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Education, Technology and Innovation for Global Competitiveness: Evidence from Ghana and Nigeria

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Abstract
The paper examined the states of western education, levels of technological readiness and innovation capacities in Ghana and Nigeria, in conjunction with the abilities of the two countries' to achieve their goal of becoming one of the foremost twenty economies in the world. The findings showed that differences in country's global competitiveness appear to have reflected the differential education, technology and innovation policy thrusts in Ghana and Nigeria. Moreover, unlike in Nigeria, where priority was narrowly on macroeconomic and market efficiency, Ghana did broadly prioritized infrastructural and institutional deficits without neglecting development of education, technology and innovation. Thus, inclusive and quality investment in human, managerial and knowledge capital in addition to the development of physical capital and pursuance of market efficiency is a worthwhile development strategy that both countries, especially Nigeria should adopt in a strategic manner.

Key Words: Technology, education, innovation, global competiveness, Ghana, Nigeria

Introduction

More than ever before, African countries need to explore knowledge-based, technology-driven and innovation-focused approaches to diversify their economies as they face increasing threats resulting from their lifelong dependence on natural resources. Necessity is the mother of invention is an English language proverb meaning that the primary driving force for most innovations is a need. Although Ghana and Nigeria got their political independence in 1957 and 1960 respectively, Ghana and Nigeria fall within the same cluster of countries with similar economic structure and they both desire to join the league of the 20 foremost world economies by the year 2020. Nevertheless, Ghana and Nigeria pursue different development trajectories regarding investments in education, technology and innovation owing perhaps to differences in what they considered as their national needs and priorities within their available resources. To this end, this paper aims at

i. Reviewing the desire of Ghana and Nigeria to be globally competitive and the determinants of global competitiveness.
ii. Reconstructing the dynamics among education, innovation, technology on one side and economic development in terms of the size, the spread and the speed or competitiveness of the economy on the other side.
iii. Reporting, through concrete evidence, the differences between Ghana and Nigeria with respect to:
    a. size of the economy (measured by Gross Domestic Product or GDP per capita),
    b. speed of the economy (measured by Global Competitiveness Index or GCI as different from the use of economic growth rate),
    c. spread or distributive equity of national resources measured in terms of Inequality weighted Human Development Index or IHDI, Global Peace Index or GPI and Africa Attractiveness Index or AAI.
    d. education (in terms of access and quality at primary, secondary and tertiary level),
    e. technology (measured by technological readiness) and
    f. Innovation (non-technological-based and technological based).

iv. Reinstating evidence-based arguments on the disservice from low priority for education, technology and innovation
v. Reinforcing earlier declarative statements about the importance of education, technology and innovation in national development agendas.

The Desire of Ghana and Nigeria to be Globally Competitive

It is the shared determination of Ghana and Nigeria to join the 20 top competitive economies in the world by 2020 (International Monetary Fund, 2012 and Federal Republic of Nigeria, 2010). Ghana and Nigeria believe that the attainment of the Vision would enable them achieve a lofty size of the economy in a speedy manner and an equitable spread of the national resources to improve standard of living for their citizens. To achieve this vision, both countries crafted different 'home-grown' medium-term development strategies with technical support (in form of poverty reduction strategies) from the International Monetary Fund (IMF). The "Ghana Shared Growth and Development Agenda (GSGDA, 2010-2013)", as the medium term strategies in Ghana is called, laid emphasis on the following trajectories: (a) expanding access to potable water and sanitation, health, housing and education; (b) reducing geographical disparities in the distribution of national resources; (c) ensuring environmental sustainability in the use of natural resources through science, technology and innovation; (d) pursuing an employment-led economic growth strategy that will appropriately link agriculture to industry, particularly manufacturing; and (e) improving transparency and accountability in the use of public funds and other national resources (International Monetary Fund, 2012).

On the other hand, Nigeria's National Economic Empowerment and Development Strategy NEEDS embraced the macroeconomic framework with emphasis on (a) reforming governance and institutions, (b) growing the private sector (security, infrastructure, finance and trade) and (c) enforcing a social charter based on human development such as education and employment as contained in the Nigeria's poverty reduction document (National Planning Commission, 2004:10). Thus, Ghana seems to have emphasized physical, human and knowledge capital development, while Nigeria tends towards the development of physical

and human capital only. The focus of this paper is to unearth the consequences of each of these strategic choices on the size, the speed and the spread of national resources in Ghana and Nigeria. To do this, it is important to know the major determinants of economic growth and global competiveness.

The Determinants of Economic Growth and Global Competitiveness

Traditionally, it is believed that appropriate investment in physical, human, managerial and knowledge capital is capable of raising national productivity and prosperity in a speedy manner. Nevertheless, it has also become a common knowledge that high national resources might not improve the standard of living of majority of the citizens if national resources are not equitably spread. Twelve determinants of national productivity and prosperity have been grouped into basic requirements, efficiency enhancers and innovation (World Economic Forum, 2010). The basic requirements are institutions, infrastructure, macroeconomic environment or stability as well as health and primary education. Moreover, the efficiency enhancers are higher education and training, technological readiness as well as size and efficiency of market (goods, labour and financial). Innovation is made up of the non-technology-based business sophistication and the technology-based innovation.

Globally, countries are classified into five main categories based on the degree of their dependence on basic requirements, efficiency enhancers and innovation as drivers of their economies (World Economic Forum, 2013:6). First, there are factor-driven economies such as Ghana and Nigeria where 60%, 35% and 5% of the productive forces are driven by basic requirements, efficiency enhancers and innovation factors respectively. Second, there are countries transitioning from factor-driven to efficiency-driven economies such as South Africa where 40%, 50% and 10% of the economic structure are driven by basic requirements, efficiency enhancers and innovation factors respectively. Third, there are the efficiency-driven economies such as Algeria, Botswana, Egypt, Gabon, and Libya where the structural mix is made up of basic requirements (40%-60%), efficiency enhancers (35%-50%) and innovation factors (5%-10%). In Africa, only Seychelles is transitioning to innovation-driven economy characterized by basic requirements

(20%-40%), efficiency enhancers (50%), and innovation factors (10%-30%). Lastly, there are innovation-driven economies in which 20%, 50% and 30% of the economic structure is made up of basic requirements, efficiency enhancers and innovation factors respectively. As at 2013, there was no African country in this category.

Following the proposal of WEF in 2013, after a due consideration for their specific context and challenges, Ghana and Nigeria as factor-driven economies are expected to prioritize provision of sound macroeconomic policies, effective institutions, adequate infrastructure, and the means for ensuring a healthy and literate workforce before moving on to the next stage of efficiency-driven economy which will require them to move into more efficient production processes and increase product quality to maintain growth. However, if they aim at transitioning into the next higher level(s), they need to prioritize appropriate factors to enhance efficiency and/or boost innovation.

With respect to their contexts (in terms of revenue-base and export diversification), Ghana is a "transition" economy while Nigeria is an oil and gas exporting country (Leke, Lund, Roxburgh, & van Wamelen, 2010). Ghana as at 2010 was already making efforts to building on her current gains to diversify her economy. Although Ghana has low GDP per capita and small unsustainable markets, agriculture and resource sectors together account for about 35% of GDP and for about 66% of exports; overall costs of production are high because of poor infrastructure and poor regulatory systems and therefore, could not compete globally. The local service sectors (such as telecommunications, banking, and retailing) are expanding rapidly but have relatively low penetration rates. Ghana necessarily depends on diversified sources of income. She therefore prioritized policies to encourage expansion of intra-African trade through regional integration because of the small size of markets as well as on the improvement of infrastructure and regulatory systems to be able to compete globally with other low-cost emerging economies like China and India. Thus, the economic environment appears to have motivated Ghana to aim at investing in education, technology and innovation.

In contrast, Nigeria is an oil and gas exporting country with high GDP per capita but also the least diversified economies in Africa. Rising oil prices lifted export revenues which are spent to reduce budget deficits, fund investments and build foreign exchange reserves. Economic growth remains closely linked to oil and gas prices such that the share of manufacturing and services in GDP has remained as low as 33%. Her dependence on oil and gas revenue appears to have lowered Nigeria's incentive at investing in innovative activities to diversify her economy. The focus of this discourse is to evaluate Ghana and Nigeria based on a systematic model discussed in the next section of the paper.

Perception on Education-Economy Dynamics

The background of this paper has focused on the concern of Ghana and Nigeria to join the league of the top 20 economies. Twelve pillars have been identified as crucial in boosting global competitiveness of a nation (WEF, 2010/2011 and 2014/15). Out of these twelve determinants, education (primary, secondary and higher), technology and innovation form three and half pillars. This means that although education, technology and innovation are necessary conditions to boost the size, the speed and the spread of national prosperity, other factors outside education are also required to enhance national productivity, prosperity and proactivity.

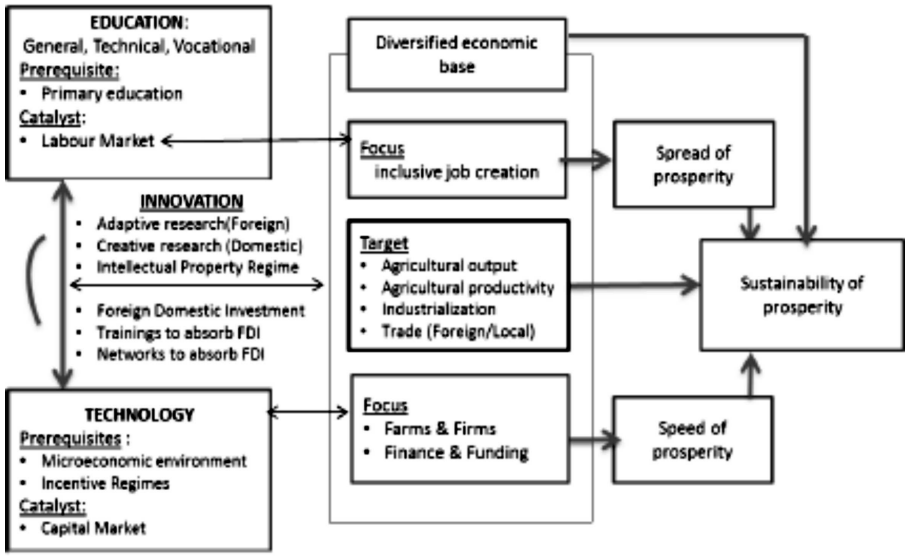

Figure 1 concentrates on the influence of education, technology and innovation system on the size, the spread, the speed and sustainability of national prosperity. Each of these elements will be briefly discussed in turn.

Education

As education (at primary, secondary and higher levels), technology and innovation (including business sophistication) are four and half out of twelve pillars of global competitiveness, schooling is only a small part of education since education can take place through incidental or subconscious, informal, non-formal and formal routes (Obanya, 2012). A school is a formally organized complex comprising a set of classrooms in which there are organized chairs, tables and writing boards for learners and teachers to interact for the purposes of learning. Depending on the resource situation of the provider (public or private), these classrooms might be built with blocks; mud, bricks or fabricated materials. In some cases, classes might be held under shades and sheds. A school is also made up of offices for teachers, administrators and the head teacher. Some schools might contain a field where learners carry out physical exercises and in most cases with network of pathways or roads laid with side flowers or trees. Some schools might contain some health

facilities to take care of the health needs of the learners. Occasionally, a school might have a fence to enhance security and safety of learners. Generally, a school is a former and organized environment consisting mainly of learners, sizable numbers of teachers and few administrators. Therefore, the economic impact of education in a country with low qualities of educational inputs and process cannot be the same as another country with high qualities of educational inputs and process just because learners are exposed to the same years of schooling. Thus, six years of schooling in Ghana might not yield the same economic result as six years of schooling in Nigeria. Consequently, general education received in schools (primary, secondary, higher, teacher training, technical and vocational, technological, etc.) is a necessary but not a sufficient condition for economic development owing variation in the qualities of input and delivery. The prerequisite to enhance the economic impact of general, scientific and technical education is an inclusive and quality primary education which stands as the foundational level in the education system. The quantity and quality factors aside, the education system (including technology and innovation) requires an inclusive and efficient labour market to make the needed impact on the economy and the society. The catalyst for a functional education system is an inclusive and efficient labour market development (De Ferranti, Perry, Gill, Guasch, Maloney, Sanchez-Paramo, & Schady, 2003). The labour market is needed to apply skills, technology and innovation embodied in the educated citizens. When a substantial proportion of educated people are not allowed to participate in the labour market owing to a narrow spread of job opportunities, a nation stands to lose in terms of size and speed of productivity and prosperity.

All hands inside and outside of the education system are therefore expected to be on deck to enhance an effective link among education, technology, innovation and national prosperity. Adequate inputs should be provided and efficiently managed to enable the formal education system perform its expected roles in national development and global competitiveness. Generally speaking, to make a school effective, the provider of education would make available the required number of equipped classrooms, hire sufficient number of qualified teaching and non-teaching staff, supply the curriculum as well as other learning

materials, and ensure that a critical mass of learners enrol and continue to attend their classes till they attain the expected permanent learning outcomes. Thus, in addition to provision of inclusive quality inputs, an effective quality-assurance system should be in place to ensure an efficient process of scientific knowledge capturing (absorption), creation (generation) and communication (application) to industry and commerce so as to enhance global competitiveness of a nation. The formative aspect of the quality assurance system is more or less a technological process particularly if the scientific information produced is applied innovatively to solve practical problems in the education system and/or in the society. What then is technology and how does it translate to global competitiveness?

Technology

It has become a common knowledge that the four main problems of most countries in Africa are undiversified economic base, deindustrialization, low agricultural productivity and product as well as exclusive system of wealth distribution. In spite of the progress in respect of the growing strength of African economy, economic growth in the continent is neither inclusive (in term of the spread of the fruits of the economic growth) nor sustainable owing to (a) the general dependence on rapidly depleted and erratically priced natural resources most of which are non-renewable, (b) relatively low per capita agricultural output and productivity; and (c) deindustrialization in the face of growing urbanization (United Nations Conference on Trade and Development, 2011). To address these challenges, technology is needed in Africa.

This is because technology is the purposeful application of scientific knowledge to invent and/or adapt things so as to solve practical problems especially in industry and commerce. According to De Ferranti, et al. (2003), macroeconomic stability and incentive regimes are the prerequisites to the absorption of foreign technology and creation of indigenous technology. Foreign technology gets easily transferred through training and networking in the processes of foreign trades, foreign domestic investment, licencing of patents, Intellectual Property Rights and adaptive Research and Development (R&D). At the same time, macroeconomic stability and incentive regimes are prerequisites to

domestic generation of scientific knowledge through advanced indigenous human capital development such as creative R&D, registrations of patents and other Intellectual Property Rights. An efficient capital or financial market is however, required for a purposeful application of scientific knowledge for national development and global competitiveness.

Innovation

Innovation can emerge from (a) new non-technological knowledge and (b) technological knowledge. Non-technological innovation is related to improvement in productivity (expertise, experience and engagement) owing to adoption of the existing technologies that are embedded in the business sophistication of organizations. Technological innovation is related to improvement in productivity resulting from new scientific breakthroughs as experienced during the industrial revolution with the invention of steam engine and electricity and digital revolution with the invention of the computer. Although less-advanced countries like Ghana and Nigeria can still improve their productivity by adopting existing technologies, for those that have reached or are transitioning into the innovation stage of development (like Seychelles) adaptive research is no longer sufficient for increasing productivity. Firms in innovation-driven countries must design and develop cutting-edge products and processes to maintain a competitive edge and move toward even higher value-added activities. This progression requires an environment that is conducive to innovative activity and supported by both the public and the private sectors. In particular, it means sufficient investment in creative Research and Development (R&D), especially by the private sector; the presence of high-quality scientific research institutions that can generate the basic knowledge needed to build the new technologies; extensive collaboration in research and technological developments between universities and industry; and the protection of intellectual property, in addition to high levels of competition and access to venture capital and financing. In the face of hardship as currently being experienced in most African countries like Ghana and Nigeria, it is important that public and private sectors resist pressures to cut back on the R&D spending especially, the African target of 1% of GDP that will be so critical for sustainable growth going into the future.

Profiling the Differences between Ghana and Nigeria

Realizing that right articulation might not always translate to the right action, this section explores concrete evidence from Ghana and Nigeria in respect of how they have translated their Vision 20:2020 into action between 2010/11 and 2014/15 and the consequential effect of their development trajectories on national prosperity.

Economic (Size and Speed) Profiles of Ghana and Nigeria (2010-2015)

Table 1 reveals that Ghana outperformed Nigeria in respect of the size and the speed of national prosperity. Ghana's GDP per capital (PPP) as a percentage of the global income increased by 5 points while that of Nigeria increased by 0.7 points between 2010/2011 and 2014/2015. Within these periods, Ghana moved three rungs up the ladder in her race to join the 20 foremost economies in the world while Nigeria remained stagnant. This might be as a result of the differences in development strategies adopted. Nevertheless, the specific context and the unique challenges faced in each country are likely to determine the development trajectories adopted. Notwithstanding, both countries are factor-driven economies that are expected to prioritize, among other factors, basic prerequisites such as institutions infrastructure, macroeconomic stability as well as health and primary education. These countries are not however, limited to these minimum requirements since they are free to go above the minimum and deploy higher factors of national productivity and prosperity such as efficiency enhancers and innovation factors. The gap in national incomes of Ghana and Nigeria can further be explained by differences in their respective medium-term development strategies. As earlier discussed, Ghana specifically aimed at expanding access to education and ensuring environmental sustainability in the use of natural resources through science, technology and innovation (physical, human and knowledge capital) while Nigeria aimed at physical and human capital development (Table 1).

Table 1: Determinants of Global Competitiveness in Ghana and Nigeria

	Global Rank by Country				Change (Δ) (2010/11 – 2014/15)	
	2010/11		2014/15			
Determinants by Country	Ghana	Nigeria	Ghana	Nigeria	Ghana	Nigeria
GDP per capita (PPP % Share)*	671 (5%)	1,142 (4.8%)	1,730(10)	1692 (5.5)	+5	+ 0.7
Global Competitiveness Index**	**114 (3.6)**	**127 (3.4)**	**111 (3.7)**	**127 (3.4)**	+3	+ 0
(a) Basic requirements	**122 (3.5)**	**136 (3.1)**	**123 (3.7)**	**140 (3.2)**	-1	- 4
Institutions	67 (3.9)	121 (3.2)	69 (3.9)	129 (3.0)	-2	-8
Infrastructure	106 (2.9)	135 (2.0)	108 (3.0)	134 (2.1)	-2	+1
Macroeconomic environment	136 (3.0)	97 (4.3)	133 (3.4)	76 (4.6)	+3	+21
Health and primary education	122 (4.3)	137 (3.0)	121 (4.5)	143 (3.0)	+1	- 6
(b) Efficiency enhancers	**96 (3.6)**	**84 (3.8)**	**89 (3.8)**	**82 (3.9)**	+14	+ 2
Higher education and training	108 (3.3)	118 (3.0)	106 (3.5)	124 (2.9)	+2	- 6
Goods market efficiency	75 (4.1)	87 (4.0)	67 (4.3)	87 (4.2)	+8	+ 0
Labor market efficiency	93 (4.2)	74 (4.3)	98 (3.9)	40 (4.5)	-5	+ 34
Financial market development	60 (4.2)	84 (4.0)	62 (4.1)	67 (4.1)	-2	+ 17
Technological readiness	117(2.8)	104 (3.0)	100 (3.1)	104 (3.0)	+17	+0
Market size	83 (3.3)	30 (4.6)	69 (3.7)	33 (4.7)	+14	- 3
(c) Innovation & sophistication	**100 (3.2)**	**83 (3.3)**	**68 (3.6)**	**103 (3.3)**	+36	- 20
Business sophistication	97 (3.5)	76 (3.8)	70 (3.9)	87 (3.8)	+27	- 11
Innovation	99 (2.8)	98 (2.9)	63 (3.3)	114 (2.8)	+36	-16

Data Sources: World Economic Forum (WEF, 2010 and 2014)

Notes: (1) Figures in parentheses under the GDP per capita are percentage shares of world total GDP (PPP) while figures in parentheses under the Global Competitiveness Index are scores out of seven; (2) ** Global Competitiveness Index (GCI) is the dependent variable being a function of three clusters of factors (a) basic requirements, (b) efficiency enhancers and (c) innovation and sophistication;

Table 1 reveals that as far as macroeconomic stability is concerned, Nigeria moved up the ladder from 97th position in 2010/11 to 76th position in 2014/15. Similarly in respect of the labour market efficiency, she moved up from 74th position in 2010/11 to 40th position in 2014/15. Yet, its global ranks dropped in health and primary education (137th to 143rd in 2014/15) as well as in higher education and training (118th to 124th) making her to be among the 20 least-competitive countries in the world as far as primary and higher education are concerned. Moreover, Nigeria is still very far from being among the first 20 economies as far as her technological readiness and innovation are concerned. In technological readiness, Nigeria ranked 104th in 2010/11 and 2014/15 respectively. In a similar vein, Nigeria has been waxing weaker in innovation as her global position dropped from 98th in 2010/11 to 114th in 2014/15. With Ghana, the story is different from that of Nigeria since Ghana has made upward leaps in primary education (from 122nd to 121st), higher education (from 108th to 106th), technology (from 117th to 100th) and innovation (from 99th to 63rd) within those periods.

Table 1 further reveals that Ghana laid emphasis on and outran Nigeria in the areas of basic and higher education, technology readiness and innovation while Nigeria laid emphasis on and outran Ghana in the areas of macroeconomic environment and market (labour and financial) development. By prioritizing education, technology and innovation, Ghana gained competitive position and outran Nigeria in global share of economic growth or GDP (PPP) while Nigeria remained competitively stagnant between 2010 and 2015 despite the fact that Nigeria is an oil and gas exporting country.

General Education Profiles in Ghana and Nigeria

Table 2 contains the general education profiles in Ghana and Nigeria and it reveals that Ghana outperformed Nigeria in all indicators of education development except in respect of Internet access in schools and the extent of staff training. Earlier study by Babalola (2015) further shows that between 2010 and 2015, Nigeria experienced a decline in global ranks in access to higher education, quality of the education system, quality of Mathematics and Science, quality of education management, Internet access in schools and research and availability of training services.

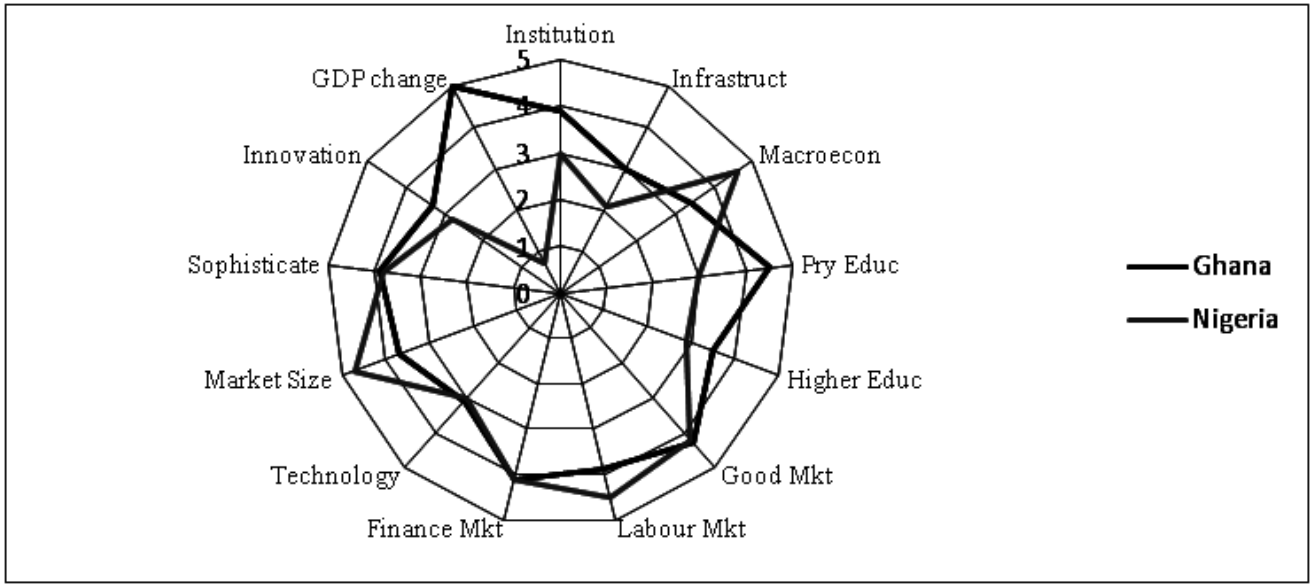

Figure 2: Indicators of global competitiveness of Ghana and Nigeria (2015)

Table 2: General Education (Primary, Secondary and Tertiary) in Ghana and Nigeria, 2014/15

Indicators	Ghana	Nigeria	Outperformer
Quality of primary education	3.0 (112)	2.6 (124)	Ghana
Primary education enrollment, net %*	87.1 (108)	63.9 (138)	Ghana
Secondary education enrollment, gross %*	61.1 (112)	43.8 (127)	Ghana
Tertiary education enrollment, gross %*	12.2 (106)	10.4 (112)	Ghana
Quality of the education system	3.8 (59)	2.9 (122)	Ghana
Quality of math and science education	4.4 (52)	2.6 (132)	Ghana
Quality of management schools	4.6 (50)	3.8 (101)	Ghana
Internet access in schools	3.2 (113)	3.4 (111)	Nigeria
Availability of research and training services	3.8 (92)	3.7 (95)	Ghana
Extent of staff training	4.1 (61)	4.3 (48)	Nigeria

Source: WEF (2014)

Fig. 3 illustrates the relative positions (measuring the aspiration and perspiration) of Ghana and Nigeria as they press towards their set goal of becoming one of the 20 foremost educationally developed countries in the world. Looking at the graph, Nigeria is closer to the goal than Ghana only in two out of 10 indicators while Ghana is closer to the mark than Nigeria in 8 out of 10 indicators of general educational development.

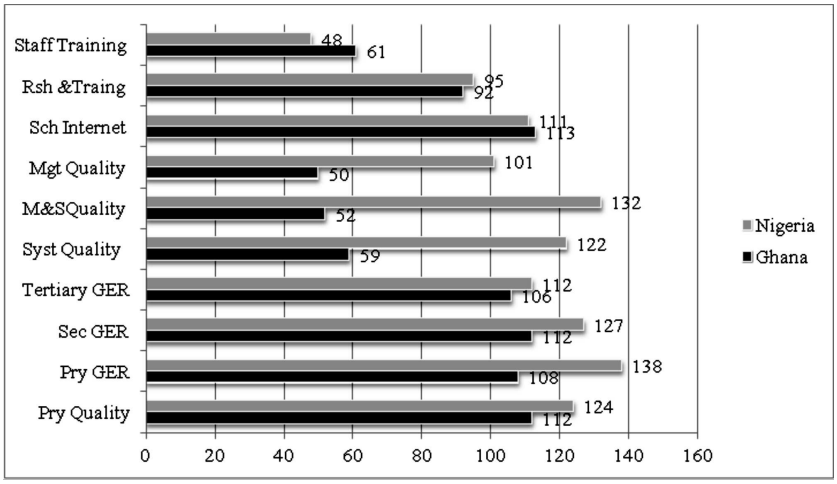

Figure 3: Positions of Ghana and Nigeria in Indicators of General Education at All Levels

The gaps between Ghana and Nigeria as they aspire to accomplish their national vision can be attributed to many reasons. First, it might be because planned and/or unplanned activities in the process of the

implementation did not relate directly to achievement of the vision. It is generally believed that activities might not translate to achievement if such activities are irrelevant to the goal. Second, resources might not be available in the right quantity and/or quality to make planned activities to translate to expected results. Third, resources might not be directed to result-oriented activities owing to capturing, illegal diversion and misappropriation in the system. Lastly, results might not be adequately rewarded (through the existing incentive regimes) thus resulting in low participation of people, unproductive activities and low achievement of goals.

Technological Readiness in Ghana and Nigeria

Technology, earlier defined in this paper, is the deliberate use of existing or new scientific knowledge to solve practical problems in the society. Table 3 reveals that Nigeria is better than Ghana in adopting and integrating existing knowledge, especially foreign technologies. Apart from the absorption of fixed broadband Internet, International Internet and mobile broadband, Nigeria outperformed Ghana in four (4) out of seven (7) indicators of technological readiness. This is most likely to be as a result of the differences in the level of national propensity as rich countries make ostentatious demand and depend on foreign goods and services thus attracting foreign investors as the case of Nigeria with her oil and gas money (EY Africa Business Centre, 2016).

Table 3: Technological Readiness (Absorption Existing Knowledge) in Ghana and Nigeria, 2014/15

Indicators	Ghana	Nigeria	Outperformer
Availability of latest technologies	4.3 (104)	4.4 (94)	Nigeria
Firm-level technology absorption	4.3 (95)	4.3 (91)	Nigeria
Foreign Domestic Investment (FDI) and technology transfer	4.2 (100)	4.5 (77)	Nigeria
Individuals using Internet, %	12.3 (121)	38.0 (87)	Nigeria
Fixed broadband Internet subscriptions/100 population	0.3 (117)	0.0 (140)	Ghana
International Internet bandwidth, kb/s per user	5.2 (116)	0.8 (141)	Ghana
Mobile broadband subscriptions/100 population	39.9 (54)	10.1 (96)	Ghana

Source: WEF (2014)

In the absence of concrete evidence on the extent to which the absorbed technologies are applied in industries and businesses in both countries, one can safely say that the picture painted that Nigeria is more technologically ready than Ghana might be true to the extent that owing to her oil and gas money, Nigeria provides a ready and an attractive market for ICT and FDI. However, being ready to use technologies is different from being able to use them effectively to speed up the catch-up period of the economy. The ability to adapt and then apply technologies to solve national problems can be built through applied science or research, technology and innovation.

Fig. 4 therefore, shows that Nigeria was nearer the Vision 20:2020 than Ghana in four out the seven indicators of technological readiness.

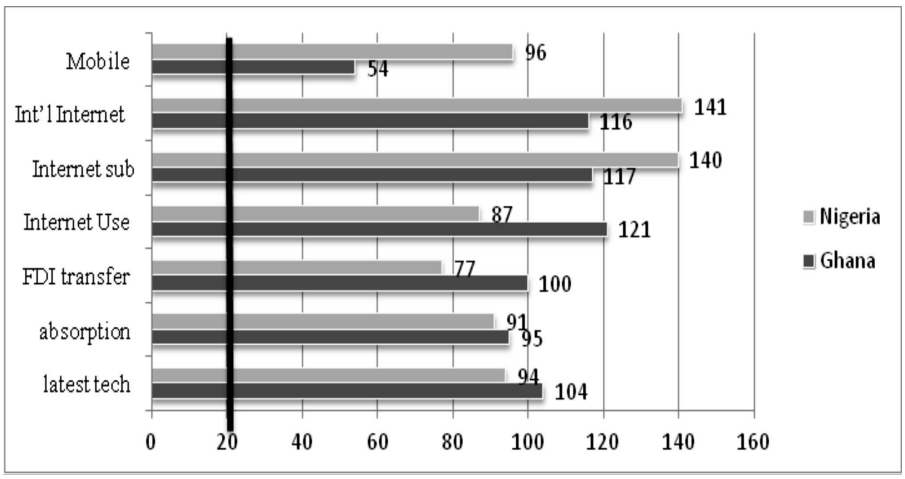

Figure 4: Positions of Ghana and Nigeria in Indicators of Technological Readiness

Innovation Profiles in Ghana and Nigeria

As earlier discussed in this paper, there are non-technology based or technology-based innovations. A country might decide to approach her development by adopting one or the combination of the two types of innovation depending on the unique economic context. Unlike a factor-based economy that can depend mainly on the adoption of existing technologies, the application of existing knowledge might not be enough

for a country that is aiming at transitioning into the innovation-based economy. Table 4 reveals that Ghana outperformed Nigeria in all indicators of innovation except in the availability of scientists and engineers in the labour force. This shows the differences in the aspiration of Ghana and Nigeria to translate ideas in the mental realm and in the mind of their citizens to market initiatives for the development of their economies.

Table 4: Innovation (Creation of New Knowledge) Profiles of Ghana and Nigeria, 2014/15

Indicators	Ghana	Nigeria	Outperformer
Capacity for innovation	4.0 (49)	3.7 (73)	Ghana
Quality of scientific research institutions	3.7 (73)	2.8 (120)	Ghana
Company spending on Research & Development (R&D)	3.5 (44)	2.8(106)	Ghana
University-industry collaboration in R&D	3.5 (77)	2.8 (123)	Ghana
Government procurement of advanced technology products	3.5 (65)	3.0 (109)	Ghana
Availability of scientists and engineers	3.6 (95)	3.8 (89)	Nigeria
PCT patents, applications/million population	0.0 (108)	0.0 (117)	Ghana

Source: WEF (2015)

Fig. 5 shows that except in the number of scientists and engineers available in the economy, Ghana was closer to her national Vision 20:2020 than Nigeria was in all aspects of innovation (patents registration, procurement of advanced technology products, university-industry collaboration, company spending on Research and Development (R&D), quality of scientific research institutions and capacity for innovation.

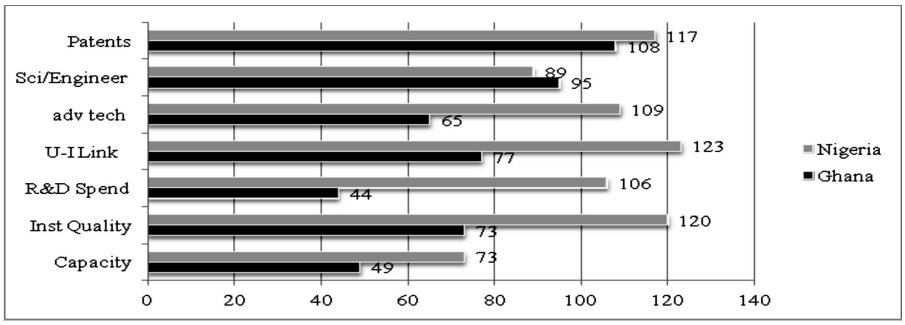

Figure 5: Positions of Ghana and Nigeria in Indicators of Innovation or Knowledge for Development

From the aspiration of both countries at developing their technology-innovation systems, there is no doubt that Ghana and Nigeria know that knowledge transfer from abroad needs an adaptive research before it can be applied locally. So, they have made some efforts at developing the capacity of the local scientists and engineers to adapt existing technologies to solve local problems. Nevertheless, both Ghana and Nigeria should improve on their present performances to prioritize all dimensions of technology and innovation respectively to enhance the absorption of the existing knowledge and technologies by local firms, farms, factories and other industrial sectors. Access to qualitative general education by a critical mass of population is required to adopt, adapt and apply transferred knowledge and technologies to solve local problems (Meek, Teichler & Kearney, 2009). On the other hand, both Ghana and Nigeria seem to be aware of the importance of knowledge creation by scientists at the local level as a critical factor for entrepreneurship and self-employability as well as the importance of protection of indigenous intellectual property by law. Nevertheless, Ghana and especially Nigeria should improve on their present efforts at capturing, creating, protecting and applying knowledge to solve practical problems at the local level.

Propositions About Disservice for Neglecting Knowledge

Downplaying education, technology and innovation in national development agenda is a disservice to a nation considering the following negative effects on the size, spread and speed of national productivity and prosperity.

Effect on the Size of National Prosperity

Figure 3 clearly illustrates the income effect of differences in development strategies of Ghana and Republic of South Korea. One major challenge in research and development in Africa concerns how to increase the public interest in it. One of the most powerful arguments for public interest in research and development in Korea is the leader's appreciation of the socioeconomic value of a well-developed system for acquisition, absorption, adaptation, accumulation and application of knowledge and technologies. How accumulation of knowledge capital has made a huge difference between Ghana and Republic of Korea between 1956 and

1990 is widely documented. Figure 3 (see the dark black portion) reveals the extent to which accumulation and application of physical and human capital, in form of additional years of schooling in the labour force, in the Republic of Korea has resulted in national income differential between Ghana and Korea with similar GDP per capita in 1958. More than this, Fig 3 (see the light black segment) has demonstrated how intangible capital (in form of improvement in the quality of education, strengthening of institutions, ease in communicating and disseminating technical information, as well as inculcating management and organisational skills) has significantly explained the difference in income between Ghana and Republic of Korea between 1956 and 1990.

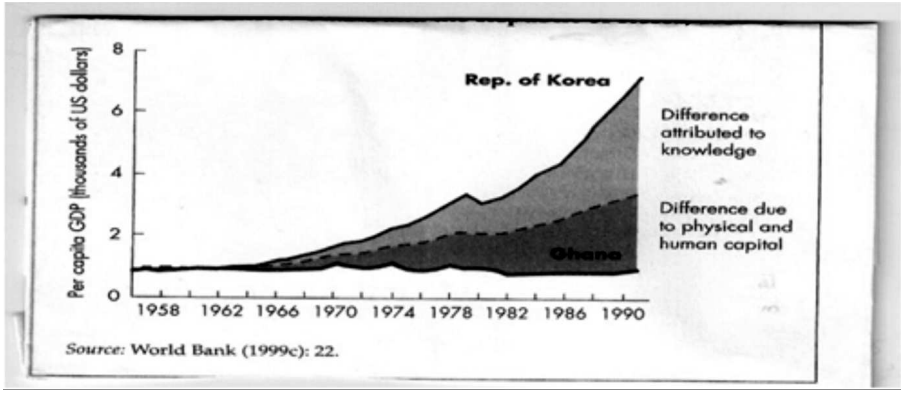

Figure 3 Differences between Ghana and Republic and Korea (1956-1990)
Source: IBRD/The World Bank 2002:11
Source: World Bank (2002:11)

Ghana's strategies reflect her response to this scientific evidence as she continues to pursue several policies and programmes to accelerate the growth of the economy and raise the living standards of the people through the accumulation of both human and knowledge capital. These include Ghana Vision 2020: The First Step (1996-2000); the First Medium-Term Plan (1997-2000); Ghana Poverty Reduction Strategy (2003-2005); and the Growth and Poverty Reduction Strategy (2006-2009). Under these strategic programmes, substantial progress was made towards the realisation of macro-economic stability and the achievement of poverty reduction goals. Within the contexts of the constitutional

requirement and the Better Ghana Agenda, the GSGDA is anchored on the themes of: ensuring and sustaining macroeconomic stability; enhanced competitiveness of Ghana's private sector; accelerated agricultural modernisation and natural resource management; oil and gas development; infrastructure, energy and human settlements development; human development, employment and productivity; and transparent and accountable governance.

Ghana's policies equally reflect the recommendation of the African Union on research and technology for development of Africa. Over the last three decades, there have been signs of a shift towards exploring the potential of science and technology as well as research for development in African countries. As far back as 1980, some African leaders met in Lagos and drew the Lagos Plan of Action and resolved that countries in Africa should allocate at least 1 percent of GDP to R&D to spur the continent's development. However, it is observed that following the meeting, many of the countries in Africa actually devoted lower than 1 percent of GDP to R&D (Mutume, 2007).

Effect on the Spread of Prosperity

Table 5 contains the relative performances of Ghana and Nigeria in respect of the spread of prosperity measured in terms of the extent to which each nation has been able to make national income or GDP per capita to touch the life of their people. Ghana performed better than Nigeria as far as the spread of prosperity is concerned (Table 5).

Table 5: Performances of Ghana and Nigeria in Spread of Prosperity (2014)

Indicators	Ghana	Nigeria
Human Development Index (HDI)*	0.579	0.514
Inequality-adjusted Human Development Index (IHDI)*	0.387	0.320
Overall Loss in HDI after adjustment for inequalities*	33.1%	37.8%
Gender Development Index (GDI)*	0.885	0.841
Multidimensional Poverty Index* (MPI, Ghana-2011; Nigeria-2013)	14. 4%	27.9%
Labour Force Participation Rate* (15 years plus)**	69.3%	56.1%
Global Peace Index (GPI)**	54	151
Africa Attractiveness Index (AAI)***	6	15

Sources: * UNDP (HDR, 2015); **Institute for Economic and Peace (IEP, 2015); and *** AY Africa Business
Notes: Multidimensional Poverty Index or MPI shows deprivations of households in education, health and living standards. A score of 33.3 % or greater is classified as multidimensional poverty; a score greater than or equal to 20 % but less than 33.3 % are near multidimensional poverty while a score greater than or equal to 50 % is severe multidimensional poverty.

Ghana's HDI was 0.579 which put the country at medium human development category. However, when the value is discounted for inequality, the HDI falls to 0.387, a loss of 33.1% due to inequality in the distribution of prosperity in all dimensions. The Human inequality coefficient for Ghana is equal to 33.1%. On the other hand, Nigeria's HDI value for 2014 was 0.514 which put the country in the low human development category. However, when the value is discounted for inequality, the HDI falls to 0.320, a loss of 37.8% due to inequality in the distribution of the HDI dimension indices. Table 5 further shows that labour force participation rate, which is a catalyst to application of knowledge in the society, was 69.3% and 56.1% in Ghana and Nigeria respectively. This implies that 30.7% of Ghanaians as against 43.9% of Nigerians were left out of formal sector job opportunities and therefore could not easily apply their skills and knowledge to solve social problems. Based on the global peace index (Ghana 54 most peaceful nation in the world against Nigeria ranked as 151st country) as well as the attractiveness index of Ghana (ranked as number 6 in Africa) and that of Nigeria (ranked as the number 15 in Africa), entrepreneurs in Nigeria would operate within an unattractive business environment thus limiting entrepreneurs from applying their creative ability and potentials.

Effect on the Combination of Size, Speed and Spread of Prosperity

The relationship among education, technology, innovation and development is a complex one in the sense that education, technology and innovation can influence the size, speed and spread of prosperity of a nation while at the same time, the reverse is true. Thus, the size, speed and spread of prosperity can influence the development of human and knowledge capital in a country. For instance, when the national prosperity is equitably spread, everybody irrespective of socioeconomic differences will have fair access to various opportunities such as quality education, technology, infrastructure, finance and decent jobs in the society. In fact, education, technology and innovation system needs an adequate support of a nation before they can positively influence the prosperity of the nation. Looking at the relationship from one side of the argument, Ghana and Nigeria must have reaped the fruits of their supports for education, technology and innovation in terms of the

Table 6: Relationship between Education-Technology-Innovation Nexus and the Size, Speed and Spread of Prosperity in Ghana and Nigeria (Last Year Available)

Indicators	Ghana	Nigeria
GDP per capita (measuring the size of monetary prosperity)	1,730	1,692
Quality of Living (Ranks of Accra and Abuja in size of non-monetary prosperity)[(2)]	166	212
Global Competitiveness Index (global rank for the speed of prosperity)	111	127
Multidimensional Poverty Index (measuring the spread of prosperity)	14. 4%	27.9%
Labour Force Participation Rate (a catalyst to the spread of prosperity)	69.3%	56.1%
Human Development Index (measuring support for human capital development**)**	**0.579**	**0.514**
Technological Readiness (global rank in knowledge absorption and application**)**	**100**	**104**
Innovation (global rank in knowledge creation**)**	**98**	**63**

Sources: Tables 1 and 5; (2) Mercer (2016) Quality of Living Rankings: 2016 City Rankings

corresponding size, speed and spread of prosperity in each of the two countries. In the absence of an elegant regression model to capture the required effect, one can argue that Ghana sowed more than Nigeria to education, technology and innovation, and therefore, has reaped more than Nigeria in terms of GDP per capita given as 1,730 and 1,692 in Ghana and Nigeria respectively. The same sowing and reaping argument can be applied to the relative speed of prosperity in terms of the global competitiveness index in Ghana (ranked 111) and Nigeria (ranked 127) respectively (Table 6).

Conclusion

In conclusion. this paper categorically declares that an inclusive quality education, technology and innovation system, though not a sufficient factor, is a necessary condition boost the size, the spread and the speed of sustainable development in Ghana and Nigeria. Data from conjectural and concrete explanations clearly demonstrate that education-technology-innovation policy trajectory that include deepening of the knowledge base of an economy as well as development of the indigenous physical and human capital enhances global competitiveness and national income. It has been pointed out that Ghana approached her development by prioritizing education, technology and innovation without losing sight of other necessary pillars for building a strong competitive economy. On the other hand, Nigeria focused on the deepening of macroeconomic stability and market efficiency with minimal support for education, technology and innovation. As a result, Nigeria lagged behind Ghana in most indexes of development and particularly in her attempt to join the league of the 20 foremost competitive economies in the world. Thus, investment in physical and human capital is no longer enough to promote a globally competitive and sustainable economy in a digital age.

Recommendation

Without any iota of doubt, a strategic development trajectory encompassing strengthening of a country's knowledge base has become a critical factor to develop the required competitive edge in a globalized world. Although, education, technology and innovation alone are not

sufficient to take Ghana and Nigeria to the Promised Land, considering this study's findings, inclusive and quality investment in human, managerial and knowledge capital in addition to the development of physical capital and market efficiency is a worthwhile development strategy that both countries, especially Nigeria should adopt in a strategic manner.

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