DIGITAL INFRASTRUCTURE, INNOVATION AND YOUTH UNEMPLOYMENT: RECENT EVIDENCE FROM WEST AFRICA

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Abstract

Digital infrastructure and innovation, both of which the youth can utilize to engage with initiatives of countries in promoting economic progress and in relation sustained development, are arguable as being under-utilized especially in West Africa countries despite high levels of access to digital infrastructure and a vibrant youth population with potentials to innovate. Based on the aforementioned, this present study explores the role of Digital infrastructure and innovation for reducing youth unemployment in West Africa utilizing balanced panel data from 2014 to 2023. Engaging panel data unit root test, and Two-Stage fixed effects estimation, the present study found that digital infrastructure boosts innovation that in turn reduces youth unemployment, and thus suggests the need for policies that will enable the maximization of entrepreneurial opportunities on account of digital infrastructure provided and harnessing youth innovation potentials, for addressing effectively high youth unemployment that threatens sustainable development of West African countries.

Keywords: Innovation, Mobile Subscriptions, Sub-Saharan Africa, Sustainable Development, Youth Unemployment,

1. INTRODUCTION

High youth unemployment prevalent in Sub-Saharan Africa (SSA) in general and countries in the West Africa region in particular over the past two decades or so, as highlighted by World Bank (2024) threatens the sustainable development of the countries. Youth unemployment, while prevalent in developed and developing countries, is peculiar to SSA countries in particular as a development challenge (Ebaidalla, 2016). Concerning West Africa, youth unemployment has fluctuated on average between 6% and 10% over the last decade, with higher youth unemployment being anticipated on account of ongoing economic challenges of respective countries and the expectation that addressing the aforementioned challenges will more realistically be achieved over the longer term.

High youth unemployment is adverse for any country on account that it reflects a loss to the country of the opportunity for youths to contribute tangibly to economic progress in general in a number of ways. First, high youth unemployment erodes the high potential of the youth for

productive activity. Second, the youth when unengaged productively are positioned for unproductive activity such as crime, violence and so on that are a consequence of unemployment. Third, high youth unemployment results in the entrenchment of poverty in countries over a sustained period of time. Thus based on the aforementioned, curbing youth unemployment must be a priority for the achievement of economic progress of countries of West Africa with associated implications for sustainable development of the countries.

The opportunities for addressing youth unemployment may be argued as existing through means such as innovation resulting from the provision of digital infrastructure, especially since 2009 when as highlighted by Mensah and Traore (2022) and Warsame (2021) fibre optic submarine internet cables arrived on the sea shores of African countries. The aforementioned is founded on the basis that youth at their young age often between ages of 15 and 24 years are well versed in the use of digital media such as internet, mobile phone and so on, and they are additionally curious and have acquired some training, which informs their high ability for innovation. For instance, there exists a growing trend globally in recent time of school start-ups resulting in highly successful businesses founded on innovation. Further, Juliana et al. (2021) highlight the value of advances in technology for creativity and innovation and also emphasize the essence of creativity and innovation for enterprise success as new ways to improve an existing product or service are discovered, and which will consequently result in the maximization of profits. Also Azu et al. (2021) argue that youths in West Africa will have their employment opportunities enhanced with increased digitalization. On the other hand, pan et al. (2024) emphasizes the need for integrating innovation and entrepreneurship giving rise to innovative entrepreneurship in the context of agriculture.

Digital infrastructure as a concept may be defined leveraging on the definition of digitalization by De Rojas et al. (2024) as technologies originating from technological firms, that are enabled through data and high-speed connectivity. On the other hand, innovation is defined by OECD (2018) as "a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)". Innovation may however be argued to result, having been enabled by digital infrastructure facilitating the acquisition of new knowledge, giving rise to the formation of ideas that are then utilized for gainful activity such as enterprise.

Youth unemployment in SSA countries is a reality and it is expected to rise in the future on account of various factors especially as the countries continue to re-structure for engendering significant growth and development in the future and to adjust to unexpected adverse developments globally. Despite the aforementioned, there exists a paucity of research as to how the potentials of youth to innovate aided by their awareness of digital infrastructure and its diverse uses amongst other factors, and high levels of access to digital infrastructure in a diverse SSA country region as West Africa, can be harnessed to stem the concerning tide of high youth unemployment.

West Africa features high rates of unemployment comprised substantially of youth unemployment in general, relative to other SSA country regions. The aforementioned is on account of most of SSA's population, including that of the youth, concentrated in the West Africa region which features countries as Nigeria, Ghana and Cote D'ivoire together constituting a sizeable proportion of SSAs population and youth population respectively. Also in West Africa are some of the highest levels of use of digital infrastructure as measured by internet subscriptions that in 2023 was 74%,

70%, and 61%, in Cape Verde, Ghana, and Senegal, and mobile cellular subscriptions that in 2023 was 116.04%, 113.04%, 171.99%, 98.81%, 98.48%, and 123.91% in Benin republic, Cape Verde, Cote D'ivoire, Ghana, Nigeria and Senegal, amongst other measures of digital infrastructure as highlighted by World Bank (2024), aided by the close proximity of the countries to the sea underneath which lie the submarine internet cables providing unfettered access to internet connectivity for innovation. Previous studies have not focussed explicitly on linking digital infrastructure to youth unemployment through innovation, with most studies either focussing on linking digital infrastructure to innovation (such as Chandio et al., 2024; De Rojas et al., 2024) or linking digital infrastructure to youth unemployment (such as Ogbonna et al., 2022; Alao & Brink, 2022; Azu et al., 2021; Metu et al., 2020; Oyedemi & Choung, 2018). Thus the present study explores whether innovation aided by access to digital infrastructure may reduce youth unemployment in a panel of West African countries which constitutes the singular hypothesis of the study.

Following the present section, section 2 is the literature review while the methodology is discussed in section 3. Analysis of results is presented in Section 4, and their discussion in section 5. Section 6 is conclusion and implications of findings, while in section 7, limitations of the study and suggestions for further studies are made.

2. LITERATURE REVIEW

Among theories that may be argued as fundamental for explaining youth unemployment in the literature are the sustainable livelihoods approach proposed by Serat and Serat (2017) that argues a sustainable livelihood as a means by which the objectives, scope, and priorities for development activities are rationalised with a premium placed on individual interests, the Technology-Organization-Environment (TOE) Framework that argues digital transformation to lie within the dimensions of technology, organization, and environment, and the Technology Acceptance Model (TAM) that as developed by Davis (1989), describes how users adopt and use new technologies based essentially on perceived usefulness and ease of use.

Empirically exploring the linkages between digital infrastructure, innovation and youth unemployment is of critical importance in recent time especially on account of the potential implications of findings for the achievement of sustainable development goals, and with youth especially central to the achievement of many of the SDGs. Thus, in recent time and in relation to the aforementioned, youth unemployment has been given increased research focus. Basol et al. (2023) find that youth unemployment captured from various dimensions experienced a decline on account of digitalization as measured by a designed Digital Economy and Society Index (DESI) comprising four sub-dimensions: "connectivity", "digital public services", "human capital", and "digital technology integration, for a sample of 27 European countries from 2018 to 2021. On the other hand, Azu et al. (2021) discover that digitization could reduce youth unemployment both in the short and long run, but not convincingly due to low appreciation of digital technologies although the study acknowledges the value of increased digitization for enhancing employment opportunities for the youths in the West African region. Similarly, the potency of digitalization to reduce youth unemployment in the context of SSA as discovered by Metu et al. (2020) depends on the digital technology with mobile phone subscriptions significantly reducing youth unemployment, while internet usage adversely but insignificantly affecting youth unemployment for a sample of 20 SSA countries from 1991 to 2018. Further regardless of whether youth unemployment is that of male or female, Ebaidalla (2017) find for a panel of 17 MENA countries

that mobile phones is insignificant for youth unemployment, while fixed telephones and internet contribute to a decline in youth unemployment.

Among the channels through which digitalization may reduce unemployment is education as highlighted by Mian et al (2022) who focussing on the e–education program offered by the government of Punjab, Pakistan, based on a sample of 416 respondents finds it significant for reducing unemployment of graduates with innovation importantly mediating in the aforementioned association. Further ICT will boost youth employment prospects where the unemployed are younger persons compared to senior citizens as found by Nouffeussie et al (2024) based on evidence from Cameroun where young persons defined as between 15 and 35 years of age are more highly probable to find a job using the internet relative to senior citizens and young Internet users are 15 times more likely to find a job compared to senior employees. Alao and Brink (2022) discover lack of ICT skills, access, income, affordability, infrastructure, poverty gap, inequality, lack of education, lack of access to information, and high demand for IT skills expectations in organizations as among the challenges that hinder youth employability in the South African economy.

3. METHODOLOGY

The present research aimed at exploring the role of digital infrastructure via innovation for reduced youth unemployment in West Africa is founded on the sustainable livelihoods approach that emphasizes the essence of sound policies and institutions for the poor and vulnerable to live meaningful lives. On the basis of the aforementioned and adapting the model of Azu et al. (2021), equations (1) and (2) constitute the model for the present study which is a panel data two-stage estimation given the nature of the hypothesis being tested that innovation aided by digitalization significantly reduces youth unemployment in West Africa. Further the model employs balanced panel data over the period of 2014 to 2023 for eleven out of the sixteen West African countries, as Cabo Verde, The Gambia, Guinea-Bissau, Liberia, and Togo are excluded from the study on account that the countries did not have data available for the period of the study.

$$\mathrm{INNOVATE}_{it} = \alpha_0 + \alpha_1 \mathrm{MCELL}_{it} + \alpha_2 \mathrm{DCRED}_{it} + \alpha_3 \mathrm{GDPPC}_{it} + \alpha_4 \mathrm{GFCF}_{it} + \alpha_5 \mathrm{SSER}_{it} + \alpha_6 \mathrm{INSTQ}_{it} + \upsilon_i + \varepsilon_t \quad (1)$$

$$\mathrm{YUNEMP}_{it} = \beta_0 + \beta_1 \widehat{\mathrm{INNOVATE}}_{it-1} + \beta_2 \mathrm{DCRED}_{it} + \beta_3 \mathrm{TROP}_{it} + \beta_4 \mathrm{GFCF}_{it} + \beta_5 \mathrm{SSER}_{it} + \beta_6 \mathrm{INSTQ}_{it} + \beta_7 \mathrm{AGP}_{it} + \upsilon_i + \varepsilon_t \quad (2)$$

Where, YUNEMP is youth (individuals aged 15 to 24 years) unemployment rate in percentage, INNOVATE is innovation (for which the number of Scientific and technical journal articles is proxy), MCELL is mobile cellular subscriptions per 100 individuals (proxy for digitalization) , DCRED is domestic credit to GDP ratio in percentage, GDPPC is GDP per capita in US Dollars (in real terms), GFCF is gross fixed capital formation in US Dollars, SSER is secondary school enrolment rate in percentage, INSTQ is institution quality (for which the average of voice and Accountability, Political stability and absence of violence, Regulatory quality, Rule of Law, Government effectiveness, and Control of Corruption indices is proxy), $\widehat{\mathrm{INNOVATE}}_{it-1}$is the predicted value of INNOVATE from the first stage estimation lagged one period, AGP is Agriculture performance (using agriculture value added in US dollars as proxy), υ_i is country fixed effects, ε is stochastic error term, α_0 is the constant, and $\alpha_1 \ldots \alpha_6$ are the coefficients of respective

independent variables of the first stage regression (equation 1), β_0 is the constant, and $\beta_1 \ldots \beta_7$ are the coefficients of respective independent variables of the second stage regression (equation 2), i is individual countries (=1 - 11), t is time period (2014-2023),

While the choice of fixed effects estimation employed by the present study is informed by the ability of the panel data estimation procedure to control for time-invariant unobserved heterogeneity across countries, the data was tested before estimation for stationarity using the Levin-Lin-Chu panel data unit root test. All data are sourced from World Bank World Development Indicators and the choice of the period of 2014 to 2023 is on account that over the period, access to digital infrastructure in West Africa had advanced in general.

4. ANALYSIS

The data employed for the present study suggested that while across the panel of West African countries in the present study, all the variables had low values on average, there was significant variation across the variables as evidenced by their sizeable standard deviations. Further, prior to analysis the time series properties of data tested using the Levin-Lin-Chu panel data unit root test revealed all variables were stationary at levels as reflected by their respective P-values all 0.000, thus validating the use of the two-stage panel data fixed effects estimation.

The results from analysis based on equations (1) and (2) revealed from equation (1) MCELL with a coefficient of 8.262, T-Statistic of 2.25 and P-value of 0.027 significant for innovation. Thus Digital infrastructure is significant for boosting innovation in West Africa based on the panel of West African countries in the present study. Further, DCRED, GDPPC, and GFCF all with significant T-statistics at the 1% level of significance found to boost innovation, with all other variables insignificant for innovation. From Equation (2), $\widehat{\text{INNOVATE}}_{it-1}$ with a coefficient of -0.0013215, T-Statistic of -2.73 and P-value of 0.008 was statistically significant for youth unemployment. Thus taken together with the first stage result concerning digital infrastructure and innovation, youth unemployment is significantly reduced by the boost in innovation arising from greater access to digital infrastructure, in West Africa. Also GFCF boosts youth unemployment from equation (2) as its coefficient was 0.080 (wit T-stat and P-value of 2.14 & 0.035), while all other variables are insignificant although institution quality was inversely related with youth unemployment.

5. DISCUSSION

The present study finds support for the central hypothesis that innovation aided by digital infrastructure reduces youth unemployment in West Africa, based on a sample of eleven countries. The aforementioned highlights the importance of both digital infrastructure and innovation for addressing high and rising youth unemployment that further threatens the achievement of countries of sustainable development. Intuitively in West Africa, access to digital infrastructure eliminates barriers to access to skill acquisition for youth which then increases their innovation, and consequently leads to entrepreneurial entry, which reduces youth unemployment. Studies such as Musariwa, and Tinonetsana (2023) and Melak and Derbe (2022) highlight the essential role of entrepreneurial entry for reduction in unemployment. Thus based on the present study, innovation is a channel linking digital infrastructure to youth unemployment decline in West Africa. The aforementioned finding aligns with findings by Basol et al (2023) for a sample of twenty-one European countries and Azu et al (2021) for west African countries, emphasizing the essence of

digital infrastructure for reducing youth unemployment. Further Metu et al. (2020), particularly emphasize the potency for youth unemployment of mobile cellular subscriptions over other digital infrastructure which is supported by the findings of the present study and may be argued to have resulted on account of the prevalence of mobile cellular usage especially among youths in many SSA countries including those of West Africa.

6. CONCLUSIONS AND IMPLICATIONS

The present study explored whether innovation aided by digital infrastructure was of relevance for reducing youth unemployment in West Africa employing balanced panel data from eleven West African countries from 2014 to 2023. The finding of the study in support of the central hypothesis is evidence highlighting the importance of access to mobile cellular subscription amongst other forms of digital infrastructure for addressing youth unemployment as such infrastructure enables innovation by the youth in particular. Hence, West Africa is well positioned to drive sustainable development in SSA as her youth are productively engaged utilizing their skills, and technical know-how enabled by high rates of access to digital infrastructure.

7. LIMITATIONS AND FURTHER STUDIES

The present study while providing valid findings is limited to digital infrastructure as captured by mobile cellular subscriptions, and may suggest the need for future studies to either perform the present study with alternative digital infrastructure such as broadband, or computers, or a composite index comprising various digital infrastructures for the panel of West African countries in the present study.

AUTHOR DECLARATIONS

Author Contributions: Conceptualization, OAO, MCO and CFN; methodology, OAO and CFN; software, CFN; validation, MCO and CFN; formal analysis, OAO and CFN; investigation, OAO, MCO and CFN; resources, MCO; data curation, OAO and CFN; writing—original draft review and editing, OAO, MCO and CFN. All authors have read and agreed to the published version of the manuscript.

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