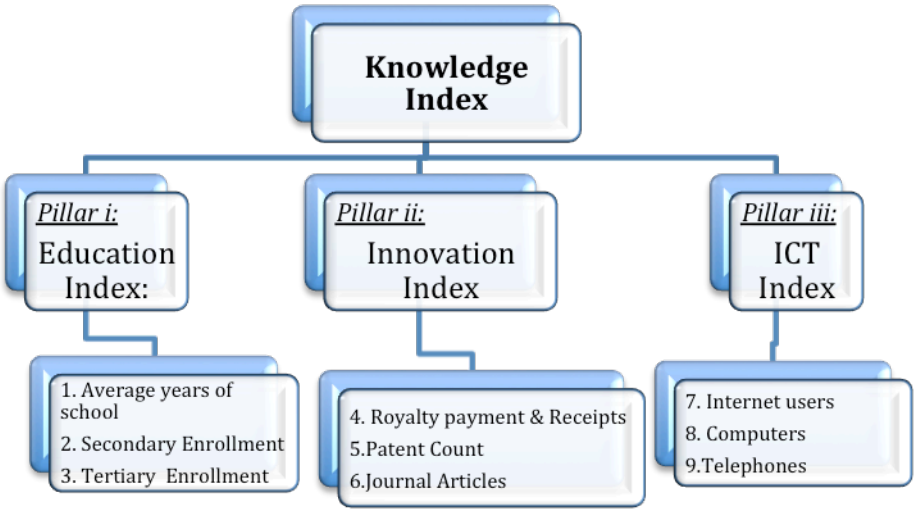

Fig.2: *KAM Knowledge Index, showing three of the four KAM pillars*

f. Knowledge Economy Index (KEI)

The KAM Knowledge **Economy** Index (KEI) goes a step further than the KI by taking into account how conducive the environment in a country is to fostering the use of knowledge for economic development. It represents the overall level of a country's development towards (or preparedness for) Knowledge Economy as defined in section IVc. It is calculated as the simple average of a country's normalized score on all the 12 key variables (Fig.3: variables 1–12) in all the four KAM KE pillars (Fig.3: Pillar *i*–*iv*) [9].

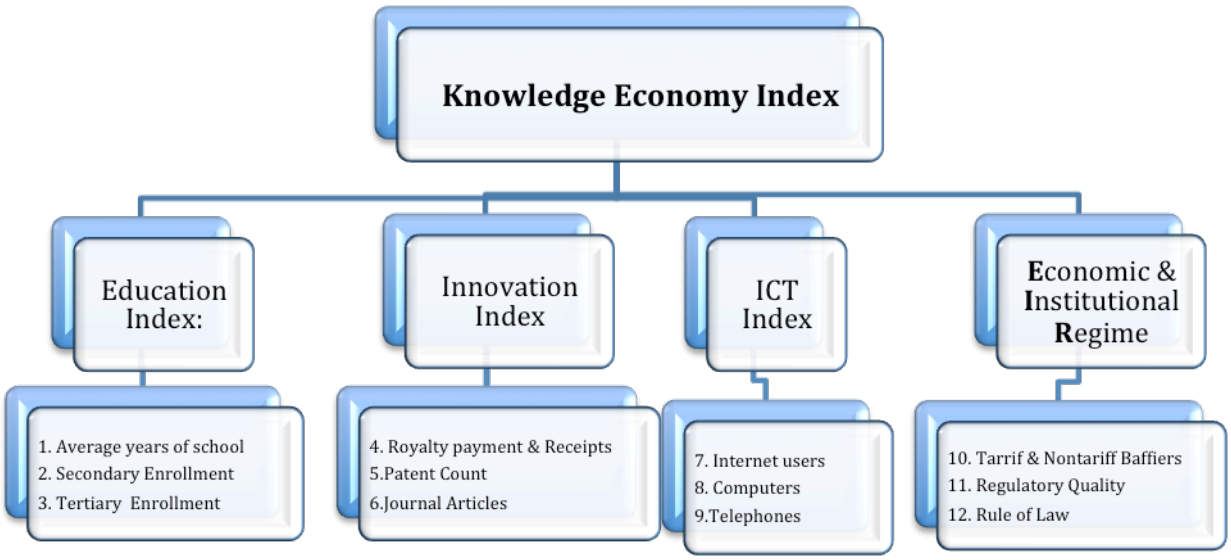

Fig.3: *KAM Knowledge Economy Index, showing the four pillars and 12 variables*

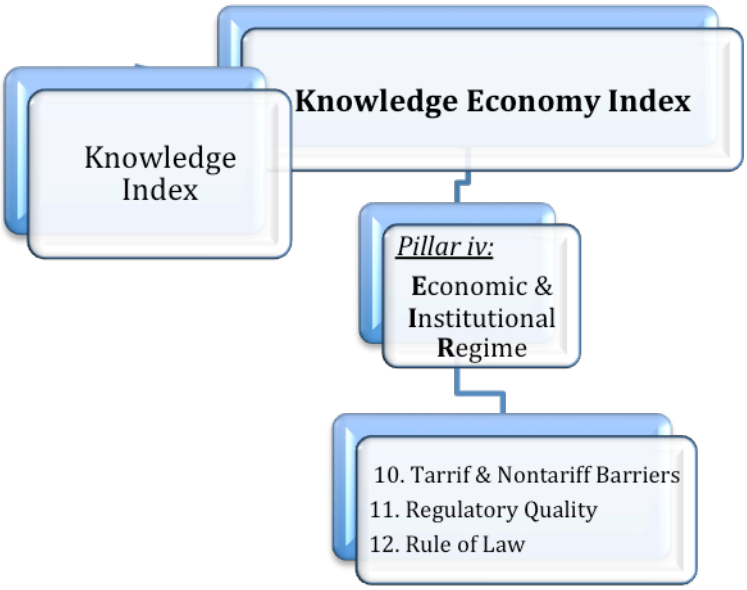

Fig.4: *Relationship between KAM Knowledge Indexes*

In Figure 4, we see the relationship between the two KAM Knowledge Indexes. The equation relating the indexes (vis-à-vis KAM *pillars*) is given as equation (1), and (vis-à-vis KAM *variables*) as equation (2):

$$KEI = \frac{1}{4}\left(\sum_{i=1}^{4} P_i\right) = \frac{1}{3}\left(\sum_{i=1}^{3} P_i\right) + EIR = KI + EIR \qquad (1)$$

where P_i – i^{th} *KAM pillar*; *EIR* – 4th *KAM pillar*

$$KEI = \frac{1}{12}\left(\sum_{i=1}^{12} V_i\right) = \frac{1}{9}\left(\sum_{i=1}^{9} V_i\right) + V_{EIR} = V_{KI} + V_{EIR} \qquad (2)$$

where V_i – i^{th} *KAM variable*; V_{KI} – *KAM variables under KI*

V. ANSWERS

In this section, we shall be answering the formulated research questions with the instrumentality of authoritative data from relevant organizations using the tools of statistical

analysis. This data is presented in Table 3. The ICT Development Index (IDI) values and Knowledge Economy Index values for 2012 from the ITU and the World Bank respectively.

a. On Correlation between ICTed and IDI in Africa

H01: *There is no correlation between ICTed and IDI for African Nations*

Ha1: *There is a relationship between ICTed and IDI for African Nations*

To test the null hypothesis *H01*, as earlier stated, we refer to Table 2 and adopt the ***ICT skills*** Index of Nations as a proxy measure of their level of ICT literacy and consequently, level of ICT Education. For a country to be included in the sample, both of the considered Indexes must be known. According to ITU, ICT skills is defined as a function of a) **A**dult literacy rate, b) **S**econdary gross enrollment ratio, and c) **T**ertiary gross enrollment ratio. These three components of ICT skills are weighted the same at 0.33:

$$ICTed \equiv ICT\ Skill = 0.33\boldsymbol{A} + 0.33\boldsymbol{S} + 0.33\boldsymbol{T} = 0.2 \cdot IDI \quad (3)$$

Since ICT education is measured by proxy through the *Skills* component of the ICT Development Index, and constitutes 20 percent of it. Then we safely assume a 1:1 correlation between ICTed and IDI. We therefore reject *H01* without fear of Type I (False Reject) error, and thus uphold *Ha1* by establishing the relationship (with ***excellent*** $R^2=1$ correlation $a.e.$) between ICT Education and the ICT Development Index of an economy, irrespective of its geographical location. With the direct correlation between ICTed and IDI established for all economies (and African economies in particular), we henceforth see the ICT development Index (IDI) of an Economy as representative of that Nations level of ICT Education (ICTed).

We now assume KEI based on World Bank Institute's Knowledge Assessment Methodology as veritable measure of a region's capacity for Knowledge Economy. Premised on this valid assumption, we proceed to establish the relationship between IDI (i.e. ICTed) and KEI (i.e. KE) in general, and for Africa in particular.

b. On correlation between IDI and KEI in Africa

H02: There is no correlation between IDI and KEI for African Nations.

Ha2: There is a correlation between IDI and KEI for African Nations

In order to test *H02*, we create a table comprising of the two indexes (KEI and IDI) from World Bank [10] and ITU [11] 2012 data respectively. The resultant table is presented as Table 3. In creating the scatter plots in Figure 5 and 6, only economies with both KEI and IDI available were used. Figure 5 represents the plot of KEI (y-axis) against IDI (x-axis) for African economies, while Figure 6 represents same for the whole world. Regression analysis was performed on the plot using Microsoft Excel and the values obtained are presented in Table 4.

Table 3: 2012 KEI and IDI Values for Africa

s|n	Economy	KEI	IDI
1	Mauritius	5.52	4.96
2	South Africa	5.21	4.19
3	Tunisia	4.56	4.07
4	Botswana	4.31	3.94
5	Namibia	4.10	3.08
6	Algeria	3.79	3.30
7	Egypt	3.78	4.28
8	Morocco	3.61	4.09
9	Cape Verde	3.59	3.86
10	Swaziland	3.13	2.43
11	Kenya	2.88	2.62
12	Ghana	2.72	3.29
13	Senegal	2.70	2.20
14	Zambia	2.56	1.97
15	Uganda	2.37	1.90
16	Nigeria	2.20	2.14
17	Zimbabwe	2.17	2.68
18	Lesotho	1.95	2.22
19	Malawi	1.92	1.50
20	Burkina Faso	1.91	1.35
21	Benin	1.88	1.75
22	Mali	1.86	1.86
23	Rwanda	1.83	1.74
24	Tanzania	1.79	1.72
25	Madagascar	1.77	1.43
26	Mozambique	1.76	1.40
27	Cameroon	1.69	1.98
28	Mauritania	1.65	1.90
29	Côte d'Ivoire	1.54	1.74
30	Sudan	1.48	2.69
31	Djibouti	1.34	2.01
32	Ethiopia	1.27	1.24
33	Guinea	1.22	1.31
34	Eritrea	1.14	1.18
35	Angola	1.08	2.06

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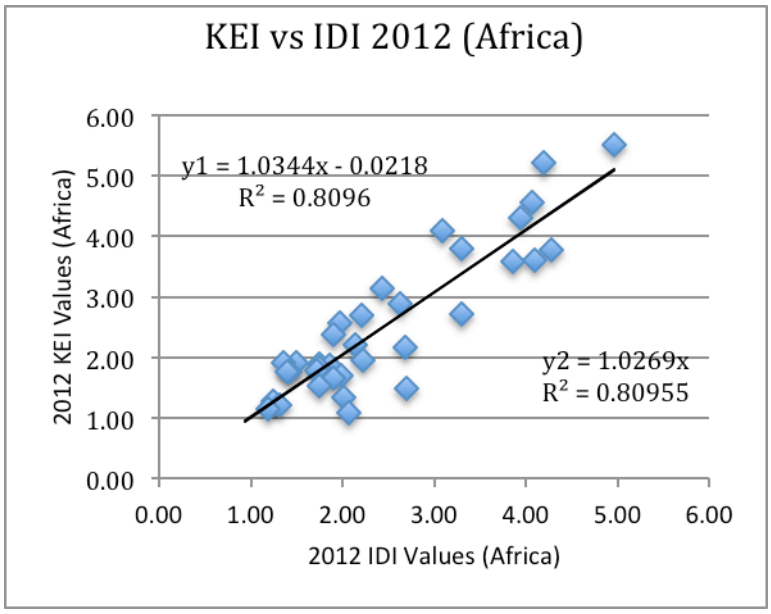

Fig.5: Relationship Between IDI and KEI for African Economies in 2012

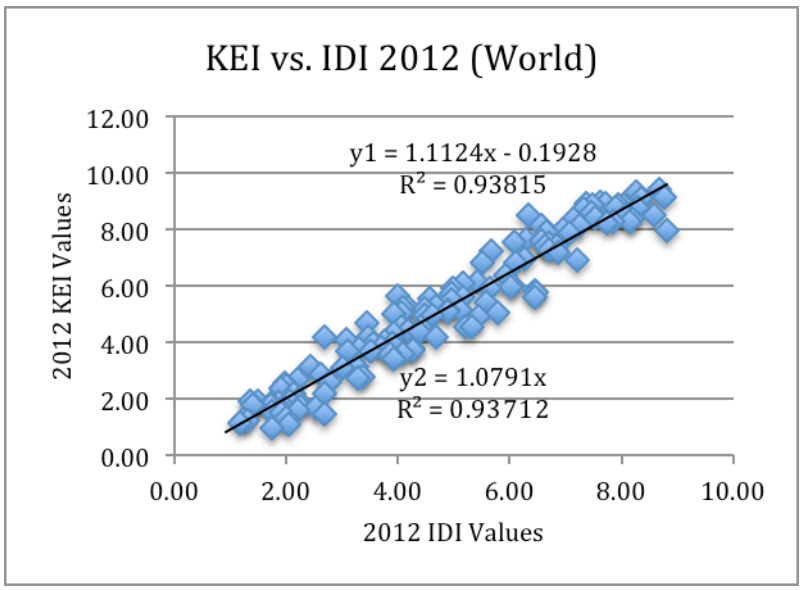

Fig.6: Relationship Between IDI and KEI for Global Economies in 2012

Table 4: Regression Analysis Results for KEI and IDI

	Africa	World
$R^2(y1)$	0.8096 (80.96%)	0.93815 (93.82%)
$R^2(y2)$	0.80955 (80.96%)	0.93712 (93.71%)
Trendline (y1)	$y1 = 1.0344x - 0.0218$ $KEI = 1.0344 \cdot IDI - 0.0218$	$y1 = 1.1124\,x - 0.1928$ $KEI = 1.1124 \cdot IDI - 0.1928$
Trendline (y2)	$y2 = 1.0269x$ $KEI = 1.0269 \cdot IDI$	$y2 = 1.0791\,x$ $KEI = 1.0791 \cdot IDI$

Table 5 shows the delineation scale for the coefficient of determination. From this scale we make the following submissions vis-à-vis the relationship between KEI and IDI for Africa and the world at large:

- **For The World**: The coefficient of determination $\boldsymbol{R^2(y1)}$ falls within the ***excellent*** range. This implies a near perfect linear relationship between the two indexes, and particularly that $\mathbf{93.82}\%$ of the variations in IDI account for the variations in KEI. This implies *statistically* that 93.82% of the variations in IDI is responsible for the variations in KEI for the World as a whole.

Table 5: Interpretation of R^2 Values

Scale	Interpretation
$\boldsymbol{R^2} \geq 90\%$	Excellent
$90\% > \boldsymbol{R^2} \geq 75\%$	Very Good
$75\% > \boldsymbol{R^2} \geq 50\%$	Good
$50\% > \boldsymbol{R^2} \geq 25\%$	Fair
$25\% > \boldsymbol{R^2} \geq 0\%$	Poor
$\boldsymbol{R^2} < 0\%$	Unsatisfactory

- **For Africa**: The coefficient of determination $\boldsymbol{R^2(y1)}$ falls within the ***very good*** range. This implies a strong linear relationship between the two indexes, and particularly that $\mathbf{80.96}\%$ of the variations in IDI account for the variations in KEI. This can be interpreted *statistically* as saying that 80.96% of the variations in IDI is responsible for the variations in KEI for African Nations. That is significant.

We therefore reject *H02*, and thus uphold *Ha2* by establishing the relationship between IDI (a measure of ICTed) and the KEI (a measure of KE) of an economy. With this result, we have shown statistically through regression analysis that a relationship exists between IDI and KEI for the whole world in general and Africa in particularly. By extension, we have likewise shown that this relationship is linear and representative of the relationship between ICTed and KE in Africa.

Extrapolating the established correlation between IDI ($\propto ICTed$) and KEI ($\equiv KE$), and reverting to Table 1 showing the top five economies by region based on the GIR; we note that the African Region has the least rankings. This fact notwithstanding, the $\boldsymbol{R^2}$ value for Africa still came out as '*very good*', for a seemingly worst-case scenario. Based on this fact, a safe assumption can be made that the $\boldsymbol{R^2}$ value for all other regions will be better than the one obtained for Africa. This is easily verifiable using the methodology presented above. *Ipso facto,* we submit without fear of contradiction that:

$$\begin{cases} \boldsymbol{KE \equiv KEI \propto IDI \propto ICTed} \\ \therefore \\ \boldsymbol{KE \propto ICTed} \blacksquare \end{cases} \tag{4}$$

We could stop here with a sense of fulfilment that the major question at the aim of this paper i.e.: '*What is the relationship between Knowledge Economy and ICT Education in Africa'* has been answered. *Alas*, the import of the question to the development of the Region under study forbids such complacency. It is for this reason we go a step further by moving expression (4) from the realm of *equivalence* and *proportionality*, to that of relational and functional

dependence. For this purpose, we use the second set of *Trendlines* (y2) as given in the regression analysis results of Table 4. This is gotten by forcing the intercept to zero, which as seen in the table has no significant effect on the important parameter $\boldsymbol{R^2}$ for Africa.

From expression (3), we have:

$ICTed = 0.2 \cdot IDI \implies IDI = 5 \cdot ICTed$

Substituting into Trendline equations for Africa we obtain:

$$\boldsymbol{KEI} \cong 1.0269 \cdot IDI = \mathbf{5.1345}\, \boldsymbol{ICTed} \tag{5}$$

We have thus established a relationship between ICT Education and Knowledge Economy both for regional Africa and the World at large. What is the import and implications of the functional equation $KEI \cong 5.1345\, ICTed = k \cdot ICTed$ for Africa?

To answer this all-important question, recall that we adopted the skills component of IDI as proxy measure of ICTed. Hence from expressions (3) and (5) we have that:

$$KEI = k \cdot ICTed = k \cdot f(A, S, T) \tag{6}$$

where **A**, **S**, **T** are Adult literacy, Secondary gross enrollment, and Tertiary gross enrollment ratios respectively. Subsequently, by bringing all established relationships to bear, we can safely submit that:

$$\boldsymbol{KE = k \cdot ICTed} \tag{7}$$

where $k = 5.1345$ is coefficient of proportionality.

It then follows from (7), that any and all factors that have an influence on ICT Education will necessarily influence the capacity of a country for Knowledge Economy.

VI. DISCUSSION

The relationship between ICT Education and Knowledge Economy has been established to be a linear one with a high correlation coefficient ($\mathrm{R} = 0.8998$). The skill indicator components of the ICT Development Index as defined by the International Telecommunication Union (i.e. Adult literacy, Secondary gross enrollment, and Tertiary gross enrollment ratios) have likewise been identified as quite important in this relationship. According to the World Bank Institute, ICT constitutes 33.33% of the pillars of Knowledge Index and 25% of the Knowledge Economy Index framework. It is therefore imperative for African economies to find ways of addressing this all-important factor required for participating in the emerging global Knowledge Economy.

African economies must begin to shy away from their over-dependence on exportation of raw unprocessed natural (and unskilled human) resources as the major source of GDP. They must diversify, while engaging KE as a path to tread towards future developmental goals. What is currently playing out globally is that a preponderance of natural resources may end up as a curse rather than blessing for the possessor thereof. In the words of Lester C. Thurrow, former

Dean of the prestigious Sloane School of Management at MIT, "… *the industries of the future are all based on brain power*." Another MIT professor Nicholas Negroponte[2] in his 1995 book – Being Digital – gave a very engaging exposé on the atoms to bits shift in technological paradigms. A cursory look around us today will convince the worst skeptic of the accuracy of his predictions.

It can only be expected, that an ICT–educated populace will engender an improvement in the ICT Development Index of its country, region, or economy. This in its turn must necessarily result in an increase in the KEI of that country, which is but an indicator of the country's readiness for KE adoption. Can one then safely assume IDI as a measure of the level of ICT capabilities and skills (education) of a country? Yes. This we have demonstrated in this paper, by using the relevant component of IDI.

VII. CONCLUSION

The relationship between ICT Education – a measure of the level of capabilities and skills available for the exploitation of the ICTs for purposes of growth and developmental enhancement – and Knowledge Economy has been established. This has been done for the world as a whole and for Africa as a region of focus. The onus now rests on African leaders and geo-political policy makers to ensure that the identified skill indicator components (A, S, T) are given the necessary impetus and right of place in policy formulation and budgetary allocations. The international bodies (WBI, ITU, et cetera) have done enough studies providing relevant statistics that can serve as authoritative sources of data for appropriate planning in this wise. It is never too late to start taking the right steps.

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