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Does Internet Adoption Influence Labour Demand in a Digital World? Empirical Evidence from Nigeria.

Abodunde Temitope Titus
Email: temitopeabodunde3@gmail.com

Innovation and Technology Policy Department (ITPD)
Nigerian Institute of Social and Economic Research (NISER), Ibadan, Nigeria

Abstract

The study investigated the relationship between internet adoption and labour demand in Nigeria. The General Method of Moment estimation technique was adopted to analyse quarterly secondary data (1999 to 2020) that were gotten from International Labour Statistics (ILOSTAT) database (2020) and world development indicators (2021). The study found that there has been significant increase in internet adoption and a significant decrease in labour demand in Nigeria overtime. Furthermore, internet adoption has a significant positive relationship with labour demand in the agricultural, industrial and services sectors in Nigeria. Meanwhile, institutional quality measured by government effectiveness ensures gender parity in the demand for labour in Nigeria. This implies that if the government of Nigeria is very effective in this discharge of its fundamental responsibilities, labour demand in Nigeria will not be gender biased. The study further asserted that free flow of information via the use of the internet can lead to easy dissemination of information that can aid production and lead to employment.

Keywords: Digital Era, Endogenous Theory, Government Effectiveness, Institutional Quality, Romer's Model

1. Introduction

In this digital era, several factors have accounted for the inability of the adoption of internet to create sustained growth in labour demand in developing countries such as Nigeria. A major factor is weak institutional structure (Krammer 2016). This is because a weak institutional framework might lead to lack of proper implementation of internet related policies that will translate to increase in labour demand especially in a developing country like Nigeria. Another cause as found by scholars is rapidly growing urban labour force arising from rural-urban migration. Rural-urban migration is mostly explained in terms of push-pull factors which include the pressure resulting from man-land ratio in the rural areas and the existence of serious underemployment arising from the seasonal cycle of climate. This is further aggravated by the lack of infrastructural facilities, which makes the rural life unattractive making youths to move to urban areas with the probability of securing lucrative employment in the industries and to enjoy the available social amenities. Salami (2013) emphasized lack of political will, especially in fighting hard against corruption and enforcing vocational and technical education. Rapid population growth is also considered as one of the major causes of urban unemployment.

However, this study first of all explores the trend of internet use in Nigeria. The number of internet users as a percentage of population was 11.5% in 2010. It later rose to 24.5% in 2015 signifying an increase of about 13.0%. Furthermore, between 2016 and 2020, the figure also grew by 9.23% from 25.67% in 2016 to 35% in 2020 (WDI, 2021). This clearly reveals that internet adoption seems to have witnessed consistent and significant growth in recent times.

In contrast, there seems not to have been corresponding significant increase in labour demand across sectors in Nigeria. Based on ILO statistics 2019, labour demand in the service sector grew by 0.73% between 2000 and 2001 and later fell to 0.82% in 2003. In the same vein, labour demand in the agricultural sector was 48.75% in 2000, it fell to 44.95% in 2005 and further fell to 36.04% in 2017 and 34.97% in 2019. This implies that between 2000 and 2005, labour demand in the agricultural sector fell by about 3.8% and between 2005 and 2019, it fell by 9.98%. Meanwhile, in the industrial sector, labour demand was 12.3% in 2000, it dropped to 11.43% in 2005 and further decreased to 10.25% in 2010 and 10.14% in 2011. This implies that growth in sectoral labour demand has been staggering and infinitesimal.

Meanwhile, this study contributes to the existing literature by accounting for the dynamic effect of internet adoption on sectoral labour demand using a methodological technique (General method of moments) that

accounts for endogeneity bias. The endogeneity bias occurs as a result of the dynamic effect of internet adoption on labour demand and the simultaneity bias that occurs between internet adoption overtime and labour demand. By dynamic effect of internet adoption on labour demand, the study intends to investigate the effects of past adoption of internet (internet adoption overtime) on current adoption of internet and then labour demand. Besides, several studies have established a relationship between past and current adoption of internet (Farooqi 2020, Rhiel 2014). In addition, the analysis will be done on a sectoral level in order to reveal the perculiarity of the nature of labour demand in specific sectors of the economy. (Services, Agricultural and Industrial sectors).

Furthermore, this study adds to the existing literature by investigating the effect of internet adoption on labour demand by gender in Nigeria. The study recognizes the fact that gender differences affect labour demand and therefore analyses the effects of internet adoption on male and female labour demand respectively in services, agricultural and industrial sectors. Several studies have done similar analysis in the developed economies such as Williams et al. 2019 but the analysis was not done on a sectoral level. Also, the study will interact institutional quality with internet adoption in order to examine the effects of internet adoption on labour demand in the presence of institutional quality. The reason for including institutional quality into the analysis is based on the fact that internet can affect sectoral labour demand via its effects on economic growth, therefore, if economic growth occurs within a weak institutional framework, it may not translate to increased sectoral labour demand.

2. Literature Review

This section xrays the extant literature and reveals the contributions of several authors on internet adoption and labour demand.

2.1 Empirical Literature Review

There has been a plethora of studies on internet adoption and ICT-related labour demand. Some of these studies investigated the advancements in the current digital economy. Such studies include Ciriani et.al (2017), Liu et.al (2017), Nicholson (2016) and Van Welsum et.al (2009). Some other studies have examined the effects of internet adoption on macroeconomic variables such as productivity and export competitiveness. They include Atkinson (2018) De Stefano et al., (2018), Holt et.al (2009). Furthermore, there have also been studies on the direct and indirect effect of internet on international trade Hagsten et.al (2017).

Contrary to the perception that internet adoption may have adverse effects such as unemployment to low skilled worker, some studies have validated the opposite effect. Such studies reveal that internet adoption has positive significant effect on labour demand irrespective of the perculiarities of the economy such as economic

development and worker qualification. Although, internet related jobs tend to require high expertise and skills, the potential for the adoption of the internet in economic activities may create significant increase in labour demand.

In addition, several other studies that have also investigated the relationship between internet adoption and labour demand in Nigeria. They include Kehinde (2015), Oladunjoye (2014), Muhammad (2013), Okogun (2012) and Oye (2011). Most of these studies found out that internet adoption positively and significantly influences labour demand in Nigeria.

3. Theoretical Framework and Methodology

3.1 Theoretical Framework

3.1.1 Romer's model of Endogenous growth theory

This study is hinged on the Romer model of endogenous growth theory. The Romer's model regards technology as an endogenous variable as against the exogenous models that regard technology as an exogenous variable. In fact, Solow model of exogenous growth regards technology as a residual. The basic distinguishing factor of the Romer's model is that it regards technology as an input in the production process.

The **formula for basic production function, according to Romer is as:**

$Y_i = AK_i^a L_i^{1-a} K^b$

Where K_i^a is capital, L_i^{1-a} is labour and K^b is technical progress.

3.2 Methodology

3.2.1 Data Sources

The data utilized for this study is quarterly secondary data (1999 to 2019) from international labour statistics (ILOSTAT) database (2020) and world development indicators (2021). The World Development Indicators is a compilation of relevant, high-quality, and internationally comparable statistics about global development and the fight against poverty.

3.2.2 Econometric Specifications

In order to examine the effects of internet adoption on labour demand across sectors, equation 1 is estimated.

$$LSLD_t = \beta_0 + \beta_1 LIA_{t-1} + \beta_2 LGDP_t + \beta_3 INF_t + \beta_4 LPI_t + \beta_5 LINST_t IA_{t-1} + e_t \quad \text{.....1}$$

Where LIA_{t-1} = log of Past Internet adoption

LGDP= Log of Gross domestic product

INF= inflation

LPI=Log of private sector investment

$INSTIA_{t-1}$=Institutional quality (government effectiveness) interacted with log of past internet adoption

LSLD= Log of Sectoral labour demand

The rationale behind the adoption of the GMM estimation technique is to account for the endogeneity bias that may arise between dynamic effect of internet adoption (IA_{t-1}) and sectoral labour demand. Dynamic effect of internet adoption simply means internet adoption overtime and this implies that there is a relationship between internet adoption in the past and current adoption of internet. It is expected that there will be a positive relationship between the dynamic effect of internet and Sectoral labour demand. This is because if internet adoption in the past, will translate to more of internet adoption in the present which in turn lead to increase in sectoral labour demand. This is a novel contribution of this study

In addition, in order to examine the effects of internet adoption labour demand with respect to gender, equation 2 is estimated.

$LGLD_t = \beta_0 + \beta_1 LGDP_t + \beta_2 INF_t + \beta_3 LPI_t + \beta_4 LIA_{t-1} + \beta_5 INSTIA_{t-1} + e_t$ 2

Where LIA_{t-1} = Log of Past Internet adoption

LGDP = Log of Gross domestic product

INF= inflation

LPI = Log of private sector investment

$INSTLIA_{t-1}$=Institutional quality (government effectiveness) interacted with log of past internet adoption

$LGLD_t$ = Log of Gender labour demand

The rationale behind the adoption of the GMM estimation technique is that endogeneity bias may arise between gross domestic product and gender labour demand. Endogeneity bias in this case means gross domestic product influences sectoral labour demand, also, sectoral labour demand can influence gross domestic product. The major difference between model 1 and 2 is that model 2 examines the dynamic effect of internet adoption in the presence of institutional quality on gender labour demand while model 1 examines the dynamic effects of internet adoption on sectoral labour demand in the presence of institutional quality.

Table 1: Table of Variable Description

Variable	Variable description	Source
Internet adoption	Internet users as percent of Population	World bank (2021)

Institutional quality	Government effectiveness	World bank (2021)
Inflation	Percentage changes in price Index	World bank (2021)
Private sector investment	Private sector credit to GDP and broad money as percent of GDP	World bank (2021)
Sectoral labour demand	Sectoral employment	International labour statistics (2020)
labour demand by gender	Sectoral female and male employment	International labour statistics (2020)
Economic growth	Gross domestic product	World bank (2021)

Source: Research Finding.

4.0 Results and discussions

This section discusses the empirical results from the econometric equations estimated via the GMM estimation technique.

4.1 Trend of internet adoption in Nigeria.

There has been significant growth in the number of internet users in Nigeria. For instance, the number of internet users as percent of population was 0.0088% in 1996, it further rose to 0.041% in 1999 and got to 3.45% in 2005. This implies that the number of internet users as percent of population increased by over about 3.4% from the mid 1990's to mid-2000's. Furthermore, by the year 2010, the figure had risen to as high as 11.5%, it later rose to 24.5% in 2015 and 35.5% in 2020. Based on the foregoing, it is clear that the number of internet users per population increased tremendously in the 2000's.

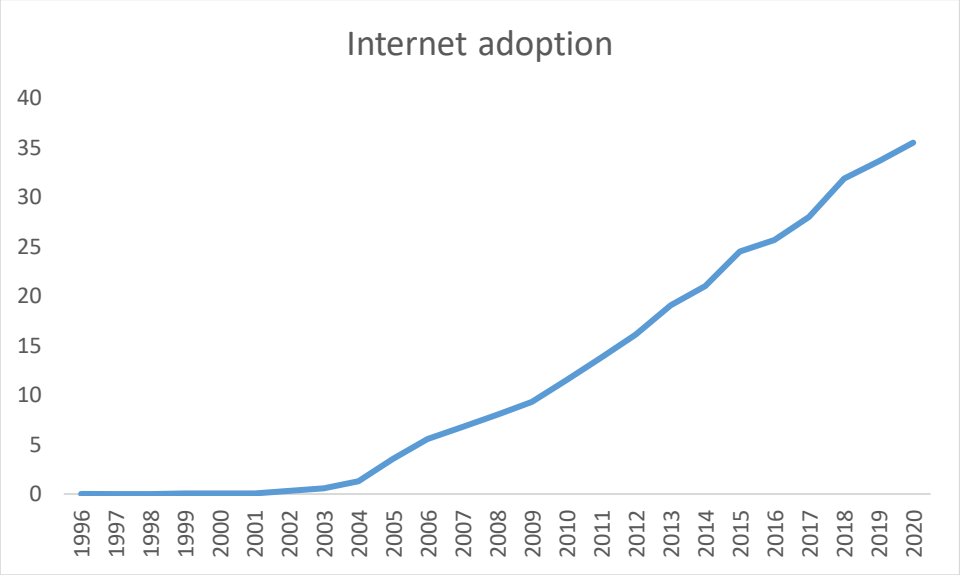

Figure 1: The trend of internet adoption proxied by number of internet users as a percentage of population

Source: Research Finding

4.2 Trend of Agriculture labour demand

The demand for labour in the agricultural sector has been on a steady decline since 1990's. In 1995, the percentage of agricultural sector labour force employment in total employment was 50.18%, it fell to 49.2% in 1999 and further dropped to 44.95% in 2005. This implies that between the mid 1990's and mid 2000's, the percentage of agricultural labour force employment in total employment dropped by about 10%. Meanwhile, the figure later declined to 41.36% in 2010, fell further to 36.93% in 2015 and later on to 34.97% in 2019. This clearly depicts a decline in the demand for labour in the agricultural sector. This is consistent with the findings of Odozi et al (2018), Ajaikaye et al.(2016) and Olomola (2007) that although the agricultural sector is an important source of employment in Nigeria, it has been experiencing a rapid decline in employment share and contribution to GDP since 2001. A plausible explanation for this decline could be the shift of attention of the labour force from agricultural to the oil sector because of the high wages earned in the oil sector. It could also be a result of the failure of the government to provide appropriate funding and adequate infrastructural facilities that will make agriculture attractive to the labour force.

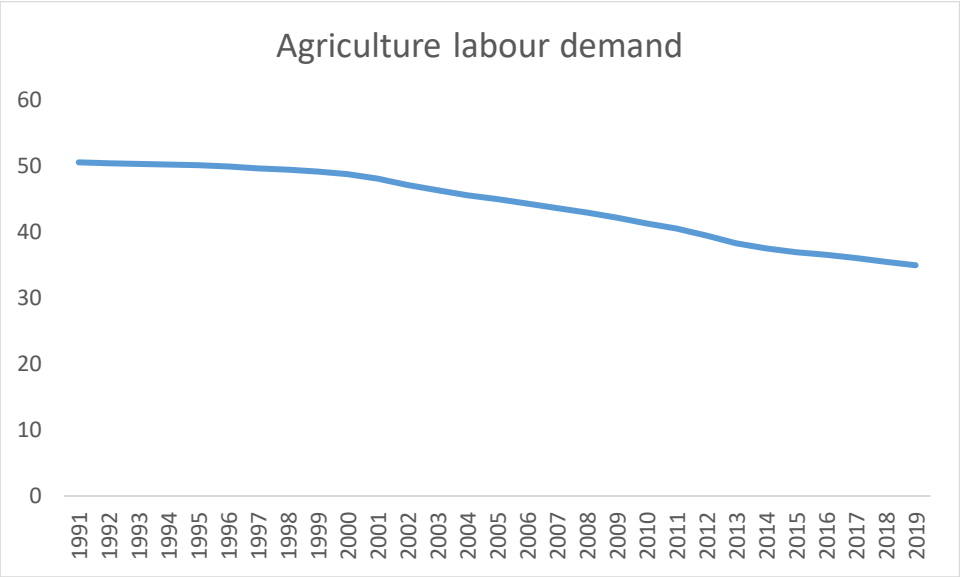

Figure 2: the trend of employment in the agricultural sector as a percentage of total employment in Nigeria

Source: Research Finding

4.3 Trend of Industry labour force

The demand for labour in the industrial sector has also been on the decline since 1990's. This is evident from figure 3 below. The percentage of industrial sector employment in total employment was 13.11% in 1995, it later fell to 12.56% in 1999 and further fell to 11.43% in 2005. Meanwhile, the figure further fell to 10.25% in 2010, 11.93% in 2015 and then slightly rose to 12% in 2019. This clearly indicates that the rate of employment in the industrial sector as a percentage of total employment has been on a steady decline. A plausible explanation for this might be low productivity in this sector which is a result of the infrastructural deficit present in the sector. Infrastructural deficits such as epileptic power supply, bad roads, poor market networks and so on.

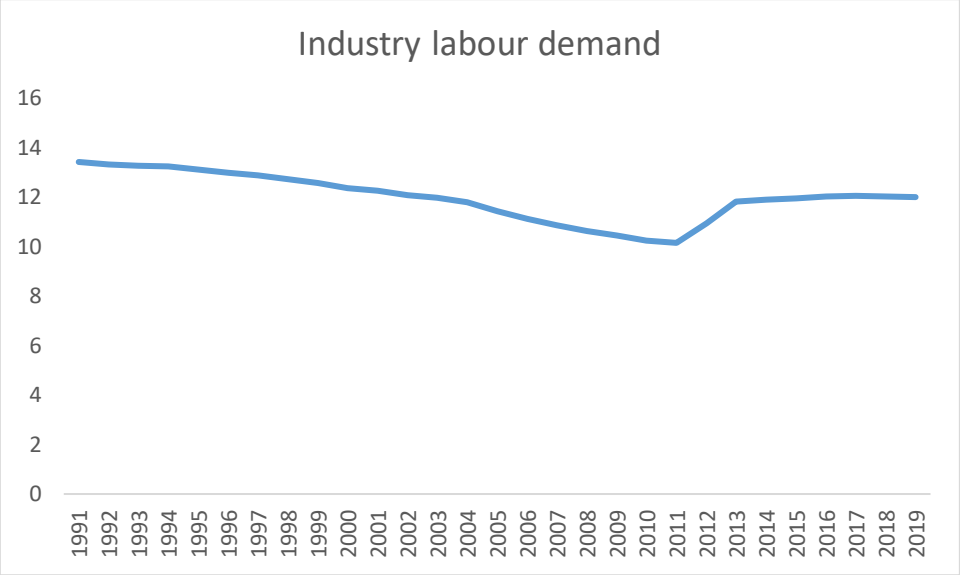

Figure 3: the trend of employment in the industrial sector as a percentage of total employment in Nigeria

Source: Research Finding

4.4 Trend of Services labour force

A critical look at figure 4 reveals that in the services sector, there has been increase in employment as a percentage of total employment. For instance, in 1995, the employment in the services sector as a percentage of total employment was 36.70% in 1995, it later rose slightly to 38.22% in 1999 and further rose to 43.61% in 2005. Afterwards, in 2010, it jumped to 48.38%, further increased to 51.11% in 2015 and 53.09% in 2019. Based on the foregoing, it seems that the services sector has been the highest employer of labour in Nigeria since 2010. This is because, in 2010, the services sector accounted for 48.38% of the total employment and since then has been on the increase while the agricultural sector accounted for 41.36% in the same 2010 and the industrial sector accounted for about 10.25%. It should be noted that while the services sector employment rate has been increasing since 2010, the employment rate of the agricultural and industrial sectors has been on a steady decline thus making the services sector the highest employer of labour in Nigeria.

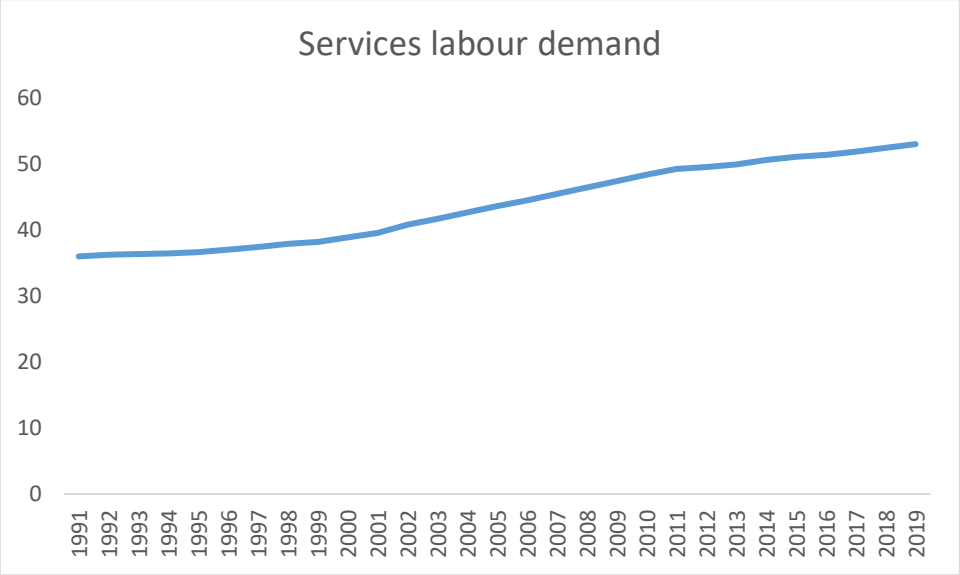

Figure 4: the trend of employment in the services sector as a percentage of total employment in Nigeria.

Source: Research Finding

4.5 Trend analysis of internet adoption and sectoral labour demand in Nigeria

Generally, internet adoption in Nigeria is characterized by significant growth in terms of the number of internet users as percentage of population and mobile cellular subscriptions per 100 people. However, the growth in the adoption of the internet has not succeeded in stimulating labour demand in the services, agricultural and industrial sectors of Nigeria. For instance, according to world development indicator (2021) as shown in the figures above, between 2000 and 2005, number of internet users as a percentage of population increased by 3.44%. It later rose to 8% between 2005 and 2010 and further to 24% between 2010 and 2020. In contrast, growth in sectoral labour demand has been on a downward trend. For instance, labour demand in the agricultural sector was 48.75% in 2000, fell to 47.099% in 2002, further fell to 36.04% in 2017 and even to as much as 34.2% in 2019. In the same vein, labour demand in the industrial sector was 12.35% in 2000, decreased to 12.06% in 2002, further dropped to 12.05% in 2017 and 12% in 2019. However, with regards to the services sector, growth in sectoral labour demand slightly increased. For instance, it was 38% in 2000, it rose to 43% in 2005, 48% in 2010 and also grew to 58% in 2019. (WDI, 2021). This clearly reveals that from the 2000's there has increased growth in the adoption of internet but a retarded growth in sectoral labour demand.

4.6 Effect of internet adoption on sectoral labour demand in Nigeria

The study also conducted a GMM estimation to examine the effect of internet adoption on sectoral labour demand. The results presented in table 1 below reveal that there is a positive and significant relationship

between past adoption of internet and sectoral labour demand. However, it should be implicitly noted that there is a positive relationship between past adoption of internet and current adoption of the internet. The reason why past adoption of the internet is used in the model is because the use of the internet involves learning and learning occurs overtime. This means that, the more the use of the internet, the better the understanding of the operations of the internet and, therefore, the more other individuals will adopt the internet. This then implies that, past adoption of the internet influences current adoption of the internet which then influences sectoral labour demand positively and significantly. This finding is consistent with (Kehinde 2015, Oladunjoye 2014, Muhammad 2013, Okogun 2012 and Oye 2011). Furthermore, gross domestic product exhibits a positive and significant relationship with sectoral labour demand. This implies that an increase in gross domestic product will lead to an increase in sectoral labour demand. A plausible explanation for this is the fact that as gross domestic product increases, the national income of the country increases and therefore the sectors of the economy have enough resources to employ labour.

Meanwhile, inflation was negative and statistically significant in the services sector. However, it was only negative but was statistically significant for the agricultural sector and the industrial sector. This implies that in the services sector, a decrease in inflation will lead to an increase in employment significantly. Furthermore, private domestic investment was significant and positive for all sectors under consideration. This implies that when there is a significant increase in private domestic investment, employment will increase in the agricultural, industrial and services sector. In addition, the adoption of internet in the presence of institutional quality (government effectiveness) was positive and statistically significant. This implies that when there is strong institution (government effectiveness), the effect of internet adoption on employment will be felt more than when the institutions are weak. This is evident in the values coefficient of the variable $INSTIA_{t-1}$ (0.934, 0.811, 0.919) which are higher than the coefficients of the variable IA_{t-1} (0.456, 0.656, 0.551).

Table 2: GMM estimation showing the effect of Internet adoption on labour demand

	LAGLD	LINLD	LSRLD
LIA_{t-1}	0.456*** (0.021)	0.656** (0.231)	0.551*** (0.111)
LGDP	0.565*** (0.023)	0.789** (0.313)	0.414*** (0.123)
INF	-0.543	0.433	-0.345***

	(0.871)	(0.456)	(0.021)
LPI	0.654*** (0.01)	0.554** (0.211)	0.789** (0.312)
$INSTLIA_{t-1}$	0.934*** (0.001)	0.811** (0.123)	0.919** (0.422)
Constant	2.114*** (0.001)	3.231*** (0.002)	0.567*** (0.023)

Note *, **, *** represent 1%, 5% and 10% level of significance respectively

Figures in parenthesis are standard errors

Source: Research Finding

4.7 Effect of internet adoption on labour demand by gender in Nigeria

The study further examines the effect of internet adoption on gender labour demand in Nigeria. The results in table 2 reveals that there is a positive and significant relationship between internet adoption and male employment in the agricultural sector while the relationship between internet adoption and female employment in the agricultural sector in positive and insignificant. The reason might be agriculture is not yet highly mechanized in Nigeria and therefore, employment will be gender biased in favour of males because of the physical strength required. Furthermore, gross domestic product and private domestic investment are positively and statistically related to male employment in the agriculture. This implies that as gross domestic products and private domestic investments increase, male employment increases. Furthermore, the results reveal that a decrease in inflation will lead to a significant increase in male employment. However, when institutional quality is introduced, the result shows that internet adoption influences both female and male employment in the agricultural sector. This implies that with government effectiveness, internet adoption can influence both male and female employment in the agricultural sector because institutions in charge of production and employment in the agricultural sector will be properly regulated and policies will be implemented effectively.

Likewise, in the industrial sector, employment is also tilted towards the male. For instance, internet adoption, gross domestic product and private domestic investment exhibit positive and significant relationship with male employment. A plausible explanation could also be the industrial sector is Nigeria is not highly sophisticated yet in terms of technology rather it is mostly driven by manual or less sophisticated technology. Therefore, there is every tendency that employment will be tilted towards males because physical strength will be much needed production processes. Also, the industrial sectors require the use of sophisticated and heavy equipment

which might be better handled by men. However, with the interaction of institutional quality (government effectiveness) and internet adoption, internet adoption influenced both male and female employment because government effectiveness will lead to gender equity in the implementation of employment policies.

Moreover, with regards to the services sector, internet adoption exhibits a positive and statistically significant relationship with both male and female employment. A plausible explanation is that the services sector does not discriminate between gender when demanding for labour. This might be as a result of the fact that less heavy equipment is not used in the services sector. Furthermore, other variables such as gross domestic product and private domestic investment also positively and significantly both male and female employment. This further reinforces the fact that the services sector is not gender biased in employment. This is consistent with the findings by Williams et al. (2019). In addition, when institutional quality is introduced, internet adoption further significantly influences both male and female employment and it is evident in their coefficients. For instance, before the introduction of government effectiveness, the coefficient of internet adoption was 0.323 and 0.545 for male and female employment respectively. However, with the introduction of governance, the coefficients increased to 0.898 and 0.591 for male and female employment respectively.

Table 3: Shows the effect of internet adoption on labour demand by gender in various sector

	LAGLD		LINLD		LSRLD	
	Male employment	Female employment	Male employment	Female employment	Male employment	Female employment
LIA_{t-1}	0.531* (0.201)	5.221 (4.121)	0.334** (0.111)	0.557 (0.422)	0.323*** (0.012)	0.545** (0.200)
LGDP	0.441*** (0.111)	0.422 (0.303)	0.765*** (0.212)	0.676 (0.422)	0.456*** (0.111)	0.561** (0.211)
INF	-0.341*** (0.002)	-0.717 (0.645)	0.567 (0.618)	0.437 (0.423)	-0.765** (0.312)	-0.711** (0.231)
LPI	0.282** (0.114)	0.123 (0.345)	0.456*** (0.123)	0.717** (0.311)	0.515** (0.123)	0.444 (0.321)
$INSTLIA_{t-1}$	0.856** (0.345)	0.965** (0.456)	0.966** (0.315)	0.543** (0.121)	0.898** (0.322)	0.591*** (0.001)
Constant	0.412*** (0.111)	0.554** (0.212)	0.562** (0.222)	0.444*** (0.111)	0.231** (0.100)	0.321** (0.112)

Note *, **, *** represent 1%, 5% and 10% level of significance respectively

Figures in parenthesis are standard errors

Source: Research Finding

5.0 Summary of findings, Conclusions and Policy Recommendation

5.1 Summary of finding

The main findings of the study are as follows;

- Over the years, there has been significant upward trend in the number of internet users as a percent of population in Nigeria.
- Over the years, there has been significant decline in the number of employment in agricultural sector as a percent of total employment
- Over the years, there has been significant decline in the number of employment in industrial sector as a percent of total employment
- Over the years there has been slight increase in the number of employment in services sector as a percent of total employment.
- Gross domestic product, internet adoption, private domestic investment and government effectiveness positively and significantly influences employment in the agricultural and industrial sector. However, inflation was inclusive in the services sector but inflation negatively and significantly influenced employment.
- Internet adoption, gross domestic product, inflation, private domestic investment and government effectiveness significantly influence male employment in the agricultural sector while Internet adoption, gross domestic product, private domestic investment and governance influence male employment in the industrial sector and Internet adoption, gross domestic product, inflation, private domestic investment and government effectiveness significantly influence male employment.
- Government effectiveness significantly influences female employment in the agricultural sector while government effectiveness and private domestic investment significantly influences female employment in the industrial sector while Internet adoption, gross domestic product, inflation and government effectiveness significantly influences female employment in the services sector.

5.1 Conclusions

The study investigates internet adoption and sectoral labour demand in Nigeria. Specifically, the study identifies the trend of Internet adoption and sectoral (Services, Agricultural and Industrial sectors) labour demand in Nigeria. It further examines how internet adoption influences labour demand and gender labour

demand in the Services, Agricultural and Industrial sectors in Nigeria. The study was necessitated by the fact that despite the significant increase in the number of internet users per population, demand for labour was still on a steady decline. The study asserts that free flow of information via the use of the internet can lead to easy dissemination of information that can aid production and thus lead to employment.

Meanwhile, the study adopted both descriptive and econometric analysis on quarterly data gathered from world bank data base and international labour organization. The study found out that internet adoption will significantly increase demand for labour in all sectors of the economy. The study further found that if there is strong institution (government effectiveness), employment would be created across all sectors without any gender bias.

5.2 Policy recommendation

The study proffers the following policies derived from the main findings of the study.

- The Central bank of Nigeria and the federal government of Nigeria should use monetary and fiscal policies respectively to regulate inflation to its barest minimum since it is clear from the study that a decrease in inflation, other things being equal, will lead to increase in sectoral labour demand.
- The Nigerian communication commission should endeavor internet service providers provide quality services to facilitate free flow of information since it is known that free flow of information can create sensitization and boost productivity and employment.
- Government agencies such as federal character commission and ministry of labour should ensure they implement and regulate employment policies and labour laws in order to avoid gender bias and uphold merit in employment processes.
- The central bank of Nigeria should use monetary policies to regulate interest rates to enable the private sector secure funds for investment purposes. This is because increase in private sector investment will lead to increase in employment in all sectors of the economy.
- The federal government through the central bank of Nigeria should provide loans for agricultural and manufacturing businesses to produce and expand since it is evident from this study that these sectors are experiencing steady decline in labour demand.

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