

Chapter 39

Upgrading Skills, Technology Adoption and Innovation Capacity as Part of Nigerian Recovery Trajectories from COVID-19 Shocks

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Introduction

This paper focused on Nigeria policy prioritisation between 2013 and 2019 to see how much priority she placed on education and training (skills), research (science), technology (ICT adoption) and innovation prior to the outbreak of Covid-19 relying on the data from the World Economic Forum Global Competitiveness Reports. The six bottommost pillars of development in Nigeria's agenda between 2013 and 2017 were infrastructure, innovation, health and primary education, higher education and training, technological readiness and institutions. While in 2018 and 2019 when the global attention shifted in response to the demands of the Fourth Industrial Revolution (4IR), the least six pillars were ICT adoption, innovation capacities, skills, infrastructure and institutions. Understandably, between 2013 and 2019, Nigeria barely focused on the development of her physical capital in terms of market size, labour market and macroeconomic environment.

The country paid minimal attention to the holistic development of human capital (especially health and education) and knowledge capital (science, technological readiness or ICT adoption and innovation) that are critical complementary factors required for a meaningful physical capital development of a nation. Apart from the weak health system, Nigeria made skills (education and training), technology or ICT adoption as well as innovation (including research) bottommost priorities in her development agenda several years before the outbreak of the pandemic. Since no economy can be stronger than its weakest link(s), Nigeria found it difficult to respond rapidly and adequately to the health, educational and economic needs of her people at the initial stage of the pandemic in 2020. This paper, therefore, identified the weakest links, especially in Nigeria's chain of development so that governments could endeavour to strengthen skills, science, technology and innovation as soon as the combat against COVID-19 pandemic is over.

Education: A Priority of Development Agendas

Governments formulate socioeconomic policies as a public response to strengthen the weakest links in the chain of development so as to increase the size, the speed and the spread of its prosperity. Evidence from various global competitiveness reports (World

Economic Forum, WEF, 2013, 2014, 2015, 2017, 2018 and 2019) have shown that economies derive substantial strength from twelve pillars including health and education (human capital), technology and innovation.

Although most world countries have made education a priority on development agendas even before the advent of the World Economic Forum's Global Competitiveness Index (GCI), the opportunity for one country to learn from other countries came with the publication of the GCI. So also the challenges associated with the transparent global ranking of world economies have motivated countries to run with and make efforts to catch up with world economic giants. Many countries including Nigeria started to set development goals showing their competitive ambitions to become one of the topmost economies in the world and Nigeria developed the Nigerian Vision 20, 2020 (2010-2020) that hinged on human capital development.

Before this time, the National Development Plans (1962-1986), the National Policy on Education (1977, 1981, 1988, 2004, 2007, and 2013), the National Perspective and Rolling Plans (1990-2009) made education and training a priority to develop skills for the growing economy. Later, the National Economic Empowerment and Development Strategy as well as the State Economic Empowerment and Development Strategy (2005-2015), and the Nigerian Economic Recovery and Growth Plan (NERGP, 2017-2020) clearly made education a top development goal. In similar vein, the President Yar'Adua's *Seven Point Agenda* and President Jonathan's *Nigeria National Transformation Agenda (2011-2015)* made education a priority. However, this was not the case with President Buhari's *Change Agenda (2015-2020)* comprising nine non-educational issues. This has raised the curiosity to know if Nigeria's priority on education has changed either for better or for worse across successive governments.

COVID-19 struck at a time when Nigeria was planning to recover economically and making efforts to prioritise infrastructure, security and national integrity for economic growth and inclusive sustainable development. The pandemic struck at a time when the health sector was relatively fragile. The country had to fight the public health crisis in the face of a weakening economy and threats to livelihoods (World Bank Group, 2000a and 2020b). The crisis rocked the foundation as well as the strongest pillars that were supporting the economy hitherto (World Bank, 2020a).

The Interrelatedness of Pillars of Productivity and Competitiveness

The World Economic Forum (WEF) defines competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the level of prosperity that can be reached by an economy. The productivity level also determines the rates of return obtained by investments in an economy, which in turn are the fundamental drivers of its growth rates. In other words, a more competitive economy is one that is likely to grow faster over time.

The Global Competitiveness Index (GCI) is the weighted average of various components, each measuring a different aspect of competitiveness. The components are grouped into 12 categories referred to as the pillars of competitiveness; namely: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labour market efficiency, financial market efficiency, technological readiness, market size, business sophistication, and innovation.

The 12 pillars are, therefore, interrelated with one another. As such, they tend to reinforce each other, and a weakness in one area often has a negative impact in others. For instance, if the infrastructure such as road network or electricity is weak, then other pillars would feel the impact in a negative manner. In essence, the bottommost pillar on the development agenda of a country creates a weakest-link problem especially in times of unpredictable shocks. As such the strength of an economy is determined by its weakest pillars as clearly demonstrated by how nations responded to health, educational and economic challenges during the COVID-19 pandemic. The interrelatedness of pillars of productivity and competitiveness has been strongly emphasised by scholars such as Dell, *et al* (2009), Grossklags and Johnson (2009), Clark and Konrad (2006), Access (2011), and Schneier (2003:103) that:

A chain is no stronger than the weakest link . . . No matter how strong the strongest links of a chain are, no matter how many strong links there are in it, a chain will break at its weakest link. Improve the strength of the weakest link and you improve the strength of the chain.

Thus, a pillar that is lowest on the agenda of the builder can cause the whole house to collapse no matter what is done to strengthen other pillars. It is in this regard that this paper identifies the low-priority development pillars for possible reinforcement by political architects and nation builders following COVID-19.

WEF uses the weighted index (GCI) to group economies into three distinct stages of development and two transition stages between the first and second stage as well as between the second and the third stage respectively. The three stages are factor-driven stage, efficiency-driven stage and the innovation-driven stage. Depending of on their GCI, some countries might be at the transitory stages from factor-driven to efficiency-driven as well as from efficiency-driven to innovation-driven stage respectively.

The assumption is that economies in the factor-driven stage will compete based on their factor endowment that is primarily unskilled labour and natural resources. Maintaining competitiveness at this stage of development hinges primarily on well-functioning public and private institutions (1st pillar), a well-developed infrastructure (2nd pillar), a stable macroeconomic environment (3rd pillar), and a healthy workforce that has received at least a basic education (4th pillar). As a country becomes more competitive, productivity will increase and wages will rise with advancing development. Countries will then move into the efficiency-driven stage of development, when they must begin to develop more-efficient production processes and increase product quality because wages have risen and they cannot increase prices.

At this point, competitiveness is increasingly driven by higher education and training (5th pillar), efficient goods markets (6th pillar), well-functioning labor markets (7th pillar), developed financial markets (8th pillar), the ability to harness the benefits of existing technologies (9th pillar), and a large domestic or foreign market (10th pillar). Finally, as countries move into the innovation-driven stage, wages will have risen by so much that they are able to sustain those higher wages and the associated standard of living only if their businesses are able to compete using the most sophisticated production processes (11th pillar) and by innovating new ones (12th pillar).

The GCI takes the stages of development into account by attributing higher relative weights to those pillars that are more relevant for an economy given its particular stage of development. To implement this concept, the pillars are organised into three sub-indexes, each critical to a particular stage of development. The basic requirements sub-

index groups those pillars most critical for countries in the factor-driven stage. The efficiency enhancers sub-index includes those pillars critical for countries in the efficiency-driven stage. And the innovation and sophistication factors sub-index includes the pillars critical to countries in the innovation-driven stage (Table 39.1).

World Economic Forum (2018) in its 2018 Report stresses the role of human capital, innovation, resilience and agility as defining features of economic success in the 4IR. It calls for better use of technology for economic leapfrogging as part of a holistic approach with earlier established factors of competitiveness. These qualities are captured through a number of new, critically important concepts such as: entrepreneurial culture, companies embracing disruptive ideas, multi-stakeholder collaboration, critical thinking, meritocracy and social trust. These new concepts are expected to complement, not to displace, more traditional components such as ICT and physical infrastructure, macroeconomic stability, property rights, and years of schooling.

Table 39.1: Sub-index weights and income thresholds for stages of development

	Stage of Development				
	Stage 1: Factor- driven	Transition from stage 1 to stage 2	Stage 2: Efficiency driven	Transition from stage 2 to stage 3	Stage 3: Innovation stage
GDP per capita (US\$) thresholds*	< 2,000	2,000-2,999	3,000-8,999	9,000-17,000	>17,000
• Weight for basic requirements	60%	40-60%	40%	20-40%	20%
• Weight for efficiency enhancers	35%	35-50%	50%	50%	50%
• Weight for innovation factors	5%	5-10%	10%	10-30%	30%

Notes: (1) * For economies with a high dependency on mineral resources like Nigeria, GDP per capita is not the sole criterion for the determination of the stage of development. This is measured by the share of exports of mineral goods in total exports (goods and services), and assumes that countries with more than 70 percent of their exports made up of mineral products (measured using a five-year average) are to a large extent factor driven. Countries that are resource driven and significantly wealthier than economies at the technological frontier are classified in the innovation-driven stage. Any countries falling between two of the three stages are considered to be “in transition.” (2) Kenya and Ghana are classified among 35 economies, under factor-driven stage. Botswana and Nigeria are classified, among 16 economies, under transition from stage 1 to stage 2; South Africa is classified, among 31 economies in the stage of efficiency-driven.

Source: World Economic Forum (2019a). Integration of the Fourth Industrial Revolution (4IR) Features

In response to another wave of Industrial Revolution, the World Economic Forum designed new benchmarks known as the GCI 4.0. The GCI 4.0 introduces a new progress score ranging from 0 to 100 to replace the 0-7 used in the previous GCI. The frontier

(100) corresponds to the goal post for each indicator and typically represents a policy target. Each country is therefore, expected to aim at maximising its score on each indicator and the score indicates its current progress against the frontier as well as its remaining distance.

The GCI 4.0 is still made up of twelve pillars of competitiveness. These are: Institutions; Infrastructure; ICT adoption; Macroeconomic stability; Health; Skills; Product market; Labour market; Financial system; Market size; Business dynamism; and Innovation capability. These twelve pillars are further categorised into four dimensions of development. First is the *Enabling Environment* which comprises institutions, infrastructure, ICT adoption and macroeconomic stability. The second is the Human Capital comprising health and skills. The third is the Market comprising product market, labour market, financial system, and market size. The fourth is the innovation ecosystem comprising business dynamism and innovation capacity (Figure 39.1).



Figure 39.1: Components of the GCI 4.0

Unlike the previous practice where growth trajectories were defined for countries, the GCI 4.0 provides a level playground for each country to decide on the desirable path towards development. The GCI 4.0 reflects the growing complexity of policy prioritisation by weighting pillars equally rather than according to a country's current stage of development. While sequencing is dependent on the priority of each economy, the index contends that economies need to be holistic in their approach to competitiveness rather than focusing on a particular factor alone.

The idea of allowing every country a level ground to decide the desirable growth path is a highly acceptable one. Previous works by this author have consistently ignored the WEF's indicative approach to classify Nigeria with economies in transition from stage one of development (resource-driven) to stage two (efficiency driven). Nigeria often suffers from underestimation perhaps owing to the information made available to valuers. Nigeria arguably has more capacity than what WEF thought. In support of

the argument that Nigeria's potentials have always been underated, the IMF said "though it projected Nigeria's economy to grow at 2.1 per cent in 2019, it does not reflect the potentials of Nigeria."

Invariably, the relative strength of skills, science, technology and innovations, as parts of the twelve pillars recommended by the World Economic Forum, should be the top development agenda of Nigeria if economic productivity and global competitiveness are still the country's goals. These are discussed below:

Skills from Education and Training

In this paper, skills mean the attitudes, knowledge and skills, acquired mainly school education and training. Skills as used in this study are categorised into current and future skills. As measured by the World Economic Forum (2018), current skills are made up of schooling years, extent of staff training, quality of vocational training, skillset of graduates, digital skills of population and ease to find skilled staff; while future skills comprise school life expectancy, critical thinking in teaching and Teacher Ratio (STR).

Therefore, skills cannot stand alone without necessary support of other pillars of development. Neither could other pillars be effective without current and future skills. Skills can only impact the size, the speed and the spread of prosperity when there are complementary supports from the government to supply the needed infrastructure, institutions, and macroeconomic environment. For example, institutions (rules and regulations) must work efficiently to enact and enforce education quality assurance measures so as to ensure that skills produced are as dictated by government standards and also to ensure the education services are delivered to the satisfaction of the stakeholders. On the other hand, the other aspects of the economy cannot grow and develop without adequate and quality skills. It is generally believed that adequate inputs should be provided and efficiently managed to enable the formal education system perform its expected roles in national development and global competitiveness.

Technology (Information, Communication and Technologies)

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 or in firms and farms. In this study, technology is narrowly defined as Information and Communication Technologies (ICT) absorption comprising mobile-cellular telephone subscriptions, mobile-broadband phone subscriptions, fixed-broadband internet subscriptions, fibre internet subscriptions/1000\ population and Internet users' percentage population (World Economic Forum, 2018). In today's usage, ICT adoption is central to productivity and competitiveness.

The argument in this paper is that technology cannot stand alone just as other pillar of economic growth and development cannot stand without technology. For example, friendly macroeconomic environment and incentive regimes are central to the absorption of foreign technology and creation of indigenous technology (De Ferranti, Perry, Gill, Guasch, Maloney, Sanchez-Paramo and Schady, 2003). Foreign technology gets easily transferred through firm-based training and networking, foreign trades, foreign domestic investment, licensing of patents, Intellectual Property Rights and adaptive Research & Development. At the same time, macroeconomic stability and incentives are basics to domestic generation of scientific knowledge through advanced indigenous human capital development such as creative Research and Development, registrations

of patents and other Intellectual Property Rights. An efficient, supportive and inclusive financial market is however, required for a purposeful application of scientific knowledge for national development and global competitiveness.

Science and Innovation

In this paper, science and innovation are treated together since ordinarily, innovation cannot be isolated from science. 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 organisations. On the other hand, technological innovation is related to improvement in productivity resulting from new scientific breakthroughs as experienced during the industrial revolution with the invention of electricity and recently the advent of the digital revolution with the invention of the computer and Artificial intelligence or Robots. Although any country can improve their productivity by adapting existing technologies and foreign research, they need to invest in indigenous creative Research and Development to join the foremost economies. For a country to design and develop cutting-edge products and processes associated with the top competitive world economies, there is need for:

- (1) An environment that is conducive to innovative activities and supported by public and private sectors.
- (2) Sufficient investment in creative research and development (R&D), especially by the private sector. In the face of hardship as being experienced by governments in Africa, it is important that public and private sectors resist pressures to cut back on the Research & Developing spending especially, the African target of 1 percent of GDP.
- (3) The presence of high-quality scientific research institutions that can generate the basic knowledge needed to build the new technologies;
- (4) Extensive collaboration in research and technological developments between universities and industry; and
- (5) The protection of intellectual property and access to venture capital and financing.

In this chapter, innovations are classified into three; namely: interaction and diversity, research and development, and commercialisation. Under interaction and diversity there are indicators such as workforce diversity, state of cluster development, international co-inventions, and multi-stakeholder collaboration. Research and development is made up of scientific publications, patent applications, R&D expenditures % GDP, and research institutions prominence. Lastly, commercialisation comprises buyer sophistication and trademark applications

Five Topmost and Bottommost Nigeria's Priority Development Pillars 2013-2019

Data from World Economic Forum 2014, 2015, 2016 and 2017 on the Nigerian policy prioritisation and growth trajectory-2013-2017 is shown below as Table 39.2.

Table 39.2: Nigerian Policy Prioritisation of Her Growth Trajectory, 2013-2017

Global Competitiveness Indicators	Yearly Score Out of 7					Average 2013-2017	Policy Prioritisation
	2013	2014	2015	2016	2017		
Institutions	3.3	3.0	3.2	3.3	3.2	3.20	7th
Infrastructure	2.3	2.1	2.1	2.1	2.0	2.12	*12th
Macroeconomic environ.	5.3	4.6	4.6	4.0	3.5	4.40	3rd
Health and pry education	3.2	3.0	2.9	2.8	3.0	2.98	*10th
Higher educ. and training	3.3	2.9	2.8	2.9	3.1	3.00	*9th
Goods market efficiency	4.2	4.2	4.1	4.1	4.1	4.14	4th
Labour market efficiency	4.5	4.5	4.5	4.5	4.6	4.55	2nd
Financial market efficiency	4.1	4.1	3.8	3.7	3.7	3.88	5th
Technological readiness	3.1	3.0	3.0	3.1	3.0	3.05	*8th
Market size	4.6	4.7	5.1	5.0	5.0	4.88	1st
Business sophistication	4.0	3.8	3.7	3.6	3.7	3.76	6th
Innovation	3.1	2.8	2.8	2.9	2.8	2.88	*11th

Notes: (1) The World Economic Forum changed the yardstick for measuring global competitiveness as from 2017, making yearly comparison beyond 2017 impracticable for this paper. (2) * indicates the five bottommost policy options in Nigeria's agenda, 2013-2017.

The analysis of Table 39.2 reveals that market size, labour market efficiency and macroeconomic environment were topmost on the agenda of the country between 2018 and 2019. The Table also reveals that within the same period, Nigerian six lowest priorities were infrastructure (12th priority), Innovation (11th priority), health and primary education (10th priority), higher education and training (9th priority), technological readiness (8th priority) and institutions (system of rules – 7th priority). That health and primary education as well as higher education and training were among the bottommost priorities on Nigeria's agenda confirms the earlier World Bank's report that development of human capital (knowledge, skills and health accumulated by people) has remained a weak link in the chain of Nigeria's development owing to consistent under-investment (World Bank, 2018, 2020a and 2020b).

Data from World Economic Forum 2018 and 2019 on the Nigerian policy prioritisation is shown in Table 39.3.

Analysis of Table 39.3 shows that market size (1st priority), labour market efficiency (2nd priority), macroeconomic environment (3rd priority), business dynamism (4th priority) and product market (5th priority) were the five topmost pillars on the agenda of the country between 2018 and 2019. Table 39.1 however, reveals that Nigerian five lowest priorities between 2018 and 2019 were technology (ICT) adoption (12th priority), innovation capacities (11th priority), skills (education and training-10th priority), infrastructure (9th priority) and institution (8th priority).

Table 39.3: Nigerian Policy Prioritisation, 2018 and 2019

WEF's GCI 4.0 with revised indicators	Score (of 100)		Average	Policy Prioritisation
	2018	2019	2018 & 2019	
Institutions	42	41	41.5	*8
Infrastructure	42	40	41.0	*9
ICT (Technology) adoption	26	33	29.5	*12
Macroeconomic stability	56	60	58.0	3
Health	51	47	49.0	6
Skills	40	40	40.0	*10
Product Market	52	52	52.0	5
Labour Market	59	60	59.5	2
Financial Market	44	44	44.0	7
Market Size	71	71	71.0	1
Business dynamism	55	59	57.0	4
Innovation capacities	31	32	31.5	*11

Notes: (1) Higher education and training has been replaced with skills while health and primary education has been separated and replaced with health alone; (2) * denotes the five least prioritised areas of reform in 2018 and 2019.

Sources: World Economic Forum (2018, and 2019)

Nigeria's Five Bottommost Areas of Skill Development (Education and Training) – 2018-2019

Data from The Global Competitiveness Report of World Economic Forum (2018) reveals Nigeria's global rank on education and training (skills) for 2018-2019 in Table 39.4.

Table 39.4: Nigeria's global rank on education and training (skills), 2018-2019

Index	2018		2019		Weakest link
	Value	Rank/140	Value	Rank/140	
Mean schooling years	46.0	105	46.0	105	
Staff training (extent)	44.2	91	44.1	102	
Quality of voc. Training	32.2	137 ¹	30.5	139 ¹	1
Skillset of graduates	32.1	135 ²	29.8	139 ¹	2
Digital skills of Population	38.4	121 ⁵	40.4	122 ³	4
Ease to find skilled staff	46.7	98	49.1	97	
School life expectancy	48.2	133 ³	48.2	117 ⁵	4
Critical thinking in teaching	24.3	131 ⁵	23.7	135 ²	3
STR primary education	31.1	119	31.1	120 ⁴	

Table 39.4 reveals that the five bottommost areas of skill development constituting the weakest links in the chain of development in Nigeria between 2018 and 2019 were quality of vocational training, skillset of graduates, critical thinking in teaching, digital skills of population and school life expectancy respectively. This consistent low priority for education and training (skills), ICT adoption and innovation capacities (including research) in Nigeria is contrary to the global experiences in other countries of the world as reported by Markova (2017).

Nigeria's Five Bottommost Areas of Technology (ICT) 2018-2019

Data from the same Global Competitiveness Report of World Economic Forum (2018) shows Nigeria's global rank on ICT (Technology) Adoption for 2018 and 2019 in Table 39.5.

Table 39.5: Nigeria's global rank on ICT (Technology) Adoption, 2018-2019

Index (ICT adoption)	2018		2019		Weakest link
	Value	Rank/140	Value	Rank/140	
Mobile-cellular telephone subscriptions	63.3	124 ³	73.5	117 ³	3
Mobile-broadband phone subscriptions	n/a	126 ²	N/appl	120 ²	2
Fixed-broadband internet subscriptions	0.1	136 ¹	0.1	136 ¹	1
Fibre internet subscriptions/1000\ pop	n/a	104 ⁵	N/appl	116 ⁴	4
Internet users % pop	25.7	107 ⁴	42.0	102 ⁵	4

Source: World Economic Forum (2018) The Global Competitiveness Report 2018. Geneva: World Economic Forum (WEF)

Analysis of Table 39.5 shows that the five weakest links in the pillar of technology (ICT) adoption prioritised by Nigeria prior (2018 and 2019) were fixed broadband Internet subscriptions, mobile broadband telephone subscriptions, mobile cellular telephone subscriptions, fibre internet subscriptions and internet users per population in that order of weakness.

Nigeria's Five Bottommost Areas of Innovation Capacity 2018-2019

Data, from the same Global Competitiveness Report of World Economic Forum (2018), shows Nigeria's five weakest links in the pillar of innovation capacity for 2018 and 2019 in Table 39.6.

Table 39.6: Nigeria's global rank on Innovation Capacity (including R&D), 2018-2019

Index	2018		2019	
	Value	Rank/140	Value	Rank/140
Interaction and diversity				
Workforce diversity	58.3	64	57.4	70
Cluster development (state)	41.5	94 ⁵	46.3	73 ⁵
International co-inventions	0.2	119 ²	0.1	120 ²
Multi-stakeholder collaboration	34.5	119 ²	37.0	114 ³
Research and development				
Scientific publications	75.0	65	75.9	67
Patent applications	0.1	123 ¹	0.1	124 ¹
R&D expenditures % GDP	9.8	n/a	11.1	n/a
Research institutions prominence	6.5	49	7.2	50
Commercialisation				
Buyer sophistication	37.4	82	36.9	97 ⁴
Trademark applications	50.8	103 ⁴	49.6	n/a

Source: World Economic Forum (2018) The Global Competitiveness Report 2018. Geneva: World Economic Forum (WEF)

Analysis of Table 39.6 shows that the five weakest links in the pillar of innovation capacity in Nigeria between 2018 and 2019 were patent applications, international co-inventions, multi-stakeholder collaborations, cluster development and buyer sophistication.

The analysis done in Tables 39.2-39.6 can be summarised as follows:

- (1) Nigeria's strengths seven years (between 2013 and 2019) prior to COVID-19 have been consistently her big market size, labour market efficiency, macroeconomic environment, market efficiency and business sophistication.
- (2) Nigeria's weaknesses seven years (between 2013 and 2019) prior to COVID-19 have been low levels of national attention to technology (ICT) adoption, innovation capacities (including science and research), skills (from primary education, higher education and training), infrastructure and institution.
- (3) Two years (2018-2019) before the outbreak of the COVID-19 pandemic in Nigeria,
 - (a) the weakest links in the chain of skill development (education and training) in Nigeria were quality of vocational training, skillset of graduates, critical thinking in teaching and digital skills of population;
 - (b) the weakest links in technological adoption were fixed broadband Internet

subscriptions, mobile broadband telephone subscriptions and mobile cellular telephone subscriptions; and

- (c) the weakest links in innovation capacity were patent applications, international co-inventions, multi-stakeholder collaborations, cluster development and buyer sophistication.

Conclusion

From the analysis of the tables, it can be clearly seen that skills (education and training), technology or ICT adoption as well as innovation capacity continue to be weakest links in the Nigeria's development activities. As such the strength of the economy appears to have been determined by its weakest pillars especially the health system, skills from education and training system, technology (ICT) adoption and innovation capacity. A chain cannot be stronger than its weakest link. The pandemic has clearly shown that no matter how strong Nigeria is as far as her market size and efficiency, macroeconomic environment and business sophistication are concerned, a chain will break at its weakest links (in this case the weak health system in Nigeria prior to the outbreak of the pandemic). There is wisdom in improving the strength of the weakest link(s) as to improve the strength of the development chain.

In other words, If Nigeria wants to prepare for future eventualities, she should widen access to qualitative basic, secondary and higher education required to apply knowledge and technologies to solve local problems (and generate values). Also, while she should improve on her efforts at absorbing existing knowledge and technologies, she should strategically prioritise indigenous knowledge, technologies and innovation for socioeconomic development. Furthermore, investment in skills, science, technology and innovation is necessary but not a sufficient condition to enhance the desirable size, speed and spread of national prosperity. Therefore, Nigeria should clear the deficits in institutions and infrastructure to capture, create, protect, adapt and apply knowledge, technology and innovation locally.

Recommendations

Based on the discussions of this paper, the following are recommended:

- (1) To improve access to quality education and training, in preparation of the Fourth Industrial Revolution in Nigeria, the country should craft out measures to upgrade the quality of vocational training, skillset of graduates, critical thinking in teaching, digital skills of population required to apply knowledge and technologies to solve local problems.
- (2) To improve the level of technological readiness for the Fourth Industrial Revolution, Nigeria should develop strategies to upgrade the fixed broadband Internet subscriptions, mobile broadband telephone subscriptions and mobile cellular telephone subscriptions so as to absorb knowledge and technologies to solve local problems.
- (3) To raise the innovation capacities required to function in the era of Fourth Industrial Revolution, Nigeria should develop measures aimed at enhancing adaptation of foreign technologies, creating and protecting new processes and products by increasing patent applications, international co-inventions, multi-

stakeholder collaborations, and cluster development.

- (4) Nigeria should adopt more holistic and inclusive approach to growth and development. Investment in education, skills, science, technology and innovation is necessary but not a sufficient condition to enhance the desirable size, speed and spread of national prosperity. Therefore, Nigeria should approach development holistically by improving institutions, infrastructure and environment to capture, create, protect, adapt and apply knowledge, skills, science, technology and innovation locally to raise productivity, pay wages and compete globally.
- (5) Nigeria missed the third Industrial Revolution. For her to participate actively in the Fourth Industrial Revolution, the country should prioritise and invest in the quality of vocational training, skillset of graduates, critical thinking in teaching, digital skills of population and school life expectancy.
- (6) Technological, especially ICT adoption is a critical condition for competing in the age of the Fourth Industrial Revolution and Globalization 4.0; therefore, Nigeria should consider as a matter of top priority the strategic investment in fixed broadband Internet subscriptions, mobile broadband telephone subscriptions and mobile cellular telephone subscriptions.
- (7) Lastly, to strength her innovation capacity, Nigeria should vigorously pursue measures to double patent applications, international co-inventions, multi-stakeholder collaborations and cluster development.

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