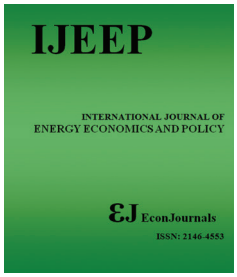

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Effects of Technological Diffusion and Access to Electricity on Employment in Nigeria

Jeremiah I. Ubah, Ebenezer K. Bowale, Jeremiah O. Ejemeyovwi*, Yvonne Okereke

Covenant University, Nigeria. *Email: jeremiah.ejemeyovwi@covenantuniversity.edu.ng

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ABSTRACT

Demographic transitions and technological advancements may lead to a net loss of 5 million jobs by 2020; hence, about 40% (1.4 billion) of the global workforce are vulnerable to unemployment. This is because a more significant percentage of tasks that are already being disrupted by automation are repetitive and standardized processes. At the same time, actions/jobs which require empathy, genuine creativity, and critical thinking will be in high demand in the new workforce, thereby achieving a human-machine collaboration. Thus, this study seeks to investigate the influence that technology has on employment in the Nigerian labor market and how Access to electricity and employment are connected using Nigeria as a case study. The unit root test was conducted via Phillip-Perron (PP) statistics and Augmented Dickey-Fuller (ADF) tests. The Auto-Regressive Distributed Lag (ARDL) model was also employed to evaluate the relationship between technology and employment in Nigeria using World Bank data (1960-2017). Results showed that technology and globalization have a long-run statistically significant inverse relationship with employment in Nigeria, which conforms to theory. Policy recommendations promote the acquisition of such skills encompassing critical thinking, empathy, and creativity to enable a better future for the Nigerian labor force.

Keywords: Employment, Labor, Technology, Globalization, Nigeria
JEL Classifications: O14, E24, J21

1. INTRODUCTION

Technological progress simply means that less work is needed to produce a unit of output. There are conflicting views and expectations about the outcome of increasing automation in the workplace. As the digital world expands, it raises worries of rather complicated catch-ups since the augmenting ambiance for successfully adapting technology rises in its demands. Information technology development is an indivisible section of societal progression, which follows swift evolutions occurring in advanced and developing nations (Onasanya et al., 2010). According to the Information Technology Association of America (ITAA), Information Technology (IT) is elucidated as a collection of thought-ware, software, and hardware utilized in processing improved usage. It combines software industries, business appliances, data processing equipment, alongside associated transmission soft-and-hardware amenities.

Technology has become a part of daily functions in our society, changing rapidly and providing unrestricted mobility (Ejemeyovwi, Osabuohien & Bowale, 2020). It is fast altering global working activities and restructuring labor markets. As employers and employees have become more connected, ICT has equally become indispensable. A lot of opportunities abound from digitalized operations and broader adoption of electronic gadgets. Digitalization offers benefits to all stakeholders in an economy; firms, individuals, and governments alike. However, it has its accompanying risks. There are degrees of digitalization, where a worker is entirely replaced by technology or where a part of a worker's duty is replaced by technology. In 2015, The World Bank Group estimated that the higher a worker's skill set, the easier it is for such a worker to reap the benefits of digitalization. While the less-skilled workers will be most adversely affected by digitalization.

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The intensity of ICT usage, degree of competition, regulatory environments, the quality of human capital, and degree of flexibility of the business environment all vary between developed and developing economies (Ejemeyovwi et al., 2018; Ejemeyovwi et al., 2019). Ikpefan et al. (2018) averred that technological improvements have made the business environment of today witness rapid changes. Strategies aimed at adequately preparing individuals for this emerging phase necessitate the joint efforts of corporations and officials with technologically savvy organizations. In order to cope better with the displacement effect; there ought to be improved platforms to aid work hunting and redeployment (Georgios, 2018; Webb, 2020).

According to the mainstream economic theory of production, labor and capital could be complements to each other in the production process, or they could be substituted one for another in the production process. Technological advancements are not new to humankind. Every improvement in technology has led to a displacement of the existing workforce. However, it has also created a lot of more new jobs that did not exist and which are more economically rewarding than the previously existent ones. According to Keynes (1937), technological advancements lead to 'technological unemployment' as two effects. The displacement effect occurs when workers lose the duties initially performed by them, while the productivity effect increases labor demand in enterprises that emerge from technology advancement.

Electrification degree in rural Nigeria is low when compared to the degree of city electrification. 2007 and 2016, which brings the average rate of rural electrification was about 33.1%, while 84% percent of the city population are electrified (WDI, 2017). The implication is that the majority of the rural dwellers (66.9%) without access to electricity far greater than the electrified (Lawal, Asaleye, IseOlorunkanmi & Popoola, 2018). At the root of this problem that has consumed Nigeria's electricity sector is the huge infrastructural gap. The country's electricity volume positions slightly above 12,000 Mega Watts (MW), but the provision, for consumption after accounting for distributional and transmission losses, floats around 3500 MW–4000 MW. According to the financial Nigeria the electricity needs of developing country was estimated at about 1000 MW per million people, as such, Nigeria will require about 180,000 MW electricity generation for its population of over 180 million million (Lawal, Olayanju, Ayeni, & Olaniru, 2019). This shows that supply is grossly inadequate to meet up with the required demand, a situation that has implication on the level of electricity consumption for the rural population that constitutes more than 50% of the Nigerian population (Blimpo and Cosgrove-Davies, 2019).

The study seeks to the relationship between employment and access to electricity in Nigeria. Also, the study aims to investigate questions about the influence of technology on employment in the Nigerian labour market.

2. LITERATURE REVIEW

Swift technical advancement and innovativeness could endanger employment. These tendencies did not just arise but are traceable to the 1930s when John Maynard Keynes hypothesized his "technological unemployment theory" that technology evolutions emanate in job loss (Keynes, 1937). Innovative technologies influence employability through two significant avenues, either by directly relieving employees from their former duties (displacement effect) or via raising labor demand inexistent and upcoming firms as a result of technological improvements (productivity impact). Autor et al. (2003) emphasize that humans are dispensable by technology in repetitive undertakings, regardless of intellectual or physical dexterity; nonetheless, currently, workers cannot be substituted by innovations in non-repetitive operations.

Venkatesh et al. (2010) employed Socio-Technical Systems (STS) theory to elucidate the mechanism through which ICT implementation in a service-based corporation in India affects work attributes and aftereffects of staff. STS postulation provides a basis for better cognizance of interdependencies between technology and human determinants of contemporary enterprises (Bostrom and Heinen, 1977). STS in company advancement is a path too complicated corporate job patterns that identify the interrelation across persons and technologies at offices. Additionally, it entails the linkages of societal composite amenities with individuals' disposition. Thus, even the community and a large number of subsidiary systems are somewhat compounded socio-technical processes. This socio-technical ideology was formulated by Fred Emery, Ken Bamforth, and Eric Trist during World War II, following their interaction with employees at English coal mines in London's Tavistock Institute.

Socio-technical structures are associated with theories concerning the social dimensions of humans and their environment alongside technological angles of managerial procedures. Socio-technical theory (STT) integrated maximisation with shared accentuation on attaining superior techniques and standards in occupational livelihood of humans. STT differs from STS, and suggests numerous approaches to acquire aggregated utilisation. They are typically dependent on structuring diverse forms of companies where the connectivity among social and technology components emanate in welfare and productivity.

According to Ricardo (1951), perspectives of the working category that using machineries often endangers their personal goals is not based on mistakes or bias but aligns with precise tenets of political economy. Brynjolfsson and McAfee (2011; 2014) opine that structural transition (huge reformations featured by sporadic increment in processing speed of computers greatly influences employment, skilfulness and the entire country) instead of the great recession is the key cause of present occupational challenges. This research has two objectives: exploring economic peculiarities about employment effects of technology adaptations as well as sectorial empirical evidence so as to give enlightenment on changing relationships between globalization and employment. Following this study, employment is explained with macroeconomic variables such as technology demand, globalization, and access to electricity and population growth rate in the Nigerian economy.

In recent years, the impact of technological innovation has helped to solve several problems affecting the power sector in developed

countries. Efficient technology use has great impact on the stability of power supply (Ejemeyovwi et al., 2019). Maintaining stability in power supply and optimizing energy consumptions will lead to efficacy (Oricha and Olarinoye, 2012). A vast amount of the power system equipment in use in various developing countries are obsolete, and as a result, there has been a considerable drop in output. Nigeria is not left out of this. One of the major challenges confronting the Nigerian power system is lack of efficient technology. In some cases, purchasing spare parts for the old equipment becomes an uphill task owing to the fact that they are not technically and economical viable to manufacture. This is not surprising, since power system equipment indices decrease as they age in operation.

With regards to scholarly empirical review, Wet et al. (2016) investigated ICT effects on jobs and individual staff lifestyle. They used a qualitative design for research with a sample of 25 employees. To collect data, semi-structured interviews, which were transcribed, recorded and processed using thematic evaluations. Results showed that good and bad encounters of ICT existed both at official premises and workers' personalized livelihood, hence, greater anticipation emanating from using ICT and its functionality among associated relations. Notwithstanding the generally presumed positive nature of ICT, workers should consciously and adequately manage their ICT infrastructures to minimize detrimental effects on employment and individual activities. The agricultural sector in Nigeria has the potential to stimulate economic growth and even increase the level of employment if it is highly financed to regain its export dominance of products like; groundnut, cotton and cocoa. Technological diffusion has adversely affected the future of labor in the primary sector of an economy, where for example the agricultural practices are being mechanised with various heavy duty machines, processed in computerized factories which has replaced the human jobs with machines (Matthew et al., 2018).

Economies that have employed computerized utilities (ICT) to national dealings have seen the drastic enhancement of progressive endeavors (Ekong et al., 2019). Nations such as a more substantial part of Europe, Japan, Canada, the United States, and Singapore have ICT as a formidable instrument for sustained progressiveness and better administrative government, more inclusive democracy, higher productive levels, regulatory efficacy, and reduced expenses. Even countries that depend primarily on their crude oil production and sale have adopted the use of modern piece of machinery to progressively enhance their production.

A study on electricity access, authored by Dang and La (2019) used a three-round panel data set contains of over 3000 families in countryside Vet Nam to inspect the impacts of electricity dependability development on welfare. The study detected that family income and also changes in income structure as confirmed by ownership upgraded electrical devices response positively to higher electricity quality. The study also prominent that upgraded electricity supply stimulates family investment in land and farming activities; and provokes upward shift in demand for bank credit for farming activities.

Riva, Ahlborg, Hartvigsson, Pachauri & Colmbo (2018) examine the linkages between electricity access and development on rural economies and observed that dynamic and endogenous complexities characterise the nexus between electricity and development in the studied rural economies; and that a causal loop diagram could represent the nature of the relationship between the two. The study noted that for electricity to impact on development, other infrastructural facilities are essential. The study approved that for electricity to affect development, other infrastructural facilities are necessary.

According to Ogunrinola and Osabuohien (2010), globalization brings about higher interconnectivity across global economies. Regardless of international rivalry amongst developing and developed countries, the national degree of competitiveness differs depending on the economy's capability to adjust to necessary alterations. Fosu (2003) and Obadan (2003) believe that poorer developing states lack sufficient competency to leverage upon benefits of international markets. Thus, yielding some contention on matters involving job creation, staff earnings, overhauling work operations, and so on.

In the World Bank Group Report put together for the G20 Employment Working Group Meeting Istanbul at Turkey 2015, technology is seen to be transforming structural linkages of jobs, having consequences for people's uncertainties. Moreover, the bigger threat exists for being outdated. This is defined as the cost level, whereby humans are unable to enjoy technological advantages. McKinsey and Company (2014) predicted that between 1.1 billion and 2.8 billion people have no internet access through cellular networks since their habitat is outside the network coverage areas. Certain divisions exist in societies among various ethnic classes. Females, specifically the elderly, less privileged, and disabled persons, have lower chances of being online. Meanwhile, these set of individuals possess high probabilities of benefiting from electronic accessibility.

This same report highlighted individual public policy attempts that could mitigate the adverse effects of advancing technology. They include: enabling the establishment of broader employment, increasing accessibility to internet-based facilities, empowering workers in an electronic era, and assisting employees through the transformation duration. Normal traditional or brick and mortar practices have been disrupted even in the banking sector which serves as the central hub for channelling funds from surplus spending units to the deficit spending unit of an economy thereby facilitating various trade and settlements with technological channels such as; mobile banking, internet banking and automated teller machine.

3. METHODOLOGY

3.1. Model Specification

For the data analysis, the study uses an experimental research design approach. This approach combines theory with empirical observation and extracts the maximum information from the data available. It, therefore, allows the researcher to observe the influences of explaining changes in the explained variable. This study specifies an employment model that captures the impact on

employment in Nigeria of the demand for technology, access to electrification, foreign direct investment (FDI), and population growth. This paper's model was adapted from Ebaidalla (2016), The implicit model referred to below:

$$EMP = f(TECH, ELE, POP\ FDI) \quad (1)$$

EMP = Employment
TECH= Communications
ELE= Access to electricity
POP= Population growth
FDI= Foreign direct investment

An explicit form of equation 1 is given below:

$$EMP = \beta_0 + \beta_1 TECH + \beta_2 ELE + \beta_3 POP + \beta_4 FDI + \varepsilon \quad (2)$$

The variables utilised in this study and information about the data sources and identifiers are displayed in Tables 1 and 2.

3.1.1. Estimation technique

ARDL Bounds testing technique as proposed by Pesaran and Shin (1999) and Pesaran et al. (2001) is adopted to confirm that long-run relationship is present between technological demand and employment in Nigeria. This method is utilised due to its capacity to tackle relations that involve combinations of I(0) or I(1) variables.

According to Okodua and Ewetan (2013), ARDL process starts with ascertaining the significance of lagged variable coefficients in their error correction model (ECM) via associated F-statistics. Pesaran et al. (1999) gave a table containing relevant critical figures for several volume of regressors to overcome difficulties connected to non-standardised forms of asymptotic distribution for automatically calculated F-statistics regardless of I(1) or I(0) status. Null hypothesis (H_0) asserts that if computed F-stat is below I(0) or lower bound value, then no co-integration (long-run linkage) exists. Notwithstanding, if F-stat surpasses I(1) or upper bound value, then long-run (co-integration) is present among variables (Bello et al., 2020). Therefore, conditional error correction ARDL model to be estimated is as follows:

$$\Delta EMP_{t=} \alpha_0 + \sum_{J=1}^{P} \Phi_j \Delta EMP_{t-j} + \sum_{J=1}^{P} \Omega_j \Delta TECH_{t-j} + \sum_{J=1}^{P} \eta_j \Delta ELE_{t-j+} \sum_{J=1}^{P} s_j \Delta POP_{t-j} + \sum_{J=1}^{P} \psi_j \Delta FDI_{t-j} + \beta 1 EMP_{t-1} + \beta 2 TECH_{t-1} + \beta 3 ELE_{t-1+} + \beta 4 POP_{t-1} + \beta 5 FDI_{t-1+} \mathfrak{U}_t \quad (3)$$

where Δ represents first-difference; p = optimal lag length. H_0 is determined using F-statistics in contrast to H_1, that is, absence vs presence of long-run relationship as elucidated below:

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0 \text{ Against } H_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$$

Once long-run connectivity is established, its related coefficients must be estimated using this model below:

$$\Delta EMP_{t=} \alpha_0 + \sum_{J=1}^{P} \Phi_{j\ j} \Delta EMP_{t-j} + \sum_{J=1}^{P} \Omega_{j\ j} \Delta TECH_{t-j} + \sum_{J=1}^{P} \eta_{j\ j} \Delta ELE_{t-j} + \sum_{J=1}^{P} s_{j\ j} \Delta POP_{t-j} \sum_{J=1}^{P} \psi_{j\ j} \Delta FDI_{t-j} + \O ECMt_1_{+} \mathfrak{U}_t (4)$$

Lastly, every short-run coefficient is linked to temporary dynamisms portraying model convergence to (Ø), thereby representing adjustment measures which reveal how errors emerging within a period are reverted in forthcoming timeframes.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Unit Root Test

Unit root test is executed via ADF and PP test statistics for to verify that no I(2) variables existed, since this would invalidate boundary test results (following the conditionality of co-integrated or mixed I(0) and I(1) dataset. Tables 3 and 4 contain the test outcome of ADF and PP, which are identical as industrial output and unemployment are stationary at I(1). In contrast, inflation and interest rates are integrated at levels. Maximum lags of 2 are selected due to annual data in line with Narayan (2004) and Pesaran and Shin (1999). Akaike Information Criterion (AIC), as recommended by Liew (2004), is used for <60 sample sizes. 2, 2, 1, 0, 0 is the best lag combination that minimizes AIC, as shown in Figure 1.

For the Bounds test result presented in Table 2, the F-stat exceeds all values of both at lower and upper boundaries (that is, I (1)). Thus, the long-run relationship is prevalent.

Table 1: Variables and data sources

Variables identifier	Data source	Measurement
Employment (EMP)	World Bank (2017)	Percentage
Communications, computer. (% of service imports – BoP (TECH)	World Bank (2017)	Percentage
Access to electricity (% of the population) (ELE)	World Bank (2017)	Percentage
Population growth rate (POP)	World Bank (2017)	Percentage
Foreign direct investment (FDI)	World Bank (2017)	Percentage

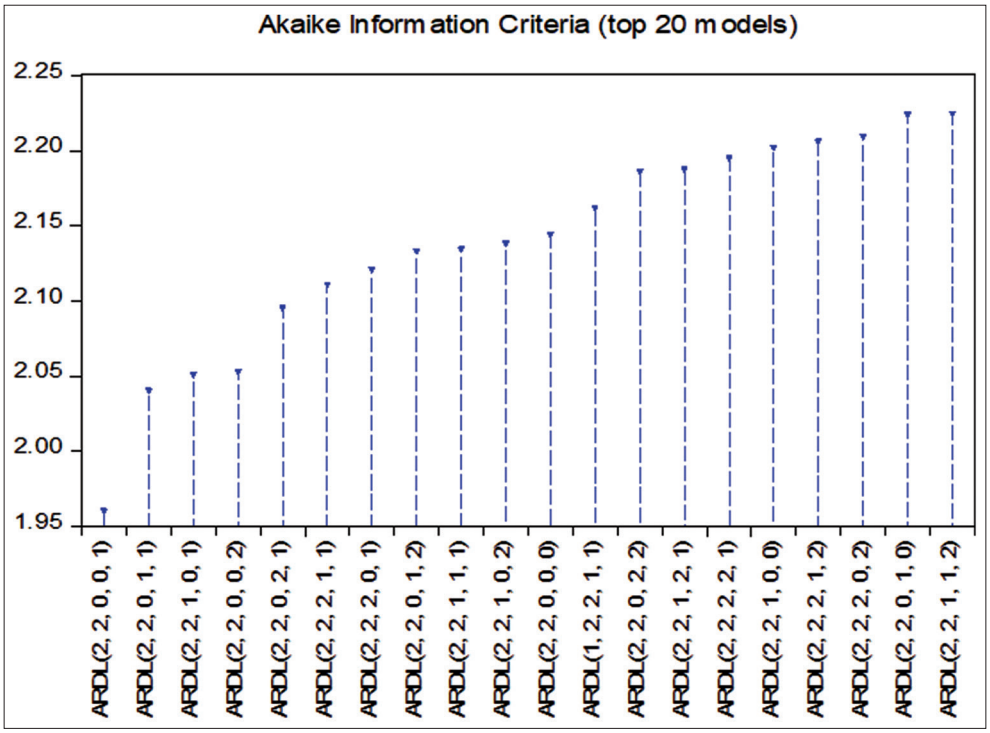
Source: Authors' computation

Table 2: ADF unit root test summary

Variables	Test statistics	Critical value	Remark	Test statistics	Critical value	Remark	Order of integration
EMP	−1.62953	−3.0048	Non stationary	−4.2107	−2.9718	Stationary	I(1)
TECH	−1.629535	−3.004861	Non stationary	−4.210754	−2.971853	Stationary	I(1)
ELE	−1.681991	−3.004861	Non-stationary	−4.804253	−3.004861	Stationary	I(1)
POP	4.148101	−2.976263	Stationary				I(0)
FDI	−3.400430	−2.936942	Stationary				I(0)

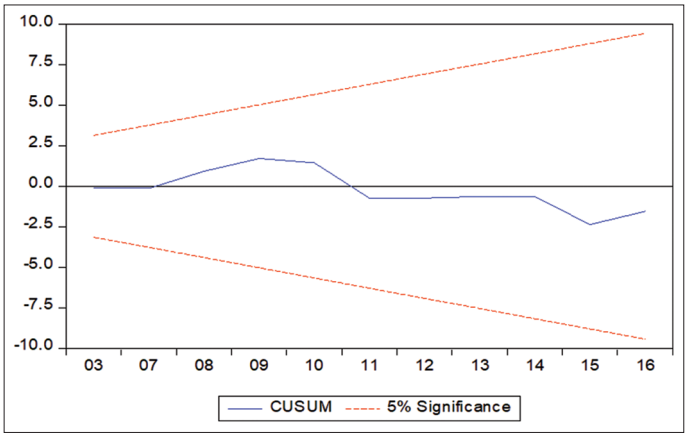
Source: E-views 10 Output, 2019

Figure 1: ARDL model selection criteria



Source: E-views 10 output, 2019

Figure 2: CUSUM stability test



Source: E-views 10 output, 2019

The model's short-term dynamics are shown in the Table 5 below. The model's ECM (adjustment rate) is of significant interest. The rule of thumb states that ECM or CointEq (−1) must be negative and range from 0 to 1. Results reveal ECM results for this specified model as "−0.75," meaning that errors from current time (year) are instantaneously rectified subsequently. V and Okunade (2016) affirm that the presence of parameter stability is an econometric necessity for properly constructed ARDL framework. The cumulative sum (CUSUM) test is used to verify short and long-term coefficient stability The CUSUM tests in Figure 2. CUSUM tests can be seen to be sitting within 5% critical limits. Therefore, ARDL shows parameter stableness. In addition, several other diagnostic tests showed no proof of serial correlation and heteroscedasticity among disorders.

Table 3: ARDL bound test

F-bounds test				
Test statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
			Asymptotic: n=1000	
F-statistic	5.747669	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Actual sample size	21		Finite sample: n=35	
		10%	2.46	3.46
		5%	2.947	4.088
		1%	4.093	5.532
			Finite sample: n=30	
		10%	2.525	3.56
		5%	3.058	4.223
		1%	4.28	5.84

Source: E-views 10 Output, 2019

Table 4: Restricted constant and no trend

Variable	Coefficient	Std. error	t-statistic	Prob.
Communications_ Computer	−0.105	0.029	−3.576	0.004
Access_to_ Electricity	0.008	0.065	0.135	0.894
Population_ Growth	5.406	6.216	0.869	0.403
Foreign_Direct_ Investment	−0.209	0.131	−1.591	0.139
C	0.913	15.35	0.059	0.953

Source: E-views 10 Output, 2019

The statistical result of this study supports Keynes (1936) and Ejemeyovwi and Osabuohien, (2018); while the report negates the empirical tests of technology's impact on sustainable

Table 5: ECM regression: Case 2: restricted constant and no trend

Variable	Coefficient	Std. error	t-statistic	Prob.
D(employment_(−1))	0.477256	0.118509	4.027185	0.0020
D(communications_computer)	−0.027171	0.009613	−2.826491	0.0165
D(Communications_Computer(−1))	0.063216	0.011759	5.375914	0.0002
D(Foreign_Direct_Investment)	−0.302206	0.055585	−5.436869	0.0002
CointEq(−1)*	−0.750762	0.106003	−7.082477	0.0000
R-squared	0.795997	Mean dependent var		0.113762
Adjusted R-squared	0.744996	S.D. dependent var		0.908469
S.E. of regression	0.458758	Akaike info criterion		1.483668
Sum squared resid	3.367339	Schwarz criterion		1.732364
Log likelihood	−10.57851	Hannan-Quinn criter.		1.537641
Durbin-Watson stat	1.976230			

Source: E-views 10 Output, 2019

entrepreneurship (Ejemeyovwi et al., 2019). This contributes to the academic debate of the impact of technology on an economy, in terms of employment, as is this study's case.

5. CONCLUSION AND POLICY IMPLICATIONS

The study carried out an ex-ante analysis to make an ex-post prediction by investigating long run relationship between employment and technology. It also used globalization in form of FDI to explain the employment, so as to understand their effect on the economy and the future of labour as the two concepts are formidable enough to displace labour. Hence, this work utilised ARDL Bounds test approach. An essential discovery shows that Access to electricity is positively and statistically significant with employment in Nigeria. Therefore, it would be prudent for the government to adopt fiscal policy needed to provide adequate electricity supply to the citizenry in order to reduce the unemployment in the Nigerian economy. This provides evidence that as access to electricity. As more people get access to electricity the employment level increases. Access to electricity is a core problem that has lacked adequate response from the government over the years and has been shown empirically as a major factor contributing to the growth of employment in the country. Technology is statistically significant with inverse long-run connectivity with EMP in Nigerian economy, which conforms to theory such as technological evolution stimulates work displacement (Keynes, 1937) also conforms to the idea that technological advancement is good but if it remains imbalanced and mismanaged, it will pose a risk to developing countries like Nigeria due to lack of shared values, benefits and concerns with the producers of technology (Sharma, 2013).

Technology is required to make production more efficient; nevertheless, it generates job insecurity. This is because persons with high skills are being sort after and even graduate jobs are no longer employing fresh graduates (Agbozo et al., 2016). Therefore, efforts should be made to promote acquisition of skill that cannot be replicated by technology such as jobs that demand overly extreme personal characteristics such as inquiries, tactical reasoning, ingeniousness, empathic feelings and communicative mediums. FDI depicts statistical significance negative and long-run relations with EMP in the Nigerian economy. This shows that as globalization increases, employment reduces. So, the government should explore self-sustenance and reduce foreign dependency. Population growth rate indicates positive long-run linkage with employment. These findings imply that continuous advancement of technology reduces the jobs for Nigerians. In order to secure future employment, we need to prepare for the jobs of the future.

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