Labour Productivity, Employment and Output Growth in Nigeria 1990 - 2018

By

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CERTIFICATION

I certify that this work was carried out by Adesoji Oladapo FARAYIBI under my supervision in the Department of Economics, Faculty of Economics and Management Sciences, University of Ibadan, Nigeria.

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DEDICATION

This thesis is dedicated to:

God Almighty in Whom there is no Variableness nor Shadow of Turning.

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Abstract

Labour productivity growth remains an engine of output growth as it increases a country's capacity to create better opportunities for decent and productive employment. However, the link among these macroeconomic variables in Nigeria remains unclear, as reflected in its economic growth pattern, which precludes an increase in employment. Labour productivity in Nigeria averaged N453.89 per hour during the 1990-2018 period. During the same period, output growth averaged 5.26%, while the unemployment rate remained high at an average of 22.45%. Few studies have carried out specific analyses on the variables but paid little attention to the link among them. This study, therefore, investigated the relationships among labour productivity (LP), employment (EMP), and output growth (YG) in Nigeria during 1990-2018.

The causal relationship among the variables was tested using the Granger Causality test. The basic Cobb-Douglas production function, derived from the neo-classical growth theory, provided the framework. A Solow growth model that captured the relationship among total factor productivity, employment, and output growth was explored. The Autoregressive Distributive Lag (ARDL) approach was used. The model incorporated other variables such as labour force (LF), labour force participation rate (LFPR), population (POP), dependency ratio (DR), total hours worked (THW), and unemployment rate (UR). Data were collected from World Development Indicators Database and National Bureau of Statistics' Annual Abstracts of Statistics. Three models (LP-YG, EMP-YG, and LP-EMP-YG) were estimated. Serial Correlation (S-C), Heteroskedasticity (H-T), and Stability Test (S-T) was carried out to ascertain the reliability of the estimates. All estimates were validated at $\alpha \leq 0.05$.

A bi-directional causality existed between labour productivity and employment, indicating a feedback effect between the two variables, while no causality existed between labour productivity and output growth. The LP-YG model results showed that LP (0.65, 0.25) significantly increased YG in both the long and short run. In the EMP-YG model, EMP (0.33, 0.69) had a positive and significant impact on YG both in the long and short run. Further, the LP-EMP-YG model results revealed that LP-EMP (0.55, 0.76) had a positive and significant net effect on YG in both the long and short run. The results of other variables considered depicted that LF (0.01, 0.05), LFPR (0.43, 0.79), THW (0.07, 0.66), DR (0.56, 0.85) and POP (0.43, 0.46) significantly boosted YG both in the long and short-run while UR (-0.26, -0.29) caused a decrease in YG in both long and short-run in Nigeria. The insignificant coefficients of S-C (0.57, p=0.70), H-T (0.77, p=0.80), and S-T of 5% were indicative of a good fit.

There is no interdependence among labour productivity, employment, and output growth in Nigeria. Output growth that emanated from increase in labour productivity did not influence employment. Therefore, there is need for a policy that would allow labour productivity induced growth to boost employment generation in Nigeria.

Keywords: Labour productivity, Output growth, Employment, ARDL, Nigeria.

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CHAPTER ONE

INTRODUCTION

1.1 Background

It is a trite assertion in macroeconomic theorizing that productivity growth remains an engine of economic growth. Obviously, one of the ways that countries are able to sustain the level of output growth needed to predicate opportunities for decent and productive work is through increases in productivity (Trpeski, et al, 2016; Karaalp-Orhan, 2017; McCullough, 2017; Choudhury, 2018 and World Development Report-WDR, 2019). Thus, output, productivity and employment relation represents a *fundamental identity* which is theoretically established to explain how output growth is generated by either productivity growth, employment growth or both. (Landman, 2004).

Output growth is a measure of a country's economic well-being, and it is a good yardstick for classification of countries according to their economic performance. However, an important aspect in the measure of output growth is the efficiency associated with the factor inputs. The productivity of factor inputs determines the link between output and other aspects of the economy including the capital market, money market, labour market etc.[1] Thus, factor inputs must be fully employed to generate the desired level of output growth.

The interaction among productivity, employment and output growth is well defined in the general new-classical framework (see Alani, 2012a; 2012b). First, productivity affects employment through different channels. In the short-run, productivity growth has little effect on employment growth because of the drive towards technological innovations, capital-intensive investments and eradication of mass poverty (WDR,

[1]The productivity of input means the quantity of input needed to produce a unit of output, that is, the ratio of output to input used. Although, the entire production process requires the use of more than one factor input, the common measure of productivity is labour productivity; often defined as the amount of labour input needed to produce a unit of output (Landmann, 2004).

2019). This fulfils the Schumpeter's condition for creative destruction theory[2]. In the long-run, productivity growth increases employment on the pedestal of structural changes in the economy whereby old jobs are lost in declining industries and new jobs are created in the expanding sectors of the economy (Alani, 2018).

However, in the absence of strong industrial base to drive efficiency of factor inputs, high rate of unemployment may induce increased productivity from workers because of the fear of job loss. The feedback effect of the dynamics of productivity on employment nevertheless depends on the employment types and the characteristics of the labour market, and this brews sufficient conflict between real wage and employment growth. Productivity growth can therefore drastically reduce unemployment rates (Camarero, *et al*, 2016).

Furthermore, productivity growth can affect output growth in various ways. An increase in the productivity of workers has positive effect on output growth because, as the efficiency of worker increases, output and investment of firms also increase. This increase in investment (by extension, increase in aggregate demand) leads to increased labour demand, and by implication, increase in employment. On the contrary, if basic Okun's law holds, there can be a trade-off between key macroeconomic variables and unemployment. This implies that, in the long-run, output growth may induce higher unemployment (Folawewo and Adeboje, 2017). Although, a common position in the extant literature is that, output growth does not automatically translate to growth in employment opportunities that corresponds to the growth in the labour force (Bhattacharya, et al 2009).

A recent study by Karaalp-Orhan (2017) argued that the high level of economic growth recorded in developed countries like United States, United Kingdom etc, was linked to rapid and sustained level of productivity growth. Consistent output growth was also driven by productivity boosters such as advancement in technology and capital-intensive investments. Nevertheless, the relationship between productivity growth and aggregate employment generation in these countries had time implications since the output growth recorded involved structural changes that accommodated employment growth in the long run. Also, the country specific analysis of Gordon (1997) emphasized a trade-off

[2]Schumpeter (1934) did a pioneer work in providing the background explanation for the concepts of innovation, creativity and entrepreneurship within the framework of economic theory.

between employment and productivity growth in the developed countries. He emphasized that the employment miracle in the United States was achieved on the basis of low productivity growth.

Improved labour productivity is therefore a panacea for increase in real incomes and improved standard of living since productivity growth has significant implications for the conduct of both monetary and fiscal policies. Although, labour productivity is not necessarily an indicator of the effort of each worker, it offers a useful measure of labour cost as a factor input in the production process (National Bureau of Statistics, 2015). Thus, in the long run, productivity, employment and output growth converge in the same positive direction because productivity growth has a spill over effect on employment and output growth.

In Nigeria, like many other developing countries with large endowments of labour, the relationship among productivity, employment and output growth becomes an issue for serious consideration. An empirical analysis of the impact of productivity growth on employment and output is an important way to understand the dynamics occurring in the labour market. It would also provide relevant insights into the trends of unemployment and output growth in the country for the purpose of achieving major macroeconomic objectives.

1.2 Problem Statement

Labour productivity growth remains a veritable driver of output growth as it increases a country's capacity to create better opportunities for decent and productive employment. A sustained productivity growth is a good channel for increasing the economic prosperity of a country. If this sustained productivity growth is backed by technological innovation and capital-intensive investment, it could have dual effects on employment level - i.e., either create or destroy jobs. However, the link among these macroeconomic variables in Nigeria remains unclear, as reflected in its economic growth pattern, which rather precludes productivity growth or increase in employment.

According to the recent International Labour Organization (ILO) data on estimates of labour productivity in 2019, Nigeria ranked 128 out of the 189 countries surveyed. Nigeria' labour productivity figure averaged 17500 USD per year behind South Africa (43800 USD) and India (20,000 USD) respectively. The countries with higher labour

productivity in the world were Luxemburg, Macau (China), Brunei, Qatar, Ireland and Singapore. For each of these economies, on the average, the GDP per worker is higher than 150,000 USD per year (ILOSTAT, 2019). Thus, low productivity growth has been the bane of the Nigerian economy.

The consequence of low productive output growth is easily perceptible in Nigeria. There is a paradox of high economic growth alongside low employment opportunities in the country[3].The unemployment rate in the Nigeria is high and has continued to increase unabatedly. The unemployment rate in Nigeria was 25.2% in 2014, this increased slightly to 25.3% in 2015. By the year 2016, the unemployment rate in Nigeria reduced to 14.23%. the value however rose again to 20.42% and 23.13% in 2017 and 2018 respectively. These unemployment figures suggest an increase in the number of those that joined the pool of the unemployed population in the country.

The sundry employment strategies in Nigeria had relied largely on factor reallocations rather than productivity enhancement. There had been labour reallocations from agriculture and manufacturing towards the low productive services sector. Therefore, the employment elasticity of growth in Nigeria, though positive, had been quite low; reflecting the country's poor overall employment generation record, especially in manufacturing (Ajakaiye, *et al*, 2016). As a remedy to filling the shortfall in the employment sector, Egwuekwe (2015) projected that Nigeria needs to create more than 50 million jobs in order to achieve the single digit unemployment rate benchmark advocated.

Further review showed that real wage in the country is low because the growth of labour productivity had been offset by high level of unemployment. People settle for jobs with lower wage rates because of the gross disequilibrium between labour supply and labour demand. The level of earnings of a workforce is considered a robust indicator of the livelihood status of the population (Karan and Selvaraj, 2008). Thus, high rate of unemployment has eroded the real wage rates in Nigeria.

Nigeria is a net importer of technology and a dependent nation with poor technological assimilation and take-off. In addition, poor human capital development has limited the

[3] See Agbodike, *et al* (2015); Egwuekwe, (2015) and Ajakaiye, *et al* (2016).

efficiency and productivity level of the workforce in the country. This low level of labour force in Nigeria therefore disproportionately undermines the requirement for sustainable output growth in the country.

To do this effectively, the study raises the following research questions:

- Is there a trade-off between labour productivity and employment in Nigeria, that is, how does labour productivity growth affect employment?
- Does output growth in Nigeria preclude the creation of decent employment? In other words, how valid is the concept of jobless growth in Nigeria?
- What is the linkage among labour productivity, employment and output growth in Nigeria?

Therefore, this study investigates the relationship among labour productivity, employment and output growth in Nigeria.

1.3. Objective of the Study

The main objective of this study is the examination of the relationship among labour productivity, employment and output growth in Nigeria. Specifically, the study

i. evaluates the causal relationship between labour productivity and employment in Nigeria.
ii. analyses the relationship between labour productivity and output growth.
iii. examines the relationship among labour productivity, employment and output growth in Nigeria.

1.4. Justification for the Study

The impact of productivity growth on basic macroeconomic variables has elicited various studies in the empirical literature with focus on both developing and developed countries (See Majid, 2000; Landmann, 2004; Feldstein, 2008; Meager and Speckesser, 2011; Klein, 2012; Yildirim, 2015; Camarero, *et al*, 2016 and Karaalp-Orhan, 2017). Most of these studies either offered inconclusive results or might have suffered from the problem of omitted variables. For instance, Landman (2004) investigated the relationship between productivity, employment and output growth in the United States,

while Wakeford (2004) analyzed the relationship between productivity, real wages, and unemployment in South Africa. However, such empirical study has not received much attention in the employment literature in Nigeria. There is still lack of specific empirical study that examines the employment, labour productivity and output growth relation in Nigeria. This is the empirical gap that this study seeks to fill.

Another development in empirical literature is the ambiguity of employment dynamics relative to productivity growth. Two important dynamics were documented in the literature concerning the nexus of employment and productivity growth. First, it was found that, in the US, increase in employment was accompanied by low productivity. This was ostensibly due to the preference of workers for increased leisure and low number of working hours. Second, in Europe, increase in unemployment was accompanied by increased productivity. This could be due to the structure of the labour market which was perhaps more capital intensive oriented. (Olomola, 2021). These dynamics depict that the employment-productivity linkage is driven by country specific characteristics. Therefore, it is important to provide basic explanation to the empirical linkage between labour productivity and employment in the Nigeria. An understanding of the behaviour of the productivity-employment linkage in Nigeria would shed light on the specific drivers of labour market, and the structure of output growth in the country.

In terms of methodology, a plethora of modelling framework has been employed in the empirical literature to show the effects of labour productivity on output growth and employment. These methodologies could be categorized into descriptive, econometric and macro-econometric methodologies. Some studies used Ordinary Least Square (OLS) method (Agbodike, *et al*, 2015; Yildirim, 2015 and Trpeski, *et al*, 2016), others employed panel cointegration analysis and three-stage least square modelling (Sodipe and Ogunrinola, 2011; Tamasauskiene and Stankaityte, 2013 and Bhattacharya and Narayan, 2015) while others used descriptive analysis or survey method (Meager and Speckesser, 2011; Agbodike, *et al*, 2015; McCullough, 2017).

Some of these methods suffered from estimation bias, most especially, in the presence of country specific characteristics. Besides, very few studies (Umoru, 2013; Karaakp-Orhan, 2017) have employed Auto Regressive Distributed Lag (ARDL) model to examine the link of labour productivity, employment and output growth despite its suitability for such analysis. Therefore, this study employs the methodology developed by Persaran, *et al* (2001) which is based on the ARDL model in its analysis. This

approach has some advantages. First, the bound test allows variables with different optimal lags. Also, it allows for unbiased estimators even in the presence of endogenous variables (Harris and Sollis, 2003).

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Generally, the analysis of output, labour productivity and employment dynamics depends on a number of factors such as the conceptual definition, measurement of variables and the methodology employed. Empirical studies for developed and developing countries often reflect country specific and cross-country characteristics based on the unique features of their macroeconomic variables. It is therefore pertinent to test the relationship among these macroeconomic variables within the Nigerian context to ascertain whether it converges relative to expectations.

Essentially, this study has three innovations. First, it empirically investigates the nexus of employment, labour productivity and output growth in Nigeria using a more robust and recent data from 1980 to 2018. Second, this study contributes methodologically by using a different econometric approach and framework to investigate relations among the variables of interest. This would bridge the weak methodological gap observed in the literature.

Particularly, the findings of a research of this nature will benefit to a lot of people. First, the findings will enable the government, through the Ministry of Labour and Productivity, to come up with relevant strategies to boost the level of employment in the

country. It would also assist the government in understanding the basic drivers of labour productivity growth in Nigeria in order to in organize the country's labour market in a productive manner.

This study becomes handy for international labour organizations, like the ILO, who often gathers country specific information about labour market characteristics. As a pool of information on the pattern of the labour productivity and employment in Nigeria, this study would inform such organizations appropriately in their quest to develop counterpart labour strategies and programmes for developing country like Nigeria. Also, a rich resource like this study will benefit labour market stakeholders such as employers, labour unions, employees as it would provide relevant information on the nature of the labour market in Nigeria. This knowledge would equip them appropriately to undertake informed wage and employment negotiations.

Further research will still be required to explain the dynamics of the labour market as they evolve. Those researchers who intend to undertake such empirical inquiry, the findings of this study would assist their inquiry into the labour market issues in the country. The research findings would also benefit the general reading public who require enlightenments on labour productivity and employment issues in the country. This would enable them have basic knowledge about the workings of the labour market in Nigeria and approach it appropriately from whatever side of the market they belong.

1.5. Scope of the study

The study examines the relationship between labour productivity, employment and output growth using a time series data for Nigeria from 1990 to 2018. This scope was determined by the labour productivity data released by the National Bureau of Statistics (NBS) which started from 1990. Since the study is based on time series data, secondary avenues become the best data source option to undertake the research. However, due to different methodologies or assumptions, these data outlets do not provide similar figures for labour and employment dataset. The NBS data provides a reliable source and overcome these challenges.

1.6. Plan of the Report

This dissertation is organised into five chapters. Following the introductory chapter one, chapter two presents the literature review and theoretical framework. It begins with the profiles the Nigerian context of the important variables in the study while the remaining sections present the review of literature which includes the conceptual issues, theoretical review, methodological review and empirical literature. In chapter three, the methodology for the study is discussed. The results and discussion are the focus of chapter four. Chapter five provides the summary and conclusions.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Profile of Labour Force in Nigeria

This section presents the profile of the labour force in Nigeria in order to describe the distribution of the labour force in the country. This becomes important to explain the employment situation in the country. Basic issues under the demographic description include the distribution of the labour force according to sex, age and dependency ratio.

2.1.1 Demographic Distribution of Labour Force in Nigeria

The gender and age distribution of labour force in Nigeria from 1990-2018 are presented in Table 2.1. Due to data availability, we further undertake a comparative analysis of Nigeria and African region. The sex data was categorized into total, male and female samples respectively, while the age category include the standard ILO age classification namely; 15+, 15-24, 25+ and 15-64 respectively.

A clear picture shown by the demographic profile of Nigerian labour force is that, the distribution of the labour force is skewed towards young population, hence, the high level of unemployment in both the Nigeria and African samples. This data is reflective of the happenings in the African region which shows the problems being faced by countries in the continents. Most of the drivers of this youth unemployment or young labour force include high birth rate, high population growth rates and continuous practices of some indigenous practices such as polygamy. Furthermore, there is also a high rate of teenage pregnancy which increase the rate of unwanted children that could

not be catered for. These children become destitute who constitute nuisance to the society. The problem has not been totally tackled by the African government due to labour market rigidities, political dimensions and weak pace of human capital development in the continents and the pace of technical assimilation in the continent which has the potential to boost the level of productivity in the region.

Table 2.1: Age and Gender Distribution of Labour Force in Nigeria (%) from 1990-2018

Sex: Total							
Age: 15+	**1990-2000**	**2005**	**2010**	**2015**	**2016**	**2017**	**2018**
Africa	14.047	14.047	12.551	12.583	12.628	12.477	12.424
Nigeria	6.1213	6.2213	6.3213	6.4213	6.5213	6.5113	6.5214
Age: 25+							
Africa	10.458	10.458	9.293	9.631	9.648	9.607	9.599
Nigeria	27.1911	27.2911	27.3111	27.0911	27.0211	27.1311	27.0411
Age: 15-24							
Africa	23.346	23.346	21.78	21.672	21.917	21.529	21.398
Nigeria	19.0044	19.0144	19.0244	19.0344	19.0444	19.0411	19.0422
Age: 15-64							
Nigeria	6.1636	6.2636	6.3636	6.4636	6.8636	6.5636	6.6636
Sex: Male							
Age: 15+							
Africa	11.745	11.745	10.185	10.619	10.608	10.5	10.428
Nigeria	6.1031	6.1131	6.1231	6.1331	6.1931	6.1531	6.1631
Age: 25+							
Africa	8.069	8.069	7.2	7.681	7.643	7.639	7.646
Nigeria	4.143	4.241	4.333	4.123	4.643	4.540	4.106
Age: 15-24							
Africa	21.192	21.792	19.091	20.124	20.327	19.995	19.73
Nigeria	18.1009	18.1109	18.1209	18.1309	18.1809	18.1409	18.1509
Age: 15-64							
Nigeria	14.1129	14.1029	14.1229	14.0121	14.1429	14.0125	14.1328
Sex: Female							
Age: 15+							
Africa	17.034	17.034	15.597	15.077	15.182	14.965	14.933
Nigeria	6.1614	6.2614	6.3614	6.4614	6.8614	6.5614	6.6614
Age: 25+							
Africa	13.664	13.664	12.072	12.175	12.252	12.153	12.122
Nigeria	4.0069	4.0169	4.0269	4.0369	4.0969	4.0469	4.0569
Age: 15-24							
Africa	25.194	25.194	24.957	23.48	23.763	23.303	23.32
Nigeria	20.1055	20.1155	20.1500	20.1511	20.1555	20.1522	20.1533

Age: 15-65							
Africa	14.047	14.047	12.551	12.583	12.628	12.477	12.424
Nigeria	7.1029	7.1129	7.1229	7.1329	7.1429	7.1401	7.1102

Source: ILO Estimates from ILOSTAT (2029)

The demographic characteristics of the Nigerian economy during the years under review also considered the dependency ratio of the country. It can be deduced that the structure of the Nigerian population was skewed with the lopsided distribution. As shown, the population of the country increased at the same rate with the number of labour force. Another important feature of the Nigerian population is that, even when disaggregated into working population and dependent population, the population growth rate still remained the same throughout the years under review. The same trend could be said about the growth rate of labour force in the period. However, the increase in the rate of labour force could not be matched by corresponding employment creation because the high rate of unemployment during the period showed this disequilibrium clearly. Based on the demographic characteristics, Nigerian labour force increased drastically and this could have been a good development if there was high labour absorption capacity.

Figure 2.1 shows the trend of the age dependency ratio. This age structure measures the ratio of the working age population to the total population. This ratio has implication on the level of output growth and labour productivity in the country. A higher dependency ratio implies that the country's labour force is skewed and cannot be fully harnessed because the majority is still dependent. As shown from the table, the dependency ratio in Nigeria rose steadily from 1990 up until 2005, with two important points between this period recording the highest value in year 2000 and 2005 respectively. However, from year 2006, the dependency ratio began to decline up until 2014.

This could be due to favourable government policy in form of population control and youth employment strategies which reduced the level of dependency in the country during this period. However, from 2015 up until 2018, the dependency ratio began to increase indicating a relaxation in some of the strategies previously adopted. This shows gross inconsistencies in the execution of government policies due to change administration. Due to political gains, which doesn't want to give credit to predecessor for programme success, most employment strategies are often discarded by current

administration no matter how lofty the ideas might be. This is a major setback and explains the trajectory in the trend of dependency ratio in Nigeria during the years under review.

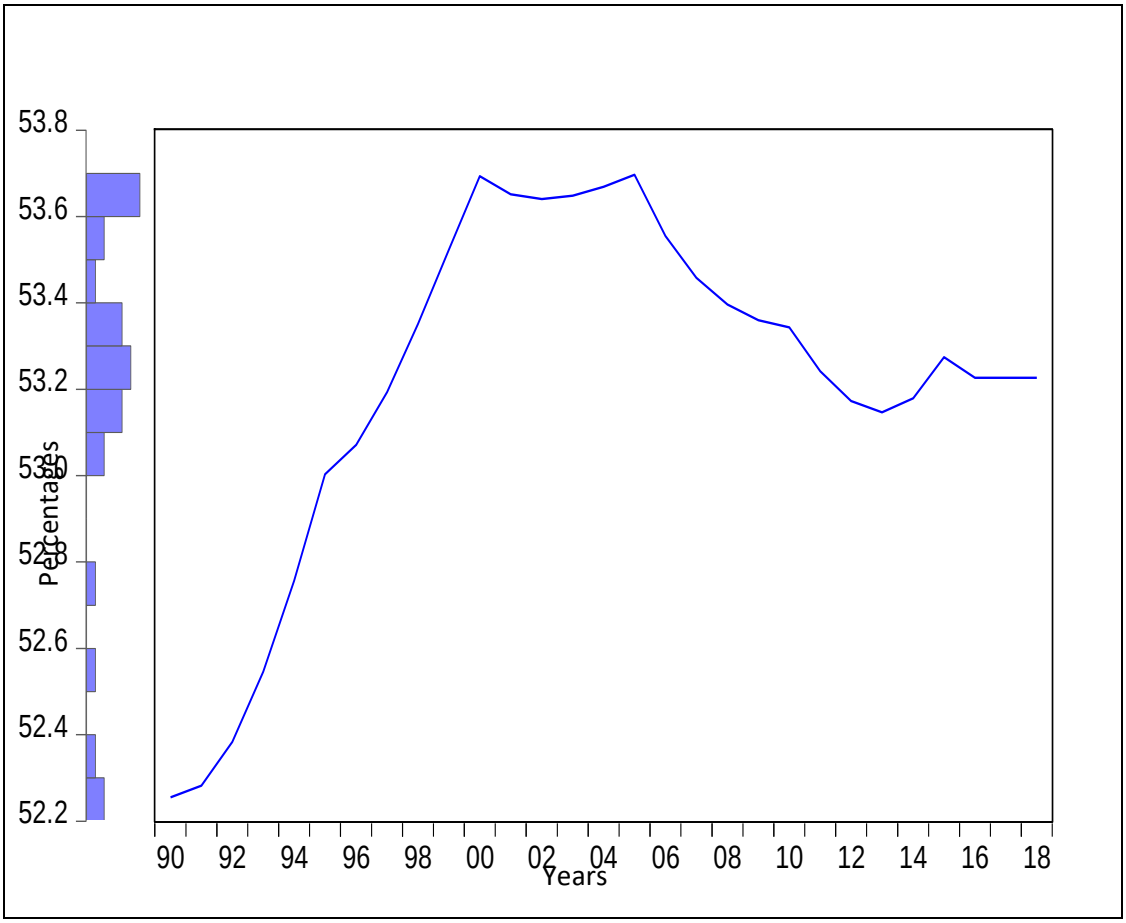


Figure 2.1: Trend of Dependency Ratio in Nigeria from 1990-2018.

Source: NBS Annual Abstract of Statistics (various issues).
KEY: AS = Dependency Ratio

2.2 Overview of Labour Productivity in Nigeria

This section reviews the performance of labour productivity in Nigeria. This provides important statistics on labour force, total hours worked per year, labour productivity and the GDP in Nigeria in order to ascertain the interrelationship among the variables. Labour productivity shows the efficiency of labour force and this has great implication on output growth and employment generation.

Starting with the total hours worked, the statistics presented on Table 2.2 shows that the average total hour worked was 58.47 billion from 1980-1989. This increased to an average of 59.95 billion from 1990-1999 and 83.97 billion from 2000-2009 respectively. The total hours worked increased continuously in 2010, 2013 and 2015 to 128.77 billion, 140.50 billion and 152.06 billion respectively. This upward trend continued in 2016, 2017 and 2018 as the total hours worked stood at 159.40 billion, 167.96 billion and 163.68 billion respectively. Essentially, the statistics shows a consistent increase in total hours worked per year due to the increase in the number of labour force and the distribution of employment across sectors.

Assessing the relationship between total hours worked per year and labour productivity is important to show whether total hours worked reflected its true opportunity cost during the period. As shown in Table 2.2, labour productivity averaged 253.58 from 1980-1989, 312.21 from 1990-1999 and 430.48 from 2000-2009 respectively. This increased to 419.70, 594.83 and 718.14 in the year 2010, 2013 and 2015 respectively. Although, the average value of labour productivity decreased to 713.77 in 2016, however, the value rose to 792.62 in 2017 and 753.19 in 2018. The trend in labour productivity during the study period fluctuated due to factors such as increased labour force as well as better technology. When disaggregated, the driver of labour productivity was sectoral based as productivity level differs from sector to sector. More importantly, labour moved from some declining sectors such as the real sector including agriculture and mining, to low productive service sector. The pattern of productivity and the

structure of the service sector which hampered by infrastructural deficit made the sector weak in employment generation.

The trend of labour productivity and of output growth in Nigeria from 1980-2017. As revealed, output growth averaged -3.41% from 1980-1984, and 0.57% from 1985-1989.

Table 2.2: Trend of Labour Productivity and Man Hour Worked in Nigeria from 1980 to 2018

Year	Labour Force (Million)	Total Hours Worked Per Year (Billions)	GDP (Constant LCU) (Billions)	Labour Productivity (Naira)
1980-1989	29.59*	58.47*	15.68*	253.58*
1990-1999	30.34*	59.95*	20.55*	312.21*
2000-2009	42.49*	88.97*	36.65*	430.48*
2010	65.17	128.77	51.43	419.7
2011	67.25	132.89	55.46	471.94
2012	69.10	136.55	58.18	551.7
2013	71.10	140.50	60.67	594.83
2014	72.93	144.11	63.94	639.34
2015	76.95	152.06	67.97	718.14
2016	80.66	159.40	69.78	713.77
2017	85.00	167.96	68.65	792.62
2018	82.83*	163.68*	69.25*	753.19*

Source: Central Bank Nigeria's Statistical Bulletin (various issues) and Author's Computation

Note: * Implies author's calculation of representative average values.

The value increased to 3.12% from 1990-1994 but dropped to 2.14% from 1995 - 1999. During the same period, labour productivity averaged 253.58 from 1980-1989 and 312 from 1990-1999. Output growth was highest in 2000-2004 which was a double-digit value of 11.55%. Thereafter, it declined continuously to 6.34% between 2010-2014 and this was followed by a recession in the late 2015 with the GDP growth rate of 2.65% and 2016 with a GDP growth rate of -1.62%. However, a positive GDP growth rate of 0.82% was recorded in 2017. However, labour productivity increased to 430.48 from 2000-2009, with the average value of 639 recorded in the year 2015 respectively. Labour productivity rose to 718 in 2015 but decline slightly to 713 in the year 2016. Labour productivity however increased to 792.62 in the year 2017 and fell to 753.19 in 2018.

Despite the increase in labour productivity during these periods, there was still high rate of unemployment in the country. This was because the level of productivity recorded was not sufficient enough to drive employment generation. The only reason for this was that productivity could have increased due to high rate of unemployment. Workers would rather work efficiently as a form of job security (i.e. to secure their jobs) to avoid being fired. This would also imply that for the employed to keep their jobs, they had to combat or settle for low wage which eventually has great effect on living standards.

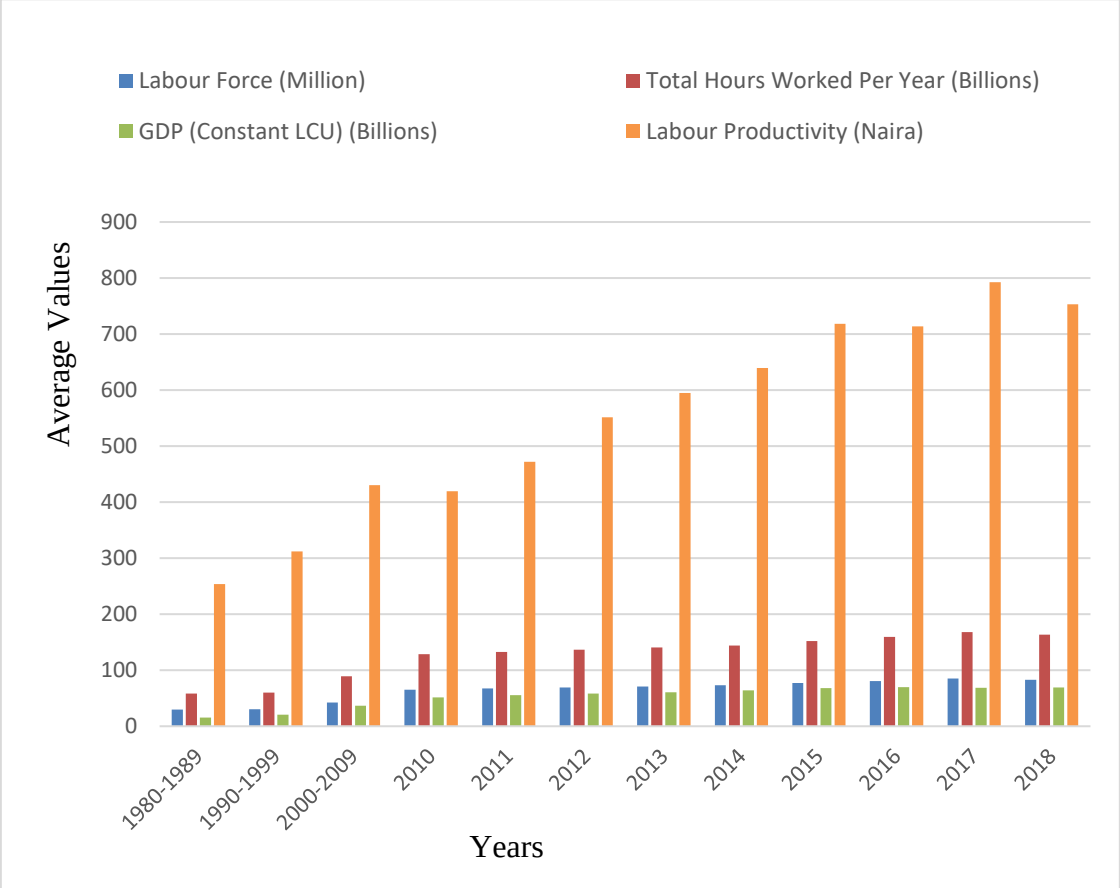


Figure 2.2: Trend of Labour Productivity in Nigeria from 1980-2018

Source: NBS' ABS (various issues).

2.2.1 Labour Force and Employment in Nigeria

This section describes the profile of labour force and employment statistics in Nigeria from 1980-2018. Table 2.3 below presents the data on labour force, unemployment rate, level of employment and labour force participation statistics for the period under study. Table 2.3 shows the level of employment in the country during the study period. As depicted, the employment statistics fluctuated as the rate of employment did not increase at the same pace with the increase in labour force. The effect of this was high rate of unemployment during the same period. This statistic shows a crowd out in the employment sector. This was due to the decline in the sectoral contribution of the agricultural sector to the gross domestic product which used to employ about 70% of the population. Also, the poor industrial base of the country had limited the contribution of the manufacturing and the industrial sectors to employment generation and labour market in Nigeria. This increased the disequilibrium between labour demand and labour supply in the country. Despite the increase in the labour force during the period, labour force participation rate was relatively low. The level of unemployment had affected the extent to which labour participation was possible in the country. This had serious implication for the social and demographic characteristics of the country. Hence, the high rate of social vices, youth unrest, and other attendant problems associated with massive number of idle youths or unemployed population.

2.2.2. Labour Force and Labour Force Participation in Nigeria

Figure 2.3 shows the relationship between labour force and labour force participation rate in Nigeria during the years under review. It revealed an inverse relationship between labour force and labour force participation rate in Nigeria due to the high rate of unemployment. The relationship between labour force and participation rate shows that the menace of unemployment had impacted negatively on the labour participation rate. This had implications for wage rate and living standards as basic human development index in Nigeria were not met during the years under review. The low participation rate also reflected over reliance on the formal sector at the detriment of the informal sector employment, thus crowding out on the opportunities and potentials of the sector.

Table 2.3: Profile of Labour Force and Employment in Nigeria from 1980 to 2018

Year	Unemployment Rate (%)	Employment (%) of Labour Force	Labour Force (millions)	Labour Force Participation Rate (%)
1980-1989	5.6*	28.50*	29.59*	48.76*
1990-1999	5.8*	30.67*	30.34*	50.00*
2000-2009	13.9*	44.11*	42.49*	54.84*
2010	21.1	51.82	48.78	54.94
2011	23.9	52.24	50.06	54.99
2012	23.9	53.73	51.41	55.06
2013	24.9	55.25	52.82	55.11
2014	25.2	56.82	54.26	55.11
2015	25.3	55.25	55.78	55.11
2016	14.23	56.82	57.35	55.16
2017	20.42	68.87	85.00	55.1
2018	23.1	69.54	90.47	55.1

Source: NBS' ABS (various issues).

Note: * Implies author's calculation of representative average value.

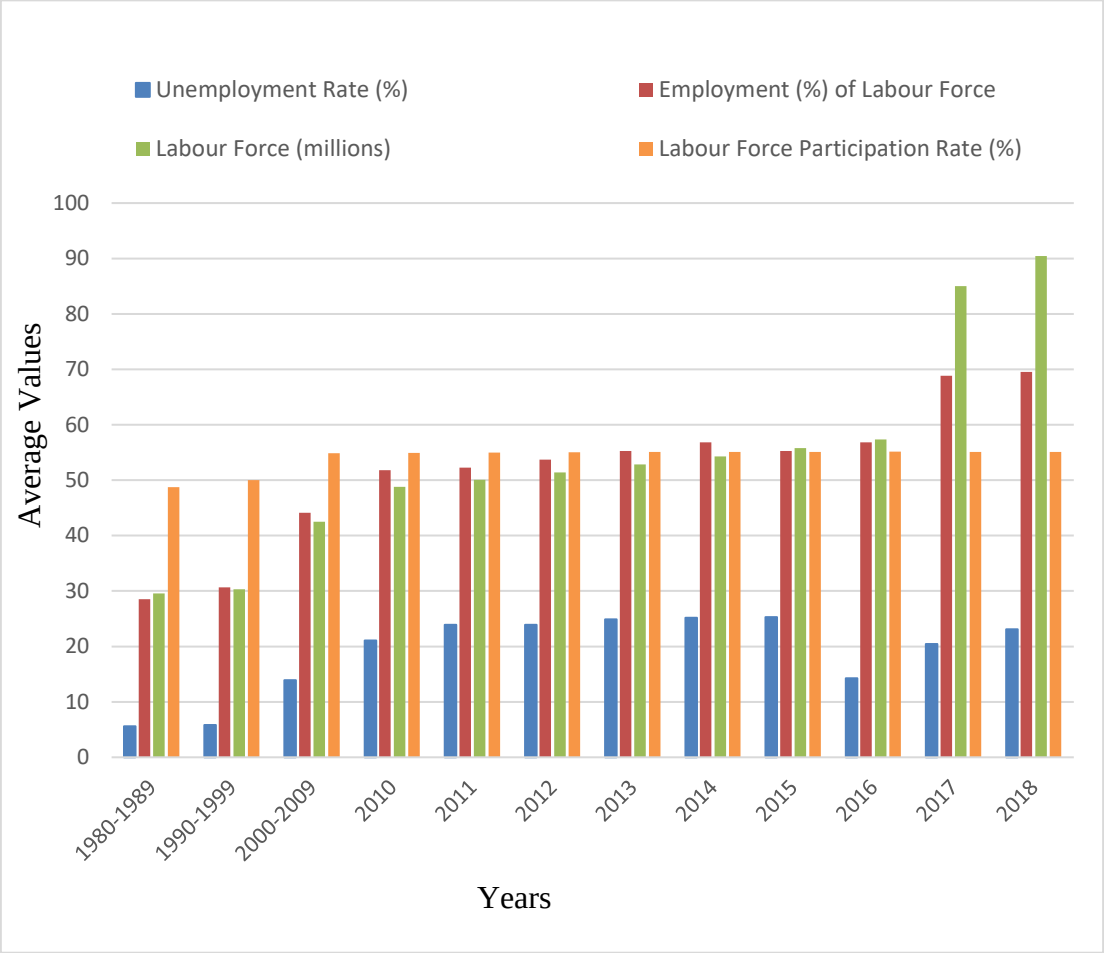


Figure 2.3: Employment and Labour Force Participation Rate in Nigeria from 1980-2018.

Source: NBS's ABS (various issues).

2.3. Overview of Output Growth in Nigeria

The starting point of any analysis of a country's level of economic development is the assessment of the GDP and per capita income. The output level underscores the potentiality of an economy and it serves as an acceptable yardstick to measuring economic performance globally. In a disaggregated analysis, output growth reflects the performance of each sector of the economy, as it reveals the percentage sectoral contributions to the GDP value.

The output growth in Nigeria from 1980-2018, presented in Table 2.4, witnessed a chequered performance. The gross domestic product at constant basic price averaged $124.9billion from 1980-1984 but dropped to an average of $112.9billion from 1985-1989. This was not unconnected with the structural adjustment programmes (SAP) in 1986, which intended to liberalize the Nigerian economy and increase aggregate economic activities from various sectors. Similarly, the GDP averaged $131.9billion, 143.6billion and 186.5 billion between the periods of 1990-1994, 1995-1999 and 2000-2004 respectively. This performance was traceable to the spill over effect of SAP and the sundry policies of the new democratic government with ambitious economic roadmaps such as National Economic Empowerment and Development Strategy (NEEDS), etc.

Table 2.4: The Average Position of Output Growth in Nigeria from 1980 to 2018

Year	GDP growth (annual %)	GDP (constant 2010 US$) in Billions	Agric Value Added (% of GDP)	Industry Value Added (% of GDP)	Manufacturing Value Added (% of GDP)	Service Value Added (% of GDP)
1980-1984	-3.41	124.91	32.97	34.92	9.72	32.12
1985-1989	0.57	112.95	38.12	33.54	7.95	28.34
1990-1994	3.12	131.96	32.55	43.91	5.89	23.54
1995-1999	2.14	143.67	34.32	42.02	5.09	23.67
2000-2004	11.52	186.53	37.05	40.49	3.55	22.46
2005-2009	6.34	301.17	33.47	40.35	2.56	26.17
2010-2015	5.74	407.51	21.89	26.39	8.06	51.71
2016	-1.62	456.77	20.86	18.37	8.77	60.42
2017	0.81	375.75	20.55	22.32	11.6	55.8
2018	2.38	397.26	21.2	22.3	7.8	52

Source: CBN Statistical Bulletin (various issues).

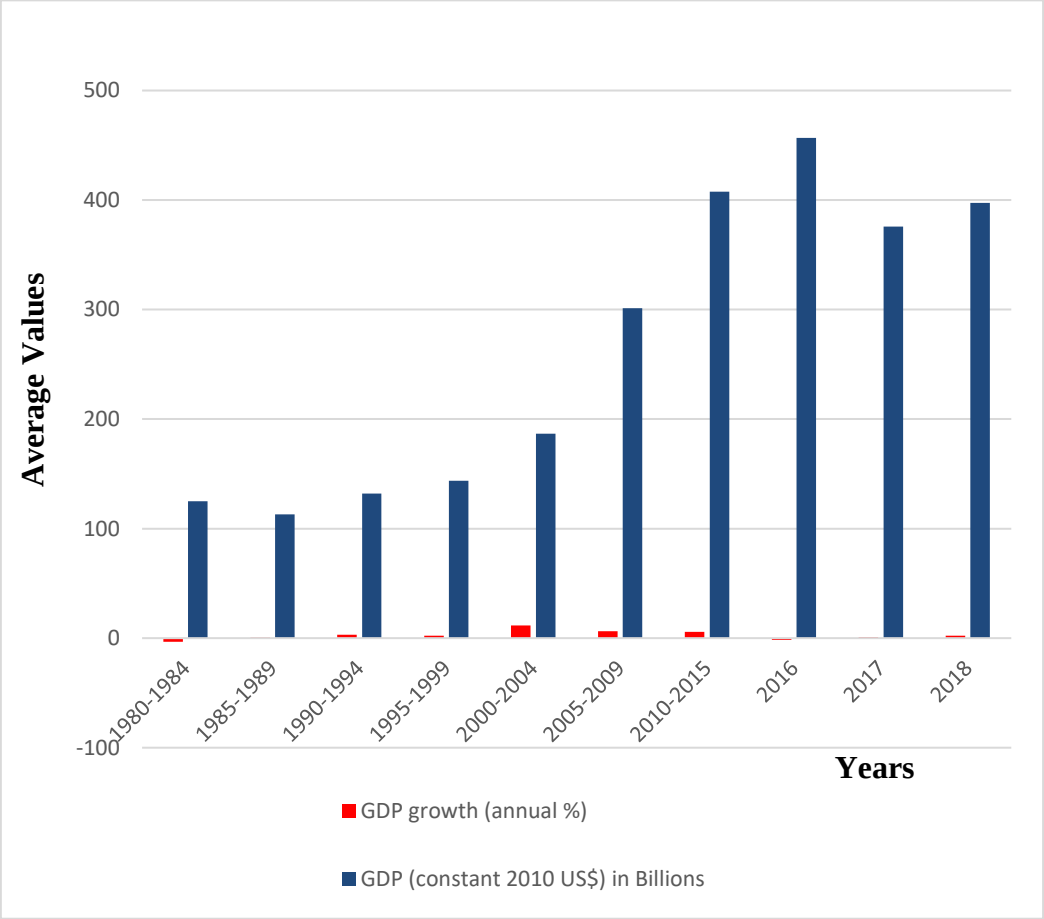


Figure 2.4: Trend of Output Growth in Nigeria from 1980-2018.

Source: NBS Annual Abstract of Statistics (various issues).

2.3.1 Drivers of Output Growth in Nigeria

The drivers of output growth in Nigeria in terms of the share of value added to GDP is discussed in this section. A unique characteristic of this trend was that the share of agricultural sector decreased throughout the period under study. the average share of agriculture value added to GDP maintained this downward movement throughout the periods. The average share of industry value added to GDP implied that at a time, the industrial sector in the country became crowded out and lost its potency or capacity to contribute maximally to output growth in Nigeria. This was traceable to the weak infrastructural base of the country. This also explains why GDP growth is not accompanied by employment growth since industrial sector that has the capacity to absorb labour and provide decent employment has performed woefully. The manufacturing value added to GDP was low throughout the years under study, implying that the manufacturing sector accounted for less than 10% of the GDP. This showed a clear absence of the country's manufacturing capacity and reflected the dependence nature of the Nigerian economy on importation. This percentage increase in the share of manufacturing value added to GDP showed an attempt to revitalize the manufacturing sector and diversify the Nigerian economy from over dependence on importation.

2.3.2 Structural Transformation and the Nigerian Economy

The disaggregated analysis of the country's GDP at constant basic price revealed an evidence of structural transformation in the Nigerian economy; that is, a shift in the pattern of sectoral contributions to the GDP was recorded in these years. A cursory look at the information presented on Figure 2.5 below reveals that there was a structural shift from agricultural sector, which was formerly the mainstay of the Nigeria economy; towards industry, manufacturing and service sector. The agricultural sector which used to contribute about 32% of the value added to GDP and accounted for about 70% of the employment declined in its performance during the year under study. This could be due to the neglect of the agricultural sector because of the windfall from crude oil exploration which now accounts for about 70% of government revenue.

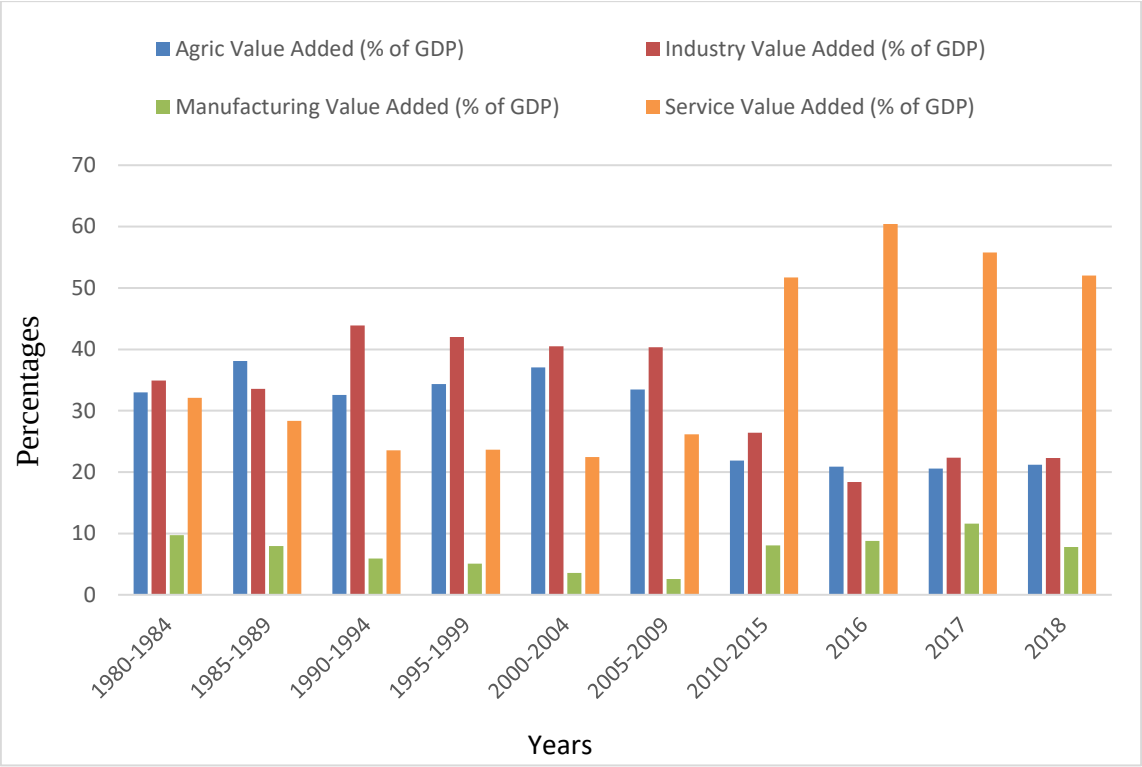


Figure. 2.5: Trend of Structural Transformation and the Nigerian Economy from 1980-2018.

Source: CBN Statistical Bulletin (various issues)

A clear shift in the structure of the Nigeria economy depicts an increase in the percentage contribution of the service sector to GDP. This could be due to the liberalization of the telecommunication sector whereby the operation licenses were given to service providers to further open up the sector. Another potent reason for the percentage change in the contribution of service sector was the recapitalization of the banking sector. This deliberate effort of government improved banking operations in Nigeria and increased their capacity to provide corporate banking, consumer banking and other financial products.

This also increased the sundry economic activities in that sector and reduced the numbers of unbanked percentage of the population. The cumulative effect of this milestone had thus increased the percentage contribution of the service sector to the GDP. In addition, a noticeable contribution of the sub-sector to GDP was recorded by the entertainment industry. Despite the poor percentage contribution to output growth recorded by other sectors of the economy, the entertainment industry continued to blaze the trail by increasing its share of value added to the GDP, even during economic recession in Nigeria.

Conclusively, as revealed from the general overview of the trends in employment, productivity and output growth in Nigeria, empirical relationship among these variables is country specific. During economic downturn, firms would downsize and keep workers just to maintain the current production level. During boom (that is, when the demand for goods increases), firms respond in various ways. They can either increase employment by hiring more workers or make the employed workers work harder; thus, aggregate increase in productivity would lead to output growth. But Figures do not depict this relation in Nigeria. Rather what we saw was output growth going *pari persu* with unemployment growth and low productivity. Output growth in Nigeria appears to be driven by factor reallocation rather than labour productivity, hence the high rate of unemployment in the county. Increases in productivity should lead to increases in output sufficient to maintain or even increase employment in the short run.

2.3.3 The Fundamental Identity

The fundamental identity is an expression used to describe the theoretical linkage among output growth, productivity growth and employment growth. According to Landman (2004), it is not feasible to think of employment, productivity and aggregate output as independently determined variables. If productivity is measured as output per person or output per hour worked, i.e., as the productivity of labour input, the three variables are linked. Thus, the fundamental identity can be expressed as:

$$\text{output} = \text{employment} \times \text{productivity}.$$

For small rates of change, this can approximately be translated into the following relation:

$$\text{output growth} \sim \text{employment growth} + \text{productivity growth}.$$

This means, for instance, that any given rate of output growth can be achieved either with high productivity growth and low employment growth, in which case the employment intensity of economic growth is said to be low or, conversely, with low productivity growth and high employment growth (a high employment intensity).

A cursory look at the data presented in Figure 2.5 shows the trend of labour productivity growth, employment growth and output growth in Nigeria. The trend of output growth during the year under review showed a great fluctuation. As shown, the growth rate of output was in 3.12% from 1990-1994 but dropped to 2.14% from 1995 - 1999. The highest output growth rate during the years under study was recorded from 2000-2004 which was a double-digit value of 11.55%. Thereafter, output growth rate declined continuously to 6.34% between 2010-2014 and this was followed by a recession in the late 2015 with the output growth rate of 2.65% and 2016 with a output growth rate of -1.62%. Thus, a negative output growth obtained reflected price fluctuations and high inflationary drives due to some policy shocks and the poor management of the economy by the political class. A path to recovery was opened in the year 2017 and 2018 when a positive growth rate of 0.85% and 2.38% was recorded.

Labour productivity was seen to be the most volatile of the three variables during the year under review. This was followed by output growth and then employment growth. As shown on the graph, the highest values of labour productivity growth were recorded in 2004, 2012, 2015 and 2018 respectively while the lowest point was recorded in the year 2010.

The main story that the trend of labour productivity growth during the years under review is telling is that the graph shows high volatility of labour productivity growth compared to employment and output growth. The main factor driving labour productivity growth in Nigeria was the growth in the service sector. A remarkable increase in labour productivity growth started in early year 2000, which coincided with the influx of the telecommunication companies into the country due to the liberalization of the communication sector. This di-investment in the TELECOMS sector to allow private participation, increased the level of efficiency in the service sector, and hence the level of labour productivity. Also, the improvement in the service sector was a signal to employment, wage rate and labour reallocation from other sectors in the country, most especially from low productive agricultural sector. However, the fall in the labour productivity growth, most especially in the year 2016, was driven by the economic recession that the country witnessed. this disrupted several productivity channels such as loss of employment and low income and real wages.

The graph also shows the trend of employment growth show the least volatility amongst the three variables. The slow variability implies that the country was witnessing high employment intensity of economic growth. Also, in these periods, the Nigerian labour market underwent problems of unemployment, public sector down-sizing, low employment generation capacity, government contradictory discretionary policies and a sort of mismatch between labour demand and supply. The demand for labour is derived from production and distribution activities in the goods and services sectors.

Figure. 2.6: Labour Productivity Growth, Employment Growth and Output Growth in Nigeria from 1980-2018.

Source: CBN Statistical Bulletin (various issues)

2.4 Conceptual Issues

This sub section discusses the conceptual issues surrounding the variables of interest. It begins with the concept of productivity and its measurement. This is followed by the concept and measure of employment and output growth. This becomes necessary to have a better understanding of these concepts as used in this study.

2.4.1 Concept of Productivity

The conceptualization of productivity stems from a multidisciplinary perspective as it is viewed differently by many people. Productivity is a very vital concept because it is of interest to many stakeholders such as government, trade unions, social institutions etc. Productivity is directly linked to a country's level of growth and development, and invariably determines the wage rate, employment level and standard of living, among others. According Krugman (1990), in the long-run, almost everything in an economy is woven around productivity.

What then is productivity? Perhaps it would be in order to start from what productivity is not, that is, clarifying some misconceptions in the conceptualization of productivity as identified in the literature, which is probably due to its multidisciplinary nature. Oyeranti (2014) identified three concepts often misunderstood as productivity. First, productivity is viewed as output growth or performance; but there is a clear difference between the two concepts. Output may be increasing without a corresponding increase in productivity, if perhaps input prices becomes indiscriminately so high. To avoid this misconception therefore, Sumanth (1984) suggested that output growth must be related to the general price level and level of inflation. In addition, he suggested that the term *productivity growth*, defined as the rate of growth in the level of productivity, should be used to classify increases in productivity and output level.

The second misconception identified in the literature is the confusion between productivity and profitability. Again, this is wrong. Profitability is achieved when a firm recovers its costs and this may not depend on the level of productivity. This distinction makes it possible to have a high productivity level without a corresponding change in profitability, most especially if there is no demand for goods produced with high level of effectiveness and efficiency.

Third, productivity is often confused with efficiency or effectiveness. Efficiency is defined as producing high quality goods in the shortest possible time while effectiveness means generating more results from using the same unit of input. Goods may be produced efficiently without actual demand for them. Also, effectiveness means making more profits or maintaining the current level of market share. In a nutshell, in defining productivity, efficiency implies the denominator (input) and effectiveness implies the numerator (output).

With the semantic confusion removed, defining productivity can begin from the business management viewpoint. Productivity means a measure of overall production efficiency, effectiveness, and performance of an industrial organisation. Productivity is used to describe quality of output, workmanship, adherence to standards, absence of complaints, customer satisfaction, absenteeism and turnover rates, absence of work disruption, trouble and other evidence of difficulty in organisations. It basically measures the quantity of units produced or volume of sales made (Udabah, 1998; Diewert, 2001). This definition tends to portray productivity only in terms of the parameters that meet the profitability objective of the firm.

The concept of productivity is better described as being shrouded in the economic theory of the firm. It is used to represent the ratio of output to input. As described by Owong (2010), productivity expresses the ratio of output to the most limited or critical input while holding all other inputs constant. To Udabah (1998), productivity is defined as a ratio of a volume measure of output to a volume measure of input use. To Eatwell and Newman (1991), productivity is defined as a ratio of some measure of output to some index of input used. This means the arithmetic ratio between the amount produced and the amount of any resource used in the production process. According to the Centre for the Study of Living Standard (CSLS, 2008), productivity is defined as 'the relationship between output of goods and services and the inputs of resources, human and non-human used in the production process, with the relationship usually expressed in ratio form'.

In the First-Time-Visitors analogy of Imoisili, *et al* (2004), productivity level in a country is best felt by the contact of a first-time visitors with the first set of workers on their first day of arrival in that country. Suppose the group of visitors arrived by air, they would meet the airport ground staff who would ensure speedy transfer of

passengers to the arrival hall. This would be followed by relevant documentation with the immigration and customs officials. Before going into town, the visitors would need to have some local currencies, hence visit a nearby bank or bureau de change. They then take public transport or a taxi to navigate the town to check in an hotel. On the way, they would assess the road networks and traffic lights, traffic flow, the emissions from vehicles, billboards/advertisements, the disposal of solid waste, and so on. When they finally get to their chosen hotel, the receptionist or hotel staff checks them into their rooms. As the visitors reviews their experience after settling down in their rooms, two expressions or emotions are possible; they may either complain bitterly if they are not satisfied with the experience so far or exclaim with a giggle if the experience had been fantastic (ILO, 2002; Imoisili, *et al*, 2004).

The three factors that could have helped the visitors to arrive at their conclusion include the observed (i) attitude to work (ii) speed of work and (iii) the price and quality of their output. These explain whether the staff were friendly, time conscious or whether the treatment of passengers' luggage, level of fares, quality of service, level of technology and the general environment was not below expectations. Hence, just within a day of interaction, the First-Time-Visitors had gathered enough information to form an opinion about the level of productivity in that country. The significance of this analogy is that productivity actually determines the overall efficiency of an economic system and this has ripple effects on every sector of the economy.

Given the various conceptualization of productivity, this study like Udabah (1998) and Oyeranti (2014), defines productivity as a ratio of a volume measure of output to a volume measure of input used. This definition is selected for two main reasons; first, it is the most commonly used definition of productivity in the literature and second, it depicts productivity in terms of the efficiency associated with the factor inputs.

2.4.2 Measure of Productivity

Productivity measurement is of great interest to many stakeholders because if its potentiality. Most especially, four main objectives come to mind whenever

productivity measure is concerned. First, productivity is measured to trace technical change of an economy, that is the potency of the currently known way of converting resources into desired output of the economy (Griliches, 1987). Second, productivity is measured to identify changes in the level of efficiency. This includes achieving both technical efficiency and allocative efficiency. Third, measuring productivity growth becomes necessary to identify real cost savings in production. This is achieved with increase in capacity utilization, learning-by-doing and reduction in measurement error of all kinds (Harberger, 1998; Giovannini and Nezu, 2001). Finally, and perhaps the most pragmatic objective is that measuring productivity is a key element towards assessing the standards of living. For instance, per capita income varies directly with one measure of labour productivity i.e. value added per hour (Chowdhury, 2018).

There are different measures of productivity identified in the literature. The choice between them depends on the objective of productivity measurement and of course, on the availability of data. The following are the different productivity measures:

a. Partial Productivity Versus Total Factor Productivity.

Various factor inputs are used in the production process. These factors contribute different percentages to the level of output achieved. Some factors contribute at a greater proportion to output level while others perform complementary roles during the production process. The best way to assess the contribution of each factor in the production process is to access their individual levels of productivity. The productivity of the individual factors of production is called partial productivity. Partial productivity is defined as the ratio of output that is obtained by engaging the appropriate factor of production to the number of involved units of that factor. Best known partial measure of productivity is labour productivity.

Labour productivity is a universal key resource and it implies the ratio of physical amount of output achieved in a given period to the corresponding amount of labour used. Thus, productivity in this context refers to the physical volume of output attained per worker or per man hour. Hence, labour productivity seems to express the intrinsic efficiency of labour alone as it describes the end results of some variables or human development indices such as technology, training, management, research, trade unions etc. It was quipped in the literature that partial productivity may be an inaccurate measure of the true combination of a single input, as other

factors may also interact that is, change in input proportion, qualitative improvements, and technological advances incorporated into the production process (see Diewert, 1990, 1994, 1997; Gallegati, *et al*, 2014).

Total factor productivity (TFP, henceforth), on the other hand, is also known as Solow residual. It refers to the increase in output that cannot be explained by the increased factors of production, capital and labour. It measures the increase in output as a result of technical progress. TFP depends on several factors such as (i). technological improvement in the production of goods and services, (ii). improved level of workers' skills, (iii). investment in commercializing new products and (iv). reduction in the prices of some important inputs (Fiti, 2009; Oyeranti, 2014). In this study, partial productivity, that is, labour productivity is adopted.

b. Output Per Worker versus Output Per Working Hour

Labour input in the production process can be classified into two, namely average annual number of employees or the total numbers of working hours per year. The former implies the aggregate number of labour force available in the economy for production of output while the latter expresses the efforts of labour as an input in the production process. Labour productivity is best determined when it is viewed as the total number of working hours per year. However, another issue that would arise is how to calculate labour productivity. Calculating labour productivity, that is, how labour as an input is measured, should be clearly defined. This clarification is essential because growth rates in output per worker and per working hour can be quite different depending on how many overtime hours are there in the economy.

The distinction between output per worker and output per working hour is based on an international framework. There are country specific characteristics needed to be considered before distinguishing between output per worker and output per working hour. For instance, in some countries like the United States, workers are paid based on the number of hours worked, so they tend to work more hours than the workers in the European countries whose wages are not hourly based. Past studies (Meager and Speckesser, 2011; Leshoro, 2013; Mkhize, 2015) argued that productivity is better expressed when based on output per worker instead of output per working hour.

c. Level of Productivity versus Productivity Growth Rates

There is a difference between the level of productivity and productivity growth rate although both measures are used for analysing the labour productivity. The level of productivity shows how much GDP per worker is accomplished in a specific year, while the growth rates of productivity show the percentage change over two different periods. The level of productivity is driven by the number of the labour force within that period and this is determined by the dynamics of the labour market; whereas, productivity growth is determined by the efficiency of factor input. It is good to note that the increase in level of output may not mean improved productivity. There is need for a positive growth rates for the level of productivity to improve.

d. Labour Productivity based on Gross Output

Labour productivity can also be measured based on the gross output. This is defined as quantity of index of gross output per quantity index of labour input. It shows the time profile of how productively labour is used to generate gross output. Labour productivity changes reflect the joint influence of changes in capital, intermediate inputs, as well as technical, organizational and efficiency change within and between firms. The influence of economies of scale, vying degree of capacity utilization and measurement errors.

Labour productivity only partially reflects the productivity of labour in terms of the personal capacities of workers or the intensity of their efforts. The ratio between output and labour input depends to a large extent on the presence of other outputs as indicated above. When measured as gross output per unit of labour input, labour productivity growth also depends on how the ratio of intermediate inputs to labour changes. Gross-output based labour productivity traces the labour requirement per unit of physical output. It reflects the change in the input coefficient of labour by industry and can help in the analysis of labour requirements by industry (Giovannini and Nezu, 2001).

The advantage of measuring labour productivity based on gross output is that the method achieves ease of measurement and readability. In particular, the gross output measures require only prices indices on gross output, not on intermediate inputs as is the case for the value-added based measure. The only disadvantage is that labour productivity, as a partial productivity, measure and reflects the joint influence of a

host of factors. It is easily misinterpreted as technical change or as the productivity of the individuals in the labour force (Giovannini and Nezu, 2001).

e. Labour Productivity based on Value Added

Another important yardstick to predicate the measure of labour productivity is on value added. This is defined as quantity index of value added per quantity index of labour input. This shows the time profile of how productively labour is used to generate value added. Labour productivity changes reflect the joint influence of change in capital as well as technical, organizational and efficiency change within and between firms, the influence of economies of scale, varying degrees of capacity utilization and measurement errors. Labour productivity only partially reflects the productivity in terms of the personal capacities of workers or the intensity of their effort. The ratio between output and labour input depends to a large degree on the presence of other inputs. In comparison with labour productivity on gross output, the growth rate of value-added productivity is less dependent on any change in the ratio between intermediate inputs and labour, or the degree of vertical integration (Giovannini and Nezu, 2001).

According to Meager and Speckesser (2011), value-added based labour productivity measures tend to be less sensitive to processes of substitution between materials plus services and labour than gross-output based measures. At the aggregate level, value-added based labour productivity forms a direct link to a widely used measure of living standards, by adjusting for changing working hours, unemployment, labour force participation rates and demographic changes. Most importantly, value-added based labour productivity is vital as a reference statistic in wage bargaining. As opined by Giovannini and Nezu (2001), the main disadvantage is that value-added measure based on a double-deflation pressure with fixed-weight Laspeyres indices suffer from several theoretical and practical drawbacks such as (i). labour productivity is a partial productivity measure and it reflects the joint influence of a host of factors and (ii).it is easily misinterpreted as technical change or as the productivity of the individuals in the labour force.

In this study, labour productivity is defined as output per worker based on the number of hours worked. Two important reasons can be given for defining labour productivity this way. First, the productivity of labour is best determined when it is

seen as the total number of working hours. Second, labour productivity measured as numbers of hours worked shows the incremental level of productivity by the total number of labour force.

2.4.3Concept and Measure of Output

The conceptualization of output of an economy tends to be less cumbersome as there is a consensus in the macroeconomic literature about its meaning and measurement. Basically, output is one of the most important economic measures for a country. According to Harvard Business Review (2018; HBR henceforth), economic output is the quantity of goods and services produced in a given period by a firm, industry or country, whether consumed or used for further production. The concept of output is essential in the field of macroeconomics. The term may refer to all work, energy, goods or services produced by an individual, company, factory or machine. The result of an economic process that has used input to produce goods and services that are available for use.

In another parlance, Mills-Scofield (2018) asserted that, in the field of macroeconomics, the concept of national output is essential because it signifies the total quantity of goods and services that an individual, company, industry, city, region or country, or even the whole world produces in a given period. To Grimsley (2018), economic output is the total value of all goods and services produced in an economy. It is a regular tool used in macroeconomic analysis to determine whether an economy is growing or contracting by comparing output during two different points in time. It is also used to compare the relative output between different countries (HBR, 2018).

Some output concepts identified in the literature include sectoral output such as industrial output, which shows the entire output of all facilities that produce goods in a country; manufacturing output, a subset of industrial output, includes the output of all factories across the whole country; and net output, which shows the difference between cost and price – the price something was sold for less the cost of producing it (HBR, 2018).

The most comprehensive measure of the total output or performance of an economy is the GDP. There are two types of GDP namely; Real GDP and Nominal GDP.

2.4.4 Concept and Measure of Employment

Conceptualizing employment in the literature is somewhat at large and elusive because of the difficulties involved in characterizing the concept across board. Defining employment has cross country and country specific characteristics whose true relevance is enshrined in certain primordial confines. Hence, two main international bodies, namely the International Conference of Labour Statisticians (ICLS) and the International Labour Organization (ILO) have the mandate to provide the international framework for defining the concept. Whether seen as employment, work, or job, these terms have the connotations of someone who is engaged in productive ventures (see Elias, 2000; Majid, 2001; Maloney, 2004; Luebker, 2008).

According to Luebker (2008), the ICLS definition of employment captures as main components all those who have done some work over a short reference period (usually one week, sometimes one day). It covers two principal categories of workers:

- those in paid employment, i.e. those who have performed some work for wage or salary, in cash or in kind; and
- those in self-employment, i.e. those who have performed some work for profit or family gain, in cash or in kind.

The central criterion according to Luebker (2008) is having done "some work" over the past day or week. This prompts two questions: what would qualify as "some", and what should be considered "work". With respect to the first, the ICLS recommends to include all those who have worked for at least one hour over the reference period. For the second, the ICLS resolution refers to the International System of National Accounts (SNA) and includes all those engaged in the production of goods and services as defined by the SNA. This ensures that employment statistics with statistics on production. The following types of activity fall inside the production boundary:

- all production of goods or services for the market, including that of intermediate goods and services; and
- the production of goods for own final consumption.

However, the production of services for own final consumption within households is excluded from the scope of the production boundary. A major reason for this is that if the "the production of personal and domestic services by members of households for their own final consumption (e.g. the preparation of meals, care and training of children, cleaning, repairs), all persons engaged in such activities would become self-employed, making unemployment virtually impossible by definition." (Luebker, 2008). However, as an exception to this rule, the production boundary includes:

- services produced by employing paid domestic staff and the own-account production of housing services by owner occupiers.
- All market-oriented activities – such as street vending or small-scale manufacturing – clearly fall within the production boundary, as do communal farming and other production of goods for own consumption (Hussmanns, 2007).

By recognizing all economic activity as work, the ICLS definition includes those as employed who are engaged in communal agriculture or work in the informal sector. Again, this is in sharp contrast to the colonial legacy that, as discussed above, sought to denigrate traditional crafts and autonomous activities outside the settler-controlled formal sector, and thus only recognized formal sector employment as "work". The broad meaning of "work" in the context of labour statistics can, however, sometimes lead to cognitive problems when people are asked whether they have worked or not during the past week (or day). Survey respondents frequently do not consider their own economic activities to be "work", especially when they are carried out at home or in agriculture and related activities (Maloney, 2004).

In addition, the following are classified as employed:

- those who are in paid employment but not currently at work but maintain a formal attachment to a job (e.g. paid sick leave or annual leave), and
- the self-employed who have an enterprise but are currently not at work for any specific reason.

The inclusion of those temporarily absent from work in the "employed" category is explained in detail in Elias (2000).

A new dimension in the conceptualization of employment is the dynamics in the narrative of what constitutes a good job. This tends to distinguish between vulnerable employment and the employment that provides income that is at least equivalent to the poverty threshold of US$2 a day. The concept of 'job quality' or the quality of job done is now being used to classify the meaning of work. Thus, work is defined based on quality and not just on availability. The kind of job available and the number of people jostling for the available jobs tends to determine to a greater extent the way job is viewed. Although the definition of job may be universal but the application varies across international boundaries as what constitute job in a particular climate may not fit into that description elsewhere. Thus, conceptualizing job quality is based on many criteria such as hours worked, job security and pay, among others. These three measures of job quality are used as a basis of conceptualization in the empirical literature (Schokkaert, *et al,* 2009; Folawewo, 2013).

The measurement of employment and unemployment is also guided by the International Conference of Labour Statisticians (ICLS), conveyed by the ILO in intervals of roughly five years. The resolutions adopted by this conference cover a wide variety of issues, and their main purpose is to "provide technical guidelines for the development of national labour statistics on the basis of accepted definitions and methods, to enhance the international comparability of labour statistics, and to protect labour statistics against public criticism and political interference at the national level" (Hussmanns, 2007).

As opined by Luebker (2008), in compiling labour statistics, statistical offices around the world draw on one single set of internationally accepted recommendations. For statistics on employment and unemployment, the 'resolution concerning statistics of the economically active population, employment, unemployment and under employment that was adopted by the 13th ICLS in October 1982 is the main guideline (ICLS, 1982; Hussmanns et al., 1990).

It uses the labour force framework that covers a country's population above a certain age threshold (often 14 or 15 years) and divides it into three mutually exclusive categories: the employed, the unemployed, and the economically inactive population. To ensure that each individual is classified into one category only, the first step is to identify all employed persons, and only then to identify the unemployed among

the remaining persons, in a second step. Taken together, the employed and the unemployed form a country's labour force (or currently active population). Those outside the labour force (i.e. those who are neither employed nor unemployed) are considered to be economically inactive; they include many students, homemakers and retirees (see Elias, 2000; Majid, 2001; Maloney, 2004; Luebker, 2008).

In this study, employment is defined as is the ratio of person employed to labour force. It covers the percentage of labour force or current active population who are engaged in paid employment or self-employment over a short reference period-usually one week and sometimes one day (ILO, 2018). The International Labour organization remains the leading authority in labour and employment matters and often makes wider consultation before defining concepts which are updated regularly. The definition of employment by ILO therefore remains the standard definition of employment globally.

2.5 Theoretical Review

There are many theories in the literature that explain the nexus of employment, productivity and output growth. The main theories of interest are marginal productivity theory, Okun's law, real business cycle (RBC) theory, Keynesian theory, and neoclassical growth theory. For the purpose of identifying most suitable for the present study, this section examines the strength and weaknesses of these theories.

2.5.1 Marginal Productivity Theory of Distribution

The marginal productivity theory (MPT) of distribution is otherwise known as the theory of factor pricing. The theory explains the distribution of national income among various factors of production and determination of the prices attributable to these factors. The basic proposition of this theory is that the price of a factor input depends upon its marginal productivity. Thus, the reward accruable to such factor input is proportional to its contribution to the total output or marginal productivity (Harvey, 1985)**.** Two important factors underpinning this theory are the force of competition and the principles of substitutions. According to Harvey (1985), the theory is further based on two anchors; first, the reward or the price of a factor depends upon its productivity or its contribution to total production and second, this

reward or the price is determined by and is equal to the marginal productivity of that particular factor. (Diewert,1990; Diewert, and Lawrence,1994).

The basic assumptions of the MPT include the perfectly competitive factor and product markets. The theory also assumes that there is no change in population, stock of capital and technology, that factor of production are homogeneous and perfectly mobile and that the economy is operating at full employment level. The theory further assumes that factors of production are perfect substitutes and are divisible into smaller units. The theory is based on the operation of the law of diminishing returns as applied to the organization of the business.

The marginal productivity theory is applicable only in the long period. In the short period, the price or the reward of a factor may be more or less than its marginal productivity. For example, if the marginal productivity of labour and the price paid to it, that is, wage is less than the marginal productivity of capital and its price, the employer would substitute more units of capital for labour. As more and more units of capital are used, its marginal productivity will fall after a certain stage, while the marginal productivity of labour will rise as less of its units are used. This will continue till the marginal productivity of each factor used and the price paid to it become equal. Thus, under equilibrium conditions, the ratio of marginal productivity of factor and price of factor *'x'* is equal to the ratio of marginal productivity and price of factor *'y'* is equal to the ratio of marginal productivity and price of factor *'z'* and so on.

This can be shown with the help of following equation.

$$\frac{MPP_x}{P_x} = \frac{MPP_y}{P_y} = \frac{MPP_z}{P_z} \qquad (3.1)$$

Equation (3.1) states that in equilibrium:

1) The marginal productivity of a factor of production is equal in all employments.

2) The marginal productivity of each factor of production is equal to that of every other factor of production in the same employment.

3) The price or the reward of a factor of production is equal to its marginal productivity or to the value of its marginal product.

The marginal productivity theory of distribution has been criticized on many grounds. First, it is difficult to find out marginal productivity of a particular single factor when production is the result of combined efforts of various factors. Second,

the theory has been criticized on the account of unrealistic assumptions such as perfect competition, homogeneity of unit of a factor, perfect mobility of factor of factors, and constant returns in production. Also, the theory does not take into account changes on the supply side and increase production is not possible by increasing any one factor of production. Finally, the theory is not useful and suitable to explain the income of organizers though it gives good explanation for wages or interest (Harvey, 1985; Diewert,1990; Diewert, and Lawrence,1994).

2.5.2 Okun's Law

One of the pioneer theories underlying empirical relationships between output and unemployment (employment) is Okun's law. Proposed by Arthur Okun in 1962, the law describes the empirical relationship between output growth and unemployment rate. Basic proposition of Okun's law state that if GDP grows rapidly the unemployment rate declines, if growth is very low or negative the unemployment rate rises, and if growth equals potential unemployment rate, then the latter remains unchanged.

In Okun's original statement of the law, 2% increase in output corresponds to a 1% decline in the rate of cyclical unemployment; a 0.5% increase in labour force participation; a 0.5% increase in hours worked per employee; and a 1% increase in output per hours worked (labour productivity). Okun's law states that a one-point increase in the cyclical unemployment rate is associated with two percentage points of negative growth in real GDP. The magnitude of relationship varies across countries and time periods (Yaaba, 2010).

Basically, Okun posited that there exists a negative relationship between output growth and unemployment such that as output increases unemployment reduces, that is, employment increases. Specifically, theorized held that a 3.0 percent increase in output corresponds to a 1.0 percent decline in unemployment rates and or rise in labour force participation, rise in hours worked and rise in labour productivity

The law states that the rate of unemployment (u) decreases, if the real output growth (y_t) is stronger than the trend rate of growth $(\bar{y})$ in a country and vice versa. Hence, the change of unemployment (Δu) can be explained by the following equation:

$$\Delta u = \ -\beta(y_t - \bar{y}) \qquad (3.2)$$

The coefficient β, also known as Okun's law coefficient, measures the impact of the GDP growth on the unemployment rate. The $(\bar{y})$ which is the growth trend reflects changes in potential output and can hardly be observed. The $(\bar{y})$ according to Blanchard (2001) depends largely on the growth rate of labour force, productivity, technical progress and cost efficiencies.

Okun originally described two empirical relationships between real output and the unemployment rate. These relationships are known as the growth version and the gap version of Okun's Law (Knotek, 2007; Yaaba, 2010).

The Growth Version

This version shows how changes in the unemployment rate are related to growth in real output. The relationship can be illustrated by the following equation:

$$\Delta y_t = \beta_0 + \beta_1 \Delta u_t \qquad (3.3)$$

Where $(y_t)$is the actual output and (u_t) is unemployment rate. If equation (3.3) is reversed by interchanging the growth rate of u and y, the estimated coefficient of β_1 will be referred to as Okun's coefficient. Hence, Equation (3.4) becomes:

$$\Delta u_t = \beta_0 + \beta_1 \Delta y_t \qquad (3.4)$$

The Gap Version

This version combines the change of unemployment with the output gap between actual and potential output. The potential output is related to full employment:

$$y_t - \bar{y}_t = -\beta(u_t - \bar{u}_t) \qquad (3.5)$$

Where $y_t$is actual output, $\bar{y}_t$ is a measure of potential output, u_t is unemployment rate and$\bar{u}_t$ is natural rate of unemployment. The parameterβ is Okun's coefficient

If $y_t - \bar{y}_t$ is represented by $\hat{y}$ and $u_t - \bar{u}_t$ is given as $\hat{u}$ then equation (3.5) becomes:

$$\hat{y}_t = \beta_0 + \beta_1 \hat{u} + \mu_t \qquad (3.6)$$

While some studies (see Moosa, 1997; Sogner and Stiassny, 2002) have suggested 2.5 percent for both $\bar{y}_t$ and $\bar{u}_t$,Yaaba (2010) applied Hodrick-Prescott (1997) filter to the time series to obtain $\bar{y}$ and $\bar{u}$which are the trend and cyclical components of output and unemployment, respectively.

Basic criticism of Okun's law is that it is too simple and not complex when compared to Keynesian framework. Firms will alter their output plans if there are changes in aggregate demand, hence changes in labour demand and consequently changes in the level of unemployment. The major weakness of this rather simple elucidation is the underlying assumption of implicitly fixed prices and wages.

New Keynesian Economics tries to overcome this major drawback by introducing nominal and real rigidities. For instance, as opined by Yaba, 2010), if a model of monopolistic competition is considered and nominal price rigidity is introduced in the market for goods and services and real wage rigidity in the labour market (e.g. efficiency wages), it is relatively easier to show that changes in aggregate demand will affect output. Also, productivity shocks can as well bring about the realization of Okun's law. however, for the law to hold strongly, the effects of productivity shocks on efficiency-wages would not be highly strong.

2.5.3 Real Business Cycle (RBC) Theory.

The real business cycle (RBC) is an offshoot of Lucas (1981) and Mankiw (1989) monetary theory of the business cycle which was based on rational expectations, market clearing and the distinction between anticipated and unanticipated monetary shocks (Plosser, 1989). RBC focuses on the supply side of the economy. The core proposition of RBC is that it distinguishes between the initial impulse of expansion phase or contraction phase of business cycle and business cycle inertia mechanism. RBC asserts that business cycles are invoked by real external shocks- which are the factors affecting particularly inputs productivity such as technological change, government spending, as well as climate change, etc. The theory rejects the effects of changes in the nominal money supply growth affecting the product.

The theory assumes that money is endogenous factor and its development adapts product development and not vice versa. The theory also assumes that there is an intertemporal substitution between work and free time in the "good times" savings increase; consumes spend less and save more, if the interest rate is growing; it is possible to increase investment and the initial shock spreads in the future. If the initial shock begins to wear off, real income will fall and cause a downturn in economic activity. RBC also assumes a highly elastic supply of labour.

In RBC, the mechanism of inertia of economic cycles is based on stimulation of economic entities to higher activity growth in real income, or vice versa. Product fluctuation is explained by changes in the volume of labour employed. The volume of work employed depends on the willingness of employees to work in "good times", when the real incomes are at a high level. If real incomes are low, workers prefer leisure time in "bad times". The labour market is expected to exhibit only the existence of voluntary unemployment. Supply of labour equals the labour demanded. The economy operates at the level of potential output and fluctuations in the economy mean the fluctuations of potential output. RBC operates with the same competitive equilibrium model of the real economy, but ignores monetary shocks as a source of business fluctuations and instead places the emphasis on real shocks such as technological shock (Hynková, 2015).

In another description by Pollak (2002), RBC emphasis on the cyclical behaviour of employment and productivity. The theory asserts that technological shock is seen as the driving force of business cycles, thus fluctuations in aggregate labour productivity are at the very root of the business cycle rather than just a secondary consequence. In its analysis, RBC demonstrates how exogenous productivity shocks displace the aggregate production function, thus generating business cycle. During the business cycle- that is, the different phases of production function during a boom or doom, the productivity shocks do not only affect the average productivity but also marginal productivity of labour and hence, the demand for labour. The RBC model thus implies a shifting labour market equilibrium and predicts a cyclical behaviour of real wages and employment which is fairly similar to the stylized fact established by empirical business cycle research: employment strongly procyclical, real wages weakly pro-cyclical (Prescott, 2002).

One of the major criticisms of RBC is that proponents of the RBC view do not consider that the business cycle inherently poses a policy problem. Rather, they view it as an expression of how a system of competitive markets efficiently handles a stochastic and unpredictable business environment in which it has no choice but to operate. According to this view, policy can ensure that markets are left free to react to exogenous shocks as efficiently as possible. Equally important is that policy itself avoids generating a source of unpredictable disturbances. Real shocks that emanate from government behaviour, in particular major changes in regulatory spending and

tax policies, play a quantitatively important role in empirical applications of RBC theory.

Another criticism is that RBC prejudicially attributes all output movements to exogeneous changes in technology even if it cannot be directly traced to changes in labour or capital input. This assertion establishes the fact that technology shocks largely explain the business cycle. However, technology shocks do not easily lend themselves to independent verification. Also, the RBC view carries the risk of encouraging dangerous inaction in the face of a really deep crisis. Technology stocks may be interpreted broadly to encompass changes in the regulatory environment or in exogenous factor input prices (Calmfors and Holmlund, 2000).

2.5.4 Keynesian Theory

The Keynesian theory posited that business cycle or business downturn and associated unemployment are first-hand evidence of a deep-rooted failure of the market system to deal with vagaries of private spending behaviour. The theory therefore, calls for corrective action directed towards the stabilization of aggregate demand growth. Keynesians attributed the cycle variations of output mainly to exogeneous changes in aggregate demand and explained the procyclical behaviour of productivity in terms of the lagged adjustment of employment. The Keynesian theory asserted that the cyclical variation of output and employment is caused by fluctuations of aggregate demand (Keynes, 1936).

As buttressed by Layard, *et al* (1991), the Keynesian theory opined changes in effective demand are the dominant cause of short-term output changes which in turn lead to workforce adjustments as dictated by production needs. Almost all production functions commonly used in macroeconomic reasoning imply that, with other factor inputs held constant, labour is subject to diminishing returns. Since there is little short-term variation in the capital stock, these production functions would lead us to expect a more than proportional response of employment to cyclical, demand-induced output changes – which would amount to a counter-cyclical behaviour of labour productivity. But this is the just opposite of what the data show. The only way to reconcile the Keynesian view of the business cycle with the pro-cyclical behaviour of productivity is to take account of labour hoarding during

recessions. Labour hoarding means that firms do not adjust their workforce down to the absolute minimum in recessions. Rather, experience shows that firms prefer to keep more workers on their payrolls than they actually need during a recession in order to avoid adjustment costs and be ready for the next recovery (Lynch and Nickell, 2001).

Keynesian theory has long been criticized for its lack of convincing microeconomic foundation – for assuming rather than proving the market imperfections and coordination failures that it stipulates are at the root of the business cycle. Keynesians have swiftly refuted the initial claim of the new classicists that the lack of microeconomic foundation condemns the Keynesian paradigm to empirical failure. They have responded to this challenge by developing a large number of interesting ideas about the microeconomic sources of macroeconomic market failure stabilization policies represent a misguided attempt to smooth a stochastic dynamic process that cannot be smoothed and is not in need of smoothing. If the Keynesian view is correct, however, the recommendation of microeconomic reforms as a cure for Japan-style economic stagnation is much like treating pneumonia with aspirin – on the grounds that the patient's behaviour does not contradict the hypothesis of an exogenous bout of fever (see Stiroh, 2001; Svensson, 2001).

2.5.5 Neoclassical Growth Theory

Pioneered by Solow and Swan (1956), the neoclassical growth theory ensued because of the limitations of the classical and Harrod-Domar models of growth. The neoclassical theory provides a requisite framework which allows the substitution of labour and capital for each other in the production function. This implies that short-term equilibrium can be reached by varying the amounts of labour and capital in the production function. The NGT argues that technological change has a major influence on an economy, and economic growth cannot continue without technological advances. The NGT is based on the following basic assumptions:

1.There are no fixed, non-augmentable factors of production which contrasts sharply with the classical assumption of a fixed supply of land.

2.The production function is assumed to be smoothly continuous and twice differentiable. An aggregate linear homogeneous production function of tbs Cobb-

Douglas type which shifts overtime as' a result of technical change is adopted. Thus, the function is of the form:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \quad (3.7)$$

where:

Y_t= national product in year t.

K_t and L_t= aggregate inputs of capital stock and labour in year $t$respectively.

α and $(1-\alpha)$ = output elasticities and relative income shares of capital and labour respectively.

$A_t = 1 \; at \; t = 0 \; and \; A_t > 1, \; = \; \frac{dA}{dt} > 0 \; for \; all \; t > 0$.

3.By adhering to the assumption of Cobb-Douglas type of production function, the neoclassical economists assumed that factor prices and factor proportions are fully variable.

4.The assumption of linear homogeneous production function implies that factors are paid their marginal products. Hence, Euler ‘s theorem' is satisfied.

5.Another significant assumption of the neoclassical economists is that technology is assumed to grow exponentially at the compound interest rate, g. That is:

$$A_t = e^{gt} \quad (3.8)$$

6. Hicks’ neutral technical change is assumed.

7. The rate of growth of population or of the labour force is assumed to be determined exogenously and is also assumed to grow at a constant exponential rate, n. That is

$$L_t = L_0 e^{nt} \quad (3.9)$$

where L_0= initial level of labour and n = natural rate of growth of labour, $t > 0$.

8. The Keynesian assumption of identity between saving and investment is adopted. Investment is strictly proportional to income as a result of fixed propensity to save. Thus;

$$I_t = S_t$$

and $I_t = \frac{dK_t}{dt} =$

sY_t (3.10)

9. Product and factor markets are perfectly competitive in this analysis.

10. The theory also assumes that full employment of capital and labour prevails.

The basic neoclassical model is based on the Cobb-Douglas production. As expounded by Solow (1956, 1957) and Romer (1990), the NGT provides a framework which traces the equilibrium growth path and shows that output grows exponentially at a rate that is a function only of the growth rates of the labour supply and technology. Also, under neoclassical conditions, equilibrium growth occurs at the natural rate and the long run growth rate is independent of the proportion of the national output devoted to saving and investment. Thus, the neoclassical production function and the assumption of competitive markets lead to the neoclassical theory of distribution and the neoclassical relations between production and the input and output markets.

The NGT had been criticized on a number of grounds, First, the existence of a production function was criticized. Second, it was pointed out that the marginal productivity theory of distribution is invalid. Also, the procedures employed by Solow in his empirical investigation was said to be controversial. For instance, it was argued that production function could not be written for the whole economy since machines and food cannot be aggregated in physical terms. and no unique index of output can exist where the proportion of machine to food changes. Thus, the neoclassical introduction of aggregate production function and aggregate inputs was criticized.

Further critics of the NGT noted that the present value measure of capital is objectionable since interest rate has to be assumed in order to arrive at any capital value. But the interest rate is supposedly the marginal product of capital from the aggregate production function. This causes circular reasoning. But, despite the criticism, the neoclassical model has been accepted as fundamental to input-output analysis.

Based on the theoretical review, this study adopts the neoclassical growth theory as the background for explaining the relationship among productivity, employment and output growth. This decision is based on two important reasons. First, the

neoclassical growth model provides the best framework for explaining factor-input and output relation which becomes essential in analysing the link among labour productivity, employment and output growth. Second, in a country specific study, the theory provides the best economic anchor to empirically validate the link among these macroeconomic variables as used in the study.

2.6 Methodological Reviews

Various methodologies and estimation techniques have been used in the literature to examine the relationship among productivity, employment and output growth. These can be broadly classified into two, namely descriptive and econometric methodologies. Some studies adopted descriptive method (Meagre and Speckesser, 2011; Bhattacharya and Narayan, 2015; McCullough, 2017), while others that have used quantitative method employed econometric and macro-econometric approaches such as Generalized Method of Moments (GMM), Computable General Equilibrium (CGE), panel regression, spatial analysis etc. (Bhattacharya and Narayan, 2006; Gollin, 2010; Alani, 2012; Azorin and Vega, 2017).

Using a time-frequency analysis for the United States, Gallegati, *et al* (2014) examined whether Productivity Affected Unemployment? The study decomposed the relevant US time series data in different time scale components and considered co-movements of productivity and unemployment over different time horizons. They concluded that, according to US post-war data, productivity created unemployment in the short and medium terms, but employment in the long run.

Athanasogloua et al (2009) assessed the evolution of output and productivity in the Greek banking industry for the period 1990–2006. Three main categories of bank output were estimated based on modern theoretical approaches, while for the estimation of output and productivity(partial and total factor) we relied on the index number method (Tornqvist index). Kim, et al (2010) contributed empirically to the literature on the productivity–employment relationship in developing countries by applying structural vector autoregression (VAR) models on Korean data.

Lee and Mukoyama (2015) estimated the plant-level dynamics of productivity and employment in the United States. They used the Annual Survey of Manufactures from the U.S. Census Bureau for the period 1972 to 1997. Applying the system generalized method-of-moments estimation developed by Blundell and Bond (1998),

the study found that productivity and employment processes were both strongly persistent.

Using a CGE Model that allows for goods and capital movements across sectors and economies, and consumption and investment dynamics, Lee and McKibbin (2018) examined the relationship between the service sector productivity and economic growth in Asia while Mahadevana and Kim (2003) examined the sources of output growth and total factor productivity (TFP) growth of four selected South Korean manufacturing industries from 1980 to 1994. The study made use of firm level data within each industry with the application of the random coefficient frontier model.

Leshoro (2013) adopted the Toda-Yamamoto technique of causality in order to examine the direction of causality between employment and economic growth. This was to investigate whether the increase in the Gross Domestic Product (GDP) translated into increased employment or not and vice versa, in South Africa, using quarterly data from 2000Q1 to 2012Q3.

Camarero, et al (2016) examined the relationship of wage, productivity and unemployment in the Eurozone from 1995-2011 using Panel Cointegration approach. Karaalp-Orhan (2017) investigated the relationship between labour productivity, real wages and unemployment in Turkey. The study employed the bounds testing procedure within an autoregressive distributed lag (ARDL) modelling approach and applies Toda-Yamamoto causality test for the period 2007:01−2016. Vector Error Correction Mechanism (VECM) methodology was adopted by Compagnucci, *et al* (2018) to examine the relationship between productivity and structural change in advanced countries (OECD) from 1970-2015.

Employment, wage and productivity in Indian manufacturing industries from 1998-2013 was the interest of Das, *et al* (2017). Adopting the Neoclassical and Keynesian models in its theoretical framework, the study employed both panel analysis and least square methods with dummy variable model (LSDV). Kim et al (2009) examined the productivity–employment relationship in developing countries evidence from Korea from 1985 – 2003 using structural vector autoregression (VAR) models. Marattin and Salotti (2011) used a panel regression to examine the nexus of Productivity and per capita GDP growth in OECD countries from 1980–2005.

Skevas, *et al* (2018) investigated productivity growth measurement and decomposition under a dynamic inefficiency specification. They applied the dynamic stochastic frontier model to the case of German dairy farms in a period that is characterized by high milk price volatility. The model captured time-specific efficiency and total factor productivity growth shocks that may have been induced by this high volatility. Furthermore, the dynamic stochastic frontier model is favoured by the data when compared to a model that imposes a very restrictive time structure on efficiency and two models that do not impose any time structure at all.

Input-Output approach was employed by Sauian, *et al* (2013) to examine the labour productivity of services sector in Malaysia. A time series data between 2000 and 2005 as well as surveys of related sub-sectors in 2012 were used for the study. Liu (2018) analysed the effects of wages and job productivity on job creation and destruction in Japan with evidence from division-level employment data 1995–2014. The study used panel analysis in its methodology which characterized the fixed effect and random effect dichotomy.

It can be adduced most of the methodologies adopted to estimate the employment-productivity or output-productivity, or output-employment relations suffered from estimation bias and inconsistent conclusions, most especially in the presence of country specific characteristics. However, only few studies such as Umoru (2013) and Karaakp-Orhan (2017) used bound test approach which is selected this study. There are two main reasons for the choice of the Auto Regressive Distributed Lag (ARDL) model. First, bound test allows variables with different optimum lag. Second, it allows for unbiased estimators even in the presence of endogenous variables (Harris and Sollis, 2003).

In terms of data employed, various types of data sets used in the literature include micro-level or survey data, firm level, macro-level (both time series and panel data). The major issue was data availability. For instance, McCullough (2017) examined labour productivity and employment gaps in Sub-Saharan Africa. The study drew on a new set of nationally representative, internationally comparable household surveys. Examining labour productivity gaps from a micro-economic perspective, the study generated labour productivity measures and other key variables from the Living Standards Measurement Survey – Integrated Surveys in Agriculture (LSMS-ISA)

dataset. It drew on a cross-section of recent LSMS-ISA datasets available, comprised of the Ethiopia Rural Socioeconomic Survey (2013–14), the Malawi Integrated Household Survey (2010–11), the Tanzania National Panel Survey (2010–11), and the Uganda National Panel Survey (2010–11).

Azorina and Vega (2017) used panel data from the Spanish provinces, between 2000–2011 to examine output growth thresholds for the creation of employment and the reduction of unemployment. The study used a spatial SUR model to link the panel data with analysis of spatial dependence in order to obtain efficient and robust results about the stability of the Verdoorn and Okun coefficients. Also, the spatial dependence was removed by using spatial filtering techniques from the semi-parametric method of vector decomposition. This study adopts yearly time series data on Nigeria to estimate the relationship among productivity, employment, and output growth.

2.7 Empirical Literature

Many studies had tried to examine the employment implications of labour productivity growth on the level of output. The first set of empirical literature relate to those that examine the labour productivity and employment relation.

Klein (2012) examined the link among real wage, labour productivity and employment trends in south Africa from 1970-2010. Findings revealed that labour productivity positively impacts real wage but excess real wage growth suppresses employment creation. Higher real wage growth generated a substitution between formal and informal employment. Meager and Speckesser (2011) investigated the nexus of wages, productivity and employment in the OECD from 1990-2008. They found that an alignment of wage growth below the rate of productivity growth was important in order to maintain high employment levels.

The relationship of wage, productivity and unemployment in the Eurozone from 1995-2011 was the interest of Camarero, et al (2016). The study revealed that increased international competition made wage determination more strictly related to productivity, and real exchange rate appreciation triggered a drop-in-wages. Karaalp-Orhan (2017) analyzed the relationship between labour productivity, real wages and unemployment in Turkey from 2007-2016. Findings showed that there was wage

rigidity because a rise in real wages and unemployment induced higher productivity by raising the cost and probability of job loss. The effect of increased productivity on unemployment in the United States was the focus of Gallegati, et al (2014). Findings showed that, according to US post-war data, productivity created unemployment in the short and medium terms, but employment in the long run. While Coen and Hickman (2006) examined an econometric model of potential output, productivity growth, and resource utilization in US from 1960-2000. They found that the factors accounting for the growth of potential output, productivity and labour supply were identified and compared.

Compagnucci et al (2018) asked whether jobs and wages had stopped rising by examining the nexus of productivity and structural change in advanced countries (OECD) from 1970-2015. Findings revealed that the break in the relation between GDP per capita growth and employment could be explained by the decoupling between productivity from one hand, and labour compensation and utilisation from the other. Findings further suggested that different economic sectors specifically contributed to the productivity change in accordance with their technological and knowledge intensity. Das, *et al* (2017) investigated the linkage of employment, Wage and Productivity in Indian Manufacturing Industries from 1998-2013. The study found that the differential effects on employment and wage through productivity growth across different industry groups and provided some serious policy implications in the context labour market flexibility.

Kim et al (2009) examined the productivity–employment relationship in developing countries evidence from Korea from 1985 – 2003. They found that productivity-enhancing technology shocks reduced hours worked in the short run. Such evidence was qualitatively similar to findings from developed countries, and more consistent with sticky price models than the real business cycle theory. Although productivity-enhancing technology shocks were important source of economic growth in Korea, they had the possibility to exert a negative impact on employment.

Kotulic (2014) evaluated the performance and productivity of the Slovak economy in relation to employment in the period from 1995 to 2012. The study found that the productivity growth of the Slovak economy was directly proportional related to the ability of enterprises to respond successfully to new challenges in the field of

innovation and the optimal use of productive resources. Lee and Mukoyama (2015) examining the nexus of productivity and employment dynamics of U.S. manufacturing plants 1972 to 1997 found that productivity and employment processes were both strongly persistent.

Sasaki (2007) investigated the impact of the rise of service employment on aggregate productivity growth in Japan from 1950-2001. The study found that, given that the growth rate of productivity in the service sector was lower than that in the manufacturing sector, both the employment share in manufacturing and the rate of economic growth would decline in the long run irrespective of the size of the elasticity of substitution between labour and service input.

Labour productivity and employment gaps in Sub-Saharan Africa was investigated by McCullough (2018). The study found that underlying the productivity gaps that were prominently reflected in national accounts data were large employment gaps. This questioned the productivity gains that labourers could achieve through structural transformation. The countries comprising the LSMS-ISA dataset exhibited considerable heterogeneity with respect to GDP per capita, agriculture's share of the labour force and economy, and productivity gaps.

Autor and Salomons (2018) probed whether automation was labour-displacing while investigating the relationship among productivity growth, employment, and the labour share. Their estimates indicated that the labour share-displacing effects of productivity growth, which were essentially absent in the 1970s, had become more pronounced over time, and were most substantial in the 2000s. The finding was consistent with automation having become in recent decades less labour-augmenting and more labour-displacing. Das (2008) examined the linkage of trade liberalization, employment, labour productivity and real wage in the organized manufacturing industry in India between 1980s and 1990s. The study showed that in the labour-intensive sectors, cotton textile, textile products, and leather and leather products, trade liberalization had a positive impact on the labour market indicators, be it employment, real wages, or labour productivity.

Liu (2018) examined the effects of Wages and Job Productivity on Job Creation and Destruction in Japan using Division-Level Employment Data 1995–2014. Results indicated that wages and job productivity significantly affect job creation and

destruction in Japan. Junankar (2013) investigated if there was a Trade-off between Employment and Productivity in lower-income economy, middle-income economy and high-income economies. The study analysed the possible trade-off between employment and productivity using panel data on world economies, developed and developing. Results suggested that there was a trade-off between employment and productivity.

Palazuelos and Fernández (2009) provided insights on the linkage of demand, employment, and labour productivity in the European economies. The study provided an explanation of the causes of the slowdown in growth in labour productivity in European economies in recent decades. Findings revealed that the weakness of domestic demand was what determined the slowdown in productivity. However, differences with the (mediocre) rates of growth of productivity between European countries were also related to the specific features of their respective labour markets because, in a context of weak domestic demand, there was a trade-off between employment and productivity.

The second set of empirical literature examined the output growth-employment relation. Starting with Azorín and Vega (2017), they investigated the output growth thresholds for the creation of employment and the reduction of unemployment, using a spatial analysis with panel data from the Spanish provinces, 2000–2011. The results showed that thresholds varied over time and the output growth required for a rise in employment was well below the level necessary to reduce the unemployment rate. Ajakaiye *et al* (2016) investigated the relationship between growth and employment in Nigeria from 1981 to 2014. Findings showed that Nigeria's growth was not employment oriented and was sustained largely by factor reallocations rather than productivity enhancement. Findings also revealed that there were labour reallocations mainly from agriculture and manufacturing towards the low productive services sector. Thus, employment elasticity of growth was positive and quite low, reflecting the country's poor overall employment generation record, especially in manufacturing.

Alani (2012) investigated the effects of Productivity Growth on Employment Generation, Capital Accumulation and Economic Growth in Uganda from 1972-2008. Findings from the study revealed that the Reduction in economic growth came

from productivity growth, and that productivity growth caused unemployment and depletion of capital stock. Second, both labour and capital productivity growth caused unemployment, decline in both capital accumulation and economic growth. Third, that economic growth, capital accumulation and employment, resulted from technical progress.

Umoru (2013) examined whether or not employment impacted significantly and positively on *GDP* growth in Nigeria over the sample period of thirty-eight years. Findings revealed that both the short-run and long-run growth effects of employment in Nigeria are significant and positive. Thus, having ascertained the significance of employment in positively influencing economic growth in Nigeria, the study thus recommended a set of policies to the Nigerian government with a view to enhancing employment and fostering economic growth in Nigeria.

Leshoro (2013) investigated whether the increase in the Gross Domestic Product (GDP) translates into increased employment or not and vice versa, in South Africa, using quarterly data from 2000Q1 to 2012Q3. The results obtained showed that causality did not run from employment to economic growth in South Africa. However, Keynes *General Theory* held for South Africa, where the empirical result showed that economic growth led to employment. These results supported the criticism of 'jobless growth' against South Africa (Kumo, 2012) and recommended robust strategy for the improvement of employment.

Mahadea and Simson (2010) examined the problem of low employment economic growth performance for the period 1994 -2008 in South Africa by drawing on the Harrod-Domar model and then over a longer time period by using regression analysis. The study used a parsimonious regression model to highlight the probable links between changes in economic growth and changes in employment. Findings revealed that the growth elasticity of employment over the 1994-2008 period was low and over a longer time horizon the marginal growth employment effect was weak.

Mkhize (2015) investigated how the sectoral employment intensity of output growth in the eight non-agricultural sectors of the South African economy had evolved in the period 2000:01-2012:04, with a view to identify key growth sectors that are employment intensive. Findings suggested that employment and economic growth

did not move together in the long run, implying that jobless growth did occur in South Africa during the period. The noted that South Africa became less labour intensive and more capital intensive, and in turn facilitated a structural adjustment that weakened the employment-growth relationship.

The third set of empirical literatures present to productivity and output relation. Lee and McKibbin (2018) analysed the relationship between service sector productivity and economic growth in Asia from 1970-2005. They found that faster productivity growth in the service sector in Asia contributed to sustained and balanced growth of Asian economies, but the dynamic adjustment was different across economies. Essentially, the study posited that, during the adjustment to higher services productivity growth, there was a significant expansion of the durable manufacturing sector that was required to provide the capital stock that accompanies higher economic growth.

Mahadevan and Kim (2003) probed whether output growth of Korean manufacturing firms from 1980 to 1994 was productivity-driven. Empirical results showed that output growth in the manufacturing industries was increasingly productivity-driven. The study recommended that the varying sources of TFP growth (i.e. technical progress and gains in technical efficiency) within the industries presented an urgent need to re-examine the effect of government policies and other factors to formulate specific policies for sustainable TFP growth.

Marattin and Salotti (2011) provided empirical evidence for the nexus of productivity and per capita GDP growth under the role of the forgotten factors in OECD countries from 1980–2005. Findings revealed that, "forgotten factors" that was identify with the employment and the activity rates and a demographic ratio, mattered more in better performing economies. The results further showed that productivity was less important in determining GDP growth in less performing economies.

Athanasogloua, *et al* (2009) assessed the evolution of output and productivity in the Greek banking industry for the period 1990–2006. They found that Bank output and labour productivity outpaced considerably the respective GDP growth and labour productivity of the Greek economy during the period. Findings also showed that capital and total factor productivity had improved remarkably since 1999, due to the

structural changes that took place within the industry, capital (mainly IT) investments and improvement in the quality of human capital. Coen and Hickman (2006) examined an econometric model of potential output, productivity growth, and resource utilization between 1960–2000. They found that the estimated output and unemployment gaps were consistent with Okun's Law.

Nakamura *et al* (2018) examined the relationship between productivity Improvement and Economic Growth in Japan. The study found that in Japan, there are two reasons behind the slowdown: first, technology and ideas accumulated by research and development (R&D) and management resources such as capital and labour are not utilized efficiently; and second, these resources are not efficiently reallocated among corporations. In order to improve Japan's productivity in the medium to long-term, it is desirable to encourage the flexible reallocation of management resources such as capital and labour by changing working process at the corporate level in accordance with changes in the socio-economic environment and the advent of new technologies, as well as by improving efficiency in the labour and capital markets.

2.8 The Gap in the Empirical Literature

Based on the review of empirical literature, three strands of studies were identified. The first set of studies focused on productivity and output relations; the second set of studies emphasized the linkage between output growth and employment, whilst the third set of studies analysed the relationship between productivity and employment growth. Generally, only a handful of studies (Majid, 2000 and Landmann, 2004) examined the relationship among productivity, employment and output growth, besides. A study that empirically examined this relationship is absent for Nigeria. Secondly, the review of the empirical literature fails to provide a conclusive answer to the linkage and dynamics of productivity, employment and output growth most especially in the presence of country specific characteristics of macroeconomic variables.

Also, the analysis of the connection among productivity, employment and output growth; most especially in developing countries will perpetually depend on a number of factors such as conceptual definition and measurement, and the methodology employed. Thus, a study that adopts a robust econometric approach in the analysis of productivity-employment-output relation becomes relevant. Finally,

an empirical investigation of the theoretical framework underpinning the linkage of employment, productivity and output growth, most especially in developing country like Nigeria becomes germane for the purpose of validating the relationship among these macroeconomic variables.

CHAPTER THREE
METHODOLOGY

Introduction

This chapter presents the theoretical framework and the methodology adopted in this study. It also discusses the empirical models and the estimation techniques. The pre-estimation and post-estimation diagnostics as well as the sources of the data used in the study are equally discussed.

3.1 Theoretical Framework.

The theoretical foundation for this study is largely based on the neoclassical growth theory. Specifically, the study derives its structure from the basic Cobb-Douglas production function (Cobb and Douglas, 1929) and Solow growth model (Solow, 1957) synthesized to build a framework for estimating the relationship among labour productivity, employment and output growth.

The Cobb-Douglas aggregate production function provides the macroeconomic foundation and theoretical construct for empirical investigation of input and output relation. The production function is based on an algebraic transformation of factor input identities which provides estimates for capital, labour and technology (Felipe

and Adams, 2005; Alani, 2018)[4]. Solow (1957) expounded on the Cobb-Douglas production function to derive the celebrated Solow growth model. As argued by Romer (1990), the central assumptions of the Solow model concern the properties of production function and the evolution of the three inputs into production over time. Solow model focuses on four variables, output (Y), capital (K), labour (L), and knowledge i.e. the effectiveness or productivity of labour (A). Thus, at any point in time, the economy has the same amounts of capital, labour and knowledge and these are combined to produce output (Romer, 1990).

From the foregoing, this study adopts the framework of Alani (2012a, 2012b and 2018) to theoretically establish the link among productivity, employment and output growth in an empirical analysis. As a precursor to the mainstream production function, the model structure begins by making use of leisure, consumption (income) and labour in man-hours. Let the relationship between leisure and income (consumption) be $Y_1 = a_1 - b_1 Z_1$; where, (Y_1),is total consumption (income), a_1 is an intercept, b_1 is a parameter and Z_1 is the amount of leisure time. Also, let $L = W - Z$; where, L is labour time and W is the total amount of time available and can be apportioned for leisure (Z) and work (L). But leisure Z_1, is a function of labour productivity i.e. $(Y/L) = L_p$ *i.e.* $Z_1 = f(Y/L) = t_1 L_p$. Also, leisure Z_2 is a function of capital productivity i.e. $(Y/K) = K_p$, i.e. $Z_2 = f(Y/K) = t_2 K_p$. Finally, let output be a function of technology such that output is expressed in terms of technology parameters. The output functions for the three scenarios are stated thus,

$$Y_1 = a_1 - b_1 t_1 L_p \quad (4.1)$$

$$Y_2 = a_2 - b_2 t_2 K_p \quad (4.2)$$

$$Y_3 = r_3 A^{\eta} \quad (4.3)$$

Obtaining the derivative of equations (4.1 – 4.3) yields equations 4.4 - 4. 6 below:

$$\frac{dY_1}{Y_1} = - r_1 \left(\frac{dL_p}{L_p}\right) \quad (4.4)$$

[4]The aggregate production function was employed by Felipe and Adams (2005) and Alani (2018) to empirically investigate the input and output relation in a country specific analysis.

$$\frac{dY_2}{Y_2} = \; - \; r_2\left(\frac{dK_p}{K_p}\right) \tag{4.5}$$

$$\frac{dY_3}{Y_3} = \; \eta\left(\frac{dA}{A}\right) \tag{4.6}$$

where, $- \; r_1.\left(\frac{dL_p}{L_p}\right)$ depicts the labour productivity growth, $- \; r_2.\left(\frac{dK_p}{K_p}\right)$ is the capital productivity growth and $\eta.\left(\frac{dA}{A}\right)$ is the technical progress while r_1, r_2, η are parameters respectively**.** Therefore, equation 4.7 below shows the combination of the contributions of technical progress, capital productivity growth and labour productivity growth towards output growth:

$$\frac{dY}{Y} = \eta\left(\frac{dA}{A}\right) \; - \; r_1\left(\frac{dL_p}{L_p}\right) - \; r_2\left(\frac{dK_p}{K_p}\right) \tag{4.7}$$

Hence, growth in both capital and labour productivity leads to decline in economic growth, whereas technological progress gives rise to economic growth**.** Substituting labour productivity growth for labour growth in the Cobb-Douglas production function enables us to determine the potential influence of labour productivity on employment and output growth as depicted by the respective coefficients.

a. Framework showing the relationship between labour productivity and employment

The specific channel through which labour productivity affects employment is based on a Cobb-Douglas production function. The general form of the Cobb–Douglas production function that is given by:

$$Y_t = \; A_t K_t^{\alpha} L_t^{\beta} \tag{4.8}$$

where $A_t$is overall level of technology in the national (or domestic) economy; $0 < \alpha < 1, \; 0 < \; \beta < 1$ are parameters of returns to scale; $K_t$is the amount of capital; $L_t$is the amount of labour used to produce output Y_t and $t$denotes particular years. The average product (i.e. productivity) of a variable input, say capital productivity

K_{pt}, is defined as the total output$Y_t$divided by the amount of variable input $K_t$and is expressed as:

$$K_{pt} = Y_t K_t^{-1} \quad (4.9)$$

Similarly, labour productivity (L_{pt}) is the total output Y_t divided by the amount of labour and is given by:

$$L_{pt} = Y_t L_t^{-1} \quad (4.10)$$

Substituting Equations (4.9) and (4.10) into Equation (4.8) yields Equation (4.11), which is an expression for total aggregate output Y_t:

$$Y_t = [A_t K_t^{\alpha} L_t^{\beta}]^{\frac{1}{(1-\alpha-\beta)}} \quad (4.11)$$

Equations (4.9) and (4.10) show that in the short run, most especially when dealing with one input with respect to output, the influence of productivity of a variable input on output is positive. Whereas equation (4.11) depicts the effect of productivity of a variable input on the amount of a given output is negative in the long run as depicted. The relationship between labour productivity and employment modelled by taking the derivative of equation 4.11 which yields;

$$\frac{dL}{L} = \frac{1}{1-\beta}\left[\lambda\frac{dA}{A} - \frac{dL_p}{L_p} + \alpha\frac{dK}{K}\right] \quad (4.12)$$

Equation 4.12 implies that productivity growth dL_p/L_p causes growth in unemployment (i.e. reduction in employment), whereas both technical progress (dA/A) and capital accumulation (dK/K) result in labour employment growth dL/L.The economy is said to be operating under decreasing returns to scale i.e. $\alpha + \beta < 1$ because the economy is operating within the feasible region of production. The parameters λ , α, β are all positive. Similarly, the variables K, L, A, L_p are all positive, but their growth rates may be either positive or negative.

Increase in labour productivity may result in unemployment because a rise in productivity may cause labourers to substitute leisure for work. The best explanation for this is that, productivity growth drives wage increases and when incomes reach the desired level for comfortable standard of living, workers tend to prefer more leisure. Since higher wage rates create a disincentive for longer hours of work, workers would find it rational to work less and still produce the same amount of output due to increased productivity (Koutsoyaiannis, 1979; Dwivedi, 2003).

However, if the growth in labour supply is a function of technical progress, then both capital and labour productivity growth result in unemployment as shown below:

$$\frac{dL}{L} = \frac{1}{1-\alpha-\beta}\left[\lambda\frac{dA}{A} - \alpha\ \frac{dK_p}{K_p} - (1-\alpha)\frac{dL_p}{L_p}\right] \quad (4.13)$$

The influence of both capital and capital productivity on unemployment as revealed by equation (4.13) is driven by the increase in technical progress which causes labour to be more skilful, innovative and able to perform many tasks within a given period. Also, increase capital stock provides labour with more tools to work with to produce more goods and services. This growth in labour productivity due to the growth in capital productivity can result in decrease in employment.

b. Framework showing the relationship between Labour Productivity and Economic Growth

The specific framework showing the relationship between labour productivity and economic growth is based on total aggregate output (Y_t)expressed in equation (4.11). This implies that, growth in level of technology has a positive influence on economic growth whereas growth in either labour productivity or capital productivity has a negative effect on economic growth. The reason being that the economy is operating within the feasible region of production with decreasing returns to scale, that is, $0 < \alpha + \beta < 1$. This implies that the value of $\alpha + \beta$ is always positive and lies between 0 and 1. Further derivative of equation 4.11 is presented as:

$$\frac{dY}{Y} = \frac{1}{1-\alpha-\beta}\left[\lambda\frac{dA}{A} - \alpha\frac{dK_p}{K_p} - \beta\frac{dL_p}{L_p}\right] \quad (4.14)$$

Equation 4.14 means that expansion in applied knowledge to produce goods and services (i.e. technical progress) give rise to economic growth whereas increase in productivity results if faster depletion of output and trade off of leisure for work resulting in reduction in economic growth. On the demand side[5], the producers would tend to reduce their demand for labour because they would prefer to produce the same amount of output by employing less labour because labour productivity has increased in order to generate more profits. Therefore, output falls as productivity

[5]Alani (2018) studied the effect of productivity on employment from the both the labour supply side (invariably the labour market) and the demand side, i.e. the actions of producers.

rises leading to the inverse relationship between productivity and output since the feasible area of production is where there is decreasing returns to scale i.e, $0 < \alpha + \beta < 1$. Further derivative of equation (4.11) gives the equation (4.15) below:

$$\frac{dY}{dL_p} = \left(\frac{1}{1-\alpha-\beta}\right)\left[\frac{Y^{(1+\alpha+\beta)}}{L_p}\right] \qquad (4.15)$$

c. Framework showing the linkage among Productivity, employment and output growth

The theoretical construct establishing the linkage among productivity, employment and output growth is based on Solow growth model. According to Blanchard and Fisher (1993), stylized facts by Solow (1970) showed that output growth reflects growth in both the labour force and labour productivity. From equation (4.8), let output growth $dY/Y = g_y$,capital accumulation $dK/K = g_k$, labour employment growth $dL/L = g_n$,and technical progress $dA/A = q$; Thus, under the same assumption of constant returns to scale, exogenous technical progress, constant growth of population, n and competitive markets; the rate of growth of output can be expressed as:

$$g_y = \alpha g_n + (1-\alpha)g_k + q \qquad \text{for } 0 < \alpha < 1 \qquad (4.16)$$

where g_y is the growth rate of output, αg_n is the growth rate of labour (population), g_k is the growth rate of capital, α is the share of labour in output, $(1-\alpha)$ is the share of capital in output and q is the multifactor productivity growth or less formally referred to as Solow residual.

In order to know how much of changes in output could be attributed to capital, applied knowledge, specialization or productivity; there is the need for a simple decomposition of output growth into the vagary influencing factor inputs. To achieve this, we give full expression into equation (4.16), yields;

$$g_y = \alpha g_n + g_k - \alpha g_k + q \qquad (4.17)$$

Addingαg_y to both sides of equation (4.17) gives the expression;

$$g_y + \alpha g_y = \alpha g_n + g_k - \alpha g_k + \alpha g_y + q \qquad (4.18)$$

Collecting the like terms in equation (4.18), yields

$$\alpha g_y + \alpha g_n = g_k - g_y + \alpha g_y - \alpha g_k + q \quad (4.19)$$

Factorizing the left-hand side of equation (4.19) yields equation (4.20)

$$(g_y + g_n)\alpha = g_k - g_y + \alpha g_y - \alpha g_k + q \quad (4.20)$$

Dividing both sides of the equation (4.20) by the share of labour parameter, we derive

$$g_y - g_n = \frac{(g_k - g_y + \alpha g_y - \alpha g_k)}{\alpha} + \frac{q}{\alpha} \quad (4.21)$$

Factorizing the numerator of the right-hand side of equation (4.21) yields

$$g_y - g_n = \frac{1\,(g_k - g_y) - \alpha(g_k - g_y)}{\alpha} + \left[\frac{q}{\alpha}\right] \quad (4.22)$$

The above can further be re-expressed as;

$$g_y - g_n = \frac{(1-\alpha)(g_k - g_y)}{\alpha} + \left[\frac{1}{\alpha}\right] q \quad (4.23)$$

To express equation (4.23) in terms of the factors influencing output growth per man hour, the following equation is arrived at;

$$g_y - g_n = \left[\frac{(1-\alpha)}{\alpha}\right]^{(g_k - g_y)} + \left[\frac{1}{\alpha}\right] q \quad (4.24)$$

where $g_y - g_n$is the output per man-hour, $\left[\frac{(1-\alpha)}{\alpha}\right]$is the share of capital-output ratio, $(g_k - g_y)$, is the output per capital employed, $\left[\frac{1}{\alpha}\right]$is the share of total factor productivity in output and q is the Solow residual.

Equation (4.24) implies that the rate of growth of output per man-hour depends positively on the rate of growth of the capital-output ratio and on the Solow residual. There can be labour productivity growth even if q is equal to zero, as long as the capital-output ratio increases. The multifactor productivity growth denoted by q, which is less formally called Solow residual, can account for that part of growth that cannot, under the maintained Solow growth theory assumptions, be explained by either growth of labour or growth of capital. This indicates that the equilibrium growth rate of labour productivity is uniquely determined by the rate of technological change[6]. Moreover, the continued improvement of (average and marginal) labour productivity growth translates into steadily increasing labour

[6]Landmann (2004) disaggregated productivity growth in total manhour, labour force and labour productivity.

demand, given Solow's assumption of an exogenously determined labour supply (population) and a constant employment rate (full employment).

3.2. Model Specification

3.2.1 Empirical Model Specification

The empirical modelling of labour productivity, employment and output growth is based on systematic analysis. The underlying assumption is that there is a causal relationship between labour productivity and employment. Also, labour productivity growth affects output growth without feedback effect from output to productivity. Lastly, labour productivity and employment affect output growth in the long-run. These three channels of interaction among the macroeconomic variables form the direction of empirical analysis in this study.

Starting with the causal relationship between labour productivity growth and employment growth, this study follows the models by Landmann (2004), Azorin and Vegas (2017) and Alani (2018). The empirical model for this relationship is expressed as:

$$EMPLt = \gamma_0 + \gamma_1 LPRDt + \gamma_2 Z_t + \varepsilon_t \quad (4.25)$$

where: $EMPL_t$ is the measure of employment, $LPRD_t$ is the measure of productivity, Z_t is the vector of control variables, ε_t is the error term, γ_1 and y_2 are coefficients of the variables, and *t* is time.

Next, the relationship between labour productivity and output growth is derived. The relationship between productivity and output growth can be represented by the following model:

$$Y_t = \beta_0 + \beta_1 LPRD + \beta_2 Z_t + \mu_t \quad (4.26)$$

where Y_t is the measure of output growth, $LPRD_t$ is the measure of labour productivity, Z_t is the vector of control variables while μ_t is the error term β_1 and β_2 are coefficients of the variables and *t* is time.

Finally, the linkage among labour productivity, employment and output growth is specified. Aggregate employment depicts the ratio of aggregate output and the average productivity of labour. The specific equation can be expressed as:

$$Y_t = \delta_0 + \delta_1 LPRD_t + \delta_2 EMPL_t + \delta_3 Z_t + \mu_t \quad (4.27)$$

where Y_t is the measure of output growth, $LPRD_t$ is the measure of labour productivity, $EMPL_t$ is the measure of employment, Z_t is the vector of control variables, μ_t is the error term while δ_1, δ_2 and δ_3 are coefficients of the variables and *t* is time. Equation (4.27) shows the interaction of productivity, employment and output growth. The magnitude and sign of the coefficients of exogenous variables with respect to the endogenous variable will determine the aggregate effect of productivity and employment on output growth.

Z is a vector of control economic variables. Six economic variables are used as control variables in this study- labour force, participation rate, working hours, population, unemployment rate and age structure. These economic variables are informed by the empirical literature on productivity, employment and output growth (Landmann, 2004; Alani, 2012, Folawewo and Adeboje, 2017 and Liu, 2018). Labour force (LF) is measured as the aggregate number of employed and unemployed population of a country. An increase in labour force is expected to boost output growth because, due to the expected effect on factor input, more importantly increase in labour force should lead to increased productivity. The age structure (AGE) depicts the ratio of working population to the dependent population. It is expected that the higher the level of age structure, the higher the level of labour productivity and vice versa. This has various implications for aggregate output as more dependent population can lead to low output (Panchanan, *et al* 2017).

Another economic variable examined in this study is labour force participation rate (LFPR). It is measured as the ratio of the total population to the working population and this shows the proportion of the population generating the output. It also reveals the percentage of increase in the labour force contributing to output growth. Worked hour (WHR) is measured as the ratio of the hours worked to the persons employed. Total number of hours worked determines the utilization level of factor input; thus, total factor productivity is determined by the numbers of hours worked rather than just the numbers of persons available for work (Tamasauskiene and Stankaityte, 2013).

Population (POP) is an important economic variable measured as the total number of people living in a geographical location. It is expected that as a country's population increases, the level of productivity also increases due to the increase in the size of

work force. Essentially, population growth affects a country's age structure, migration and size of labour force, among other things. Unemployment rate (UR) is measured as percentage of the labour force or active working population without gainful employment either in paid employment or self-employment. It is expected that increase in unemployment rate will lower labour productivity due to the fear of job loss. Ajakaiye, *et al* (2016) showed that unemployment rate is higher in developing country like Nigeria because of high population growth rate which often makes employment-unemployment ratio skewed.

3.3 Estimation Technique and Procedure

This section provides the estimation techniques and procedures in the analysis of the relationship among labour productivity, employment and output growth.

3.3.1 Granger Causality Test

To achieve the first objective of this study employed the Granger causality test. The framework is based on Granger (1969) who stated that causality is determined using the time-series data approach. Granger proposed that x is a cause of y if it is helpful in forecasting y_1. This implies that $x$is able to increasethe accuracy of the prediction of $y$with respect to a forecast, consideringonly past values of y.Thus, given an information set Ω_t expressed as$(x_t, \ldots. x_{t-j}, y_t, \ldots. y_{t-j})$ is said to be a Granger causal for $y_t$wrt.Ω_t ifthe variance of the optimal linear predictor ofy_{t+h}, based on Ω_t, has smallervariance than the optimal linear predictor of y_{t+h} based only on lagged valuesof y_t, for any h. Thus, x Granger-causes y if and only if $\sigma_1^2(y_t: y_{t-j}, x_{t-i}) < \sigma_2^2(y_t: y_{t-j})$, with j and $i = 1, 2, 3, \ldots. n\ and\ \sigma^2$representing the variance ofthe forecast error.

A Granger-causality test can be applied in three different types of situations:

i. a simple Granger-causality test is applied when there are two variables and their lags.
ii. a multivariate Granger-causality test is applicable to more than two variables are included, because it is supposed that more than one variable can influence the results.

iii. Granger-causality can also be tested in a VAR framework, in this case the multivariate model is extended in order to test for the simultaneity of all included variables.

Given the foregoing, a simple Granger-causality test will be used in this study to test whether productivity Granger causes employment and vice versa. As already stated, labour productivity (LPRD) is used as an indicator for productivity, while employment is measured by employment rate (EMPL). Thus, based on the studies of Mahdavi and Sohrabian (1989) and Foresti (2006), the following two equations can be specified.

$$(EMPL)_t = \alpha + \sum_{i=1}^{m} \beta_i (EMPL)_{t-i} + \sum_{j=1}^{n} \beta_j (LPRD)_{t-j} + \mu_t \qquad (4.28)$$

$$(LPRD)_t = \alpha + \sum_{i=1}^{p} \gamma_i (LPRD)_{t-i} + \sum_{j=1}^{q} \gamma_j (EMPL)_{t-j} + \varepsilon_t \qquad (4.29)$$

Four different hypotheses about the relationship between LPRD and EMPL can be formulated based on the estimated OLS coefficients for the equations (4.28) and (4.29).

i. Unidirectional Granger-causality from LPRD to EMPL. In this case labour productivity increases the prediction of the employment rate but not vice versa. Thus $\sum_{j=1}^{n} \beta_j \ 0 \ and \ \sum_{j=1}^{q} \gamma_j = 0$

ii. Unidirectional Granger-causality from EMPL to LPRD. In this case the growth of employment level increases the prediction of labour productivity but not vice versa. Thus$\sum_{j=1}^{n} \beta_j = 0 \ and \ \sum_{j=1}^{q} \gamma_j \neq 0$

iii. Bidirectional (or feedback) causality. In this case$\sum_{j=1}^{n} \beta_j \neq 0 \ and \ \sum_{j=1}^{q} \gamma_j \neq 0$, so in this case the labour productivity increasesthe prediction of the employment level and vice versa.

iv. Independence between GDP and SP. In this case there is no Granger causality in any direction, thus$\sum_{j=1}^{n} \beta_j = 0 \ and \ \sum_{j=1}^{q} \gamma_j = 0$.

It is therefore possible to detect the causal relationship between labour productivity and employment if one of the above results is obtained, and the rejection of the null hypothesis in each case implies causality. The direction of causality is however determined by using test statistics such as i.e. *Chi-square* –test and *F*-test. For

instance, the null hypothesis if the computed probability value(P_v)for the *Chi-square* –test/*F*-test is less than 0.05 level of significance, otherwise, we do not reject it.

i. If the $P_v > 0.05$ in equation (1) and is <0.05 in equation (4.28); it implies that the relationship between the two variables is unidirectional and the causality runs fromy_{1t}toy_{2t}.

ii. If the $P_v > 0.05$ in equation (4) and is >0.05 in equation (4.29); it implies also that the relationship between the two variables is unidirectional, however, the causality runs from $y_{2t}$to y_{1t}.

iii. If the $P_v > 0.05$ in both equations; it implies that the relationship between the twovariables is bi-directional and therefore, there is a feedback between the twovariables.

iv. Conversely however, if the $P_v > 0.05$ in both equations; it implies that there is no relationship between the two variables.

3.3.2 Auto Regressive Distributed Lag (ARDL) Estimators

To achieve objectives two and three, this study uses the autoregressive distributed lag (ARDL) framework of Pesaran and Shin (1999) and Pesaran (2001). This framework is distinct from traditional approach to determine the long-run and short-run relationships among variables using the standard Johansen cointegration (Johansen, 1988; Johansen and Juselius, 1990) and Vector Error Correction (VEC) procedures. In spite of its innovative properties and popularity, the Johansen procedure has been under scrutiny in terms of sample size (Asaleye, *et al*, 2017).

There are advantages of using ARDL framework instead of the conventional Johansen procedures as noted by Duasa (2007). The conventional cointegration method estimates the long run relationships within a context of a system of equations, the ARDL method employs only a single reduced form equation (Pesaran and Shin, 1995). The ARDL method yields consistent and robust results both for the long-run and short-run relationship between growth and human capital investment. The ARDL approach does not involve pre-testing variables, which means that the test for the existence of relationship between variables in levels is applicable irrespective of whether the underlying regressors are purely $I(0)$, purely $I(1)$ or mixture of both. This feature alone, given the characteristics of the cyclical components of the data, makes the standard of cointegration technique unsuitable

and even the existing unit root tests to identify the order of integration are still highly questionable.

Duasa (2007) noted that it is possible with ARDL that different variables have different optimal lags, which is impossible with the standard cointegration test. Most importantly, the model could be used with limited sample data (30 observations to 80 observations) in which the set of critical values were developed originally by Narayan (2004). The ARDL approach describe the existence of an equilibrium in terms of long-run and short-run dynamics without losing long-run information as presented in the two models below:

ARDL Specification for Labour Productivity and Output Growth Relation

To estimate the relationship between productivity and output growth, the long run ARDL model is first specified. This is after checking the variable's order of integration since regressing non-stationary variables can give misleading results. It is required that none of the variables is $I(2)$ or more in order to avoid spurious results. The long run ARDL model is stated as:

$$\begin{aligned}\Delta \ln(y_t) = c_3 &+ \sum_{i-1}^{a} \psi_{1i}\, \Delta \ln(y_{t-i}) + \sum_{i-0}^{b} \psi_{2i}\, \Delta \ln(lprd_{t-1}) + \sum_{i-0}^{c} \psi_{3i}\, \Delta \ln(pop_{t-1}) \\ &+ \sum_{i-0}^{d} \psi_{4i}\, \Delta \ln(wh_{t-1}) + \sum_{i-0}^{e} \psi_{5i}\, \Delta \ln(lf_{t-1}) + \sum_{i-0}^{f} \psi_{6i} \Delta \ln(lfpr_{t-1}) \\ &+ \sum_{i-0}^{g} \psi_{7i} \Delta \ln(as_{t-1}) + \emptyset_1 \Delta \ln(y_{t-1}) + \emptyset_2 \Delta \ln(lprd_{t-1}) + \emptyset_3 \Delta \ln(pop_{t-1}) \\ &+ \emptyset_4 \Delta \ln(wh_{t-1}) + \emptyset_5 \Delta \ln(lf_{t-1}) + \quad \emptyset_6 \Delta \ln(lfpr_{t-1}) + \quad \emptyset_7 \Delta \ln(as_{t-1}) \\ &+ \quad \varepsilon_t \end{aligned} \qquad (4.\ 30)$$

where the summation terms represent the Error Correction Model (ECM) dynamics. The first part of the equations with the coefficients ψ_1 - ψ_7 represent the short-run dynamics of the three models respectively while the parameters $\emptyset_1 - \emptyset_7$ represent the long-run relationship. $\varepsilon_t$is the white noise. The symbol Δ is first-difference operator, and $a,\ b,\ c, d, e, f\ and\ g$ are the optimal lag lengths for each incorporated series in the three models. Note that there is no reason that the lag-length terms are equivalent to each other.

The equations will be estimated using classical ordinary least square (OLS) method. To test the existence of a long-run level relationship the F test will be used. When long-run relationship exists, F test indicates which variable should be normalized. The null hypothesis for no cointegration (i.e. no long-run relationship) among variables in equations 4.30 are:

H_0: $\emptyset_1 = \emptyset_2 = \emptyset_3 \ldots. = \emptyset_7 = 0$

H_1: $\emptyset_1 = \emptyset_2 = \emptyset_3 \ldots. = \emptyset_7 \neq 0$

The null hypothesis assumes that there is no co integration among variables as against the alternative hypothesis which assumes otherwise.

The next step is to estimated error correction model (ECM) which shows the speed of adjustment back to long-run equilibrium after the short run disturbance. The ARDL specification of the short-run dynamics is written as:

$$\Delta \ln(y_t) = c_3 + \sum_{i-1}^{a} \psi_{1i} \Delta \ln(y_{t-i}) + \sum_{i-0}^{b} \psi_{2i} \Delta \ln(lprd_{t-1}) + \sum_{i-0}^{c} \psi_{3i} \Delta \ln(pop_{t-1}) + \sum_{i-0}^{d} \psi_{4i} \Delta \ln(wh_{t-1}) + \sum_{i-0}^{e} \psi_{5i} \Delta \ln(lf_{t-1}) + \sum_{i-0}^{f} \psi_{6i} \Delta \ln(lfpr_{t-1}) + \sum_{i-0}^{g} \psi_{7i} \Delta \ln(as_{t-1}) + \rho \mathrm{ECM}_{t-1} + \varepsilon_t \quad (4.31)$$

All coefficients of short-run equations are coefficients relating to the short-run dynamics of the model's convergence to equilibrium, and ρ represents the speed of adjustment. The ECM indicates the speed of adjustment back to long-run equilibrium after a shirt-run disturbance.

ARDL Specification for Labour Productivity, Employment and Output Growth Relations

The long run ARDL model for estimating the relationship among productivity, employment and output growth is specified. Also, this is after checking the variable's order of integration since regressing non-stationary variables can give misleading results. It is required that none of the variables is I (2) or more in order to avoid spurious results. The long run ARDL model is stated as:

$$\Delta \ln(y_t)$$

$$= c_3 + \sum_{i-1}^{a} \psi_{1i} \Delta \ln(y_{t-i}) + \sum_{i-0}^{b} \psi_{2i} \Delta \ln(lprd_{t-1}) + \sum_{i-0}^{c} \psi_{3i} \Delta \ln(empl_{t-1})$$

$$+ \sum_{i-0}^{d} \psi_{4i} \Delta \ln(pop_{t-1}) + \sum_{i-0}^{e} \psi_{5i} \Delta \ln(wh_{t-1}) + \sum_{i-0}^{f} \psi_{6i} \Delta \ln(lf_{t-1}) + \sum_{i-0}^{g} \psi_{7i} \Delta \ln(lfpr_{t-1})$$

$$+ \sum_{i-0}^{h} \psi_{8i} \Delta \ln(as_{t-1}) + \emptyset_1 \Delta \ln(y_{t-1}) + \emptyset_2 \Delta \ln(lprd_{t-1}) + \emptyset_3 \Delta \ln(empl) + \emptyset_4 \Delta \ln(pop_{t-1})$$

$$+ \emptyset_5 \Delta \ln(wh_{t-1}) + \emptyset_6 \Delta \ln(lf_{t-1}) + \emptyset_7 \Delta \ln(lfpr_{t-1}) + \emptyset_8 \Delta \ln(as_{t-1})$$

$$+ \varepsilon_t \qquad (4.32)$$

where the summation terms represent the Error Correction Model (ECM) dynamics. The first part of the equations with the coefficients ψ_1 - ψ_8 represent the short-run dynamics of the three models respectively while the parameters $\emptyset_1 - \emptyset_8$ represent the long-run relationship. $\varepsilon_t$is the white noise. The symbol Δ is first-difference operator, and a, b, c, d, e, f *and* g are the optimal lag lengths for each incorporated series in the three models. Note that there is no reason that the lag-length terms are equivalent to each other.

As already noted, the equations will be estimated using classical ordinary least square (OLS) method. To test the existence of a long-run level relationship the F test will be used. When long-run relationship exists, F test indicates which variable should be normalized. The null hypothesis for no cointegration (i.e. no long-run relationship) among variables in equations 4.32 are:

H_0: $\emptyset_1 = \emptyset_2 = \emptyset_3 \ldots. = \emptyset_8 = 0$

H_1: $\emptyset_1 = \emptyset_2 = \emptyset_3 \ldots. = \emptyset_8 \neq 0$

The null hypothesis assumes that there is no co integration among variables as against the alternative hypothesis assumes otherwise.

The next step is to estimated error correction model (ECM) which shows the speed of adjustment back to long-run equilibrium after the short run disturbance. The ARDL specification of the short-run dynamics is written as

$$\Delta \ln(y_t)$$

$$= c_3 + \sum_{i-1}^{a} \psi_{1i} \Delta \ln(y_{t-i}) + \sum_{i-0}^{b} \psi_{2i} \Delta \ln(lprd_{t-1}) + \sum_{i-0}^{c} \psi_{3i} \Delta \ln(empl_{t-1})$$

$$+ \sum_{i-0}^{d} \psi_{4i} \Delta \ln(pop_{t-1}) + \sum_{i-0}^{e} \psi_{5i} \Delta \ln(wh_{t-1}) + \sum_{i-0}^{f} \psi_{6i} \Delta \ln(lf_{t-1}) + \sum_{i-0}^{g} \psi_{7i} \Delta \ln(lfpr_{t-1})$$

$$+ \sum_{i-0}^{h} \psi_{8i} \Delta \ln(as_{t-1}) + \rho \mathrm{ECM}_{t-1}$$

$$+ \varepsilon_t$$

All coefficients of short-run equations in 4.33 are coefficients relating to the short-run dynamics of the model's convergence to equilibrium, and ρ represents the speed of adjustment. The ECM indicates the speed of adjustment back to long-run equilibrium after a shirt-run disturbance.

To conduct a bounds test for the null hypothesis, the calculated (Wald) F-statistic is compared with the critical value tabulated by Pesaran (1999) and Pesaran et al. (2001). If the test statistics exceeds the upper critical value, the null hypothesis of a no long-run relationship can be rejected regardless of whether the under lying order of integration of the variables is 0 or 1 or a mixture of both. Similarly, if the test statistic falls below a lower critical value, the null hypothesis is not rejected. However, if the test statistic falls between these two bounds, the result is inconclusive. When the order of integration of the variables is known and all the variables are $I(1)$, the decision is made based on the upper bound. Similarly, if all the variables are $I(0)$, then the decision is made based on the lower bound.

The ARDL method estimates $(k+1)^n$ number of regressions in order to obtain the optimal lag length for each variable, where $k$is the maximum number of lags to be used and n is the number of variables in the equation. The orders of the lags in the ARDL models are selected by the Akaike Information criterion (AIC), the Schwarz Information criterion (SIC), and Hannan-Quinn Information criterion (HIC) before the selected model is estimated by OLS. For annual data, Pesaran and Shin (1999) recommended choosing a maximum of 2 lags. From this, the lag length that minimizes the criteria are selected.

3.4 Pre and Post Estimation Diagnostic Tests

3.4.1 Pre-Estimation Diagnostic Test

The time series properties of the variables incorporated in the ARDL models are examined using the Augmented Dickey-Fuller unit root test in order to determine the long-run convergence of each series to its true mean. The test involves the estimation of equations with drift and trends as proposed Dickey and Fuller (1988). The test equations are expressed as:

$$\Delta Z_t = \eta_0 + \eta_1 Z_{t-1} + \sum_{i=1}^{n} \pi_i \Delta Z_{t-i} + \nu_t \quad (4.34)$$

$$\Delta Z_t = \eta_0 + \eta_1 Z_{t-1} + \eta_1 t + \sum_{i=1}^{n} \pi_i \Delta Z_{t-i} + \nu_t \quad (4.35)$$

$H_0 : \quad \eta_1 = 0$

$H_1 : \quad \eta_1 < 0$

The time series variable is represented by Z, t andν_t as time and residual respectively. The equations (4.34) and (4.35) are the test models with intercept only, and linear trend respectively.

3.4.2 Cointegration Test

After establishing that variables are stationary, it is necessary to determine whether or not there is long run relationship between them. Co-integration regressions measure the long-term relationship between the variables whose existence guarantees that the variables demonstrate no inherent tendency to drift apart. The study employs Johansen Co-integration tests.

Johansen (1988) and Johansen and Juselius (1990, 1992) proposed a maximum likelihood estimation procedure which allows for simultaneously estimating with in a system involving two or more variables, in order to circumvent the problems associated with the traditional regression methods of Engler-Granger. This method is independent of the choice of an endogenous variable, and it allows researchers to estimate and test for the presence of more than one co-integrating vector in a multivariate system. In order to identify the co-integration relationship between variables, the Johansen procedure uses a vector autoregressive model (VAR of order (p)), which can be expressed as follows:

$$\Delta Z_t = \Pi Z_{t-1} + \Gamma_1 \Delta Z_{t-1} + \ldots + \Gamma_{P-1} \Delta Z_{t-p+1} + U_0 + \varepsilon_t \quad (4.36)$$

This VAR (p) can be re-written as follow:

$$\Delta Z_t = U_0 \mid \Pi Z_{t-1} \mid \sum_{i=1}^{p} \Gamma t \mid \Delta Z_{t-1} \mid \delta_t$$

Where:

$$\Pi = \sum_{i=1}^{p} \Gamma t \; A_{i-1} \qquad \text{and} \qquad \Gamma = \sum_{j=i+1}^{p} Aj$$

Johansen thus proposes two different likelihood ratio tests – the trace test and the maximum eigenvalue test, illustrated in equations (50) and (51)

$$I_{Trace} = -T\sum_{i=r+1}^{n} Ln\ (1 - \lambda i) \quad - \quad (4.37)$$

$$I_{Max} = -\ T \sum_{i=r+1}^{n} Ln\ (1 - \lambda r + 1) \quad (4.38)$$

Where T is the Sample Size Π, λ_1 is the n_{ith} eigenvalue and r is the rank of the Π Martix.

3.4.3 Post Estimation Diagnostic Test

The specified long-run and short-run ARDL models (38-40) are estimated through the use of Classical Least Square Estimator and other time series diagnostic tests are employed such as Ramsey RESET test for the entire structural stability of the model in line with underlining classical assumptions; residual diagnostic tests like Histogram normality test, Breusch Godfrey serial correlation LM test, Breusch-Pagan-Godfrey (BPG) and ARCH Heteroskedasticity tests test to examine the level at which the estimated coefficient variance is inflated due to multicollinearity.

3.5 Data Requirements and Sources

The time series data required for this study are labour productivity, gross fixed capital formation, public expenditure, unemployment rate, education (school enrolment), GDP growth rate, structural change, population, exchange rate, gross domestic product (GDP), labour force, working hours, employment rate, participation rate and age structure. This study employed annual data that spans from 1990 to 2018. These data will be sourced from the World Bank's World Development Indicators (2019), National Bureau of Statistics Annual Abstract of

Statistics (various issues) and Central Bank of Nigeria's Statistical Bulletin (various issues).

Table 3.1: Definition of Variables

Variables	Definition	Proxy	Source
LPRD	Labour Productivity	Labour productivity, the ratio of GDP to hours worked.	NBS
EMPL	Employment	Employment rate, the ratio of person employed to labour force.	CBN and NBS
Y	Output Growth	GDP growth rates.	WDI
UNEMPL	Unemployment	Unemployment rates for the period	WDI
POP	Population	Population ratio, 15+, Total percentage.	NBS
WH	Worked Hour	The ratio of hours worked and persons employed.	NBS
LFPR	Labour Force Participation Rate	The ratio of labour force to working-age population.	NBS
DP	Dependency Ratio (or age structure)	The ratio of working- age population to the total population.	NBS
LF	Labour Force	Aggregate number of employed and unemployed members of the population.	NBS

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter presents the results of empirical analysis of the relationship among labour productivity, employment and output growth in Nigeria. It covers the pre-estimation diagnostics, empirical results of ARDL-ECM models, and post- estimation tests. This method of presentation is expected to offer a robust view of the empirical analysis of the relationship among these variables of interests in Nigeria.

4.1 Pre-Estimation Diagnostics

4.1.1 Descriptive Statistics

The result of the descriptive statistics is presented in Table 5.1. The results revealed that the average value of GDP growth (i.e. GDPGR) over the period was about 5.26%, with a maximum value of 35.84% and minimum value of -2.48% respectively. Labour productivity per hour (LPROD) averaged N453.89K with a maximum value of

N792.62K and minimum value of N304.31K while employment rate (EMPLOY) in the country was at an average of about 7.66% over the study period. The minimum and maximum values of 7.48 and 7.84 respectively showed a moderate variability for EMPLOY. The value of labour force (LF) was at the average of 47.75 million. It fluctuated between the upper limit of 90.47 million and a lower limit of 30.04 million while the average labour force participation rate (LFPR) over the period was about 5.52%, with a maximum value of 5.64% and minimum value of 5.46%.

The value of total hours worked per annum (THWPA) averaged 97.44billion with a maximum value of 169.96billion and minimum value of 58.47 billion while dependency ratio (DR) averaged 5.32% with variability ranging between 5.37% and 5.22% respectively. Population growth (POP) over the study period was at an average of about 8.13%. It fluctuated between the upper limit of 8.29% and lower limit of 7.97%. Finally, the average unemployment rate (UR) in the country during the study period was 13.3% with a fluctuation between the maximum value of 27.0% and minimum value of 1.29%.

Essentially, the standard deviation showed that variability was highest for per capita GDP, labour productivity and unemployment rate, while the variability was moderate for labour force, labour force participation rate and age structure, whereas the variability was lowest for employment rate, hours worked and population growth.

Furthermore, in statistical analysis, the assumption of data coming from a normal distribution is often made. Testing the normality of distribution therefore becomes imperative. Jarque-Bera test shows the goodness of fit of test of departure from normality of distribution based on the skewness and kurtosis. As shown on Table 5.1, the Jarque-Bera statistics reject the null hypothesis of normality very strongly, thus all the variables used in the study are normally distributed and are therefore suitable for the analysis because of their potentials to generate good estimates.

4.1.2 Unit Root Test

The Augmented Dickey–Fuller (ADF) and Phillips-Perron (PP) unit root tests were conducted in this study for all variables to determine their stationarity properties. The ADF and PP techniques employed are based on the McKinnon critical values. The null hypothesis of the tests is the presence of unit root in the series. Table 5.3 presents the results of the unit root tests which show that the variables are either stationary at levels or at their first differences when tested at between 1.0% and 10 % significant levels.

From the results presented in Table 5.2, it was observed that, for both ADF and PP; the variables GDPPC, LFPR, AS, UR and POP respectively were stationary at 5 per cent level of significance in their level form, that is, integrated of order I (0). The remaining variables were non-stationary at their level form. This led to test at first difference, which revealed that the remaining variables (i.e. LPROD, EMPLOY, LF and THWPA) were stationary at first difference, that is, integrated of order one I(1). After establishing stationarity, next is the examination of the co-integration relationship among the variables.

Table 4.1: Descriptive Statistic

	Mean	Median	Maximum	Minimum	Std. Dev.	Jarque-Bera	Probability	Obs
GDPGR	5.2611	4.3533	35.845	-2.4790	6.5142	695.3175	0.0000	116
LPROD	453.8945	419.7000	792.6200	304.3100	158.6486	3.6305	0.1628	116
EMPLOY	7.6613	7.6386	7.8456	7.4825	0.1199	10.2337	0.0060	116
LF	47781756	42063952	90470592	30043881	17222521	8.507716	0.0141	116
LFPR	5.5228	5.5095	5.6411	5.4642	0.0479	29.6303	0.0000	116
POP	8.1335	8.1316	8.2962	7.9748	0.0940	7.0010	0.0302	116
DR	5.3213	5.3248	5.3713	5.2251	0.0409	20.4335	0.0000	116
THWPA	97.444	82.494	167.9600	58.4721	36.4014	3.9791	0.1368	116
UR	13.3387	13.4225	27.0078	1.2906	8.0548	8.1275	0.0172	116

Source: Author's Computation

Table 4.2: Unit Root Test Results

Variable	Augmented Dickey–Fuller (ADF)			Phillips-Perron (PP)		
	Level	First Difference	I(d)	Level	First Difference	I(d)
GDPGR	-2.36125a	-3.38892**b	I(1)	-3.0491a	-3.0271***b	I(0)
LPROD	-0.1063a	-2.6789*a	I(1)	0.9420a	-5.2115***a	I(1)
EMPLOY	-2.0327a	-3.2405*b	I(1)	-0.2809a	-5.0260***b	I(1)
LF	1.0240a	-2.5122***b	I(1)	2.0363a	-5.1969***b	I(1)
LFPR	-3.1749**a	-2.2728**a	I(0)	-3.3954**a	-1.2925**b	I(0)
POP	-3.7435**a	-2.8794**b	I(1)	-0.9080***a	-1.1441***b	I(0)
THWPA	0.0443a	-2.91445*b	I(1)	-0.3515a	-5.1466***b	I(1)
AS	-3.1430**a	-2.7493**a	I(0)	-1.4726a	-3.2929**a	I(1)
UR	-1.2779a	-2.6036**b	I(0)	-6.4855***a	-6.4433***a	I(1)

Source: Author's computation: underlying data from WDI and NBS database

*Note: *, ** and *** imply statistical significance at 10%, 5% and 1% levels respectively. Also, "a" denotes model with constant, "b" is for a model with constant and trend and "c" is the model without constant and trend*

4.1.3 Bound Test Cointegration

The ARDL bound test shows the presence of long run relationship between the variables. The F-statistics are obtained from the Wald test and are compared to the lower and upper bound critical values. Long run relationship exists when the value of F-statistic is greater than the upper bound. The bounds test results for cointegration are reported in Table 5.3. The three Models have F-statistics that are greater than the upper bound critical values. Specifically, the table shows that for Model 1 and Model 2, the F-statistics is greater than the upper bound critical value at all levels of significance. Therefore, the null hypothesis of no level relationship is rejected, hence, long-run co-integration relationship is established among the variables in the three models. Thus, the short-run error correction models (ECMs) can be estimated for all the models.

4.1.4 Lag Length Selection Criteria

Table 5.4 reveals the lag length selection criterion for each model used in the analysis based on the ARDL bound test approach to co-integration employed in this study.

According to the procedure, there is need to first determine the lag length of the VAR which must be small enough to allow estimation and high enough to ensure that errors are approximately white noise. It is often based on different information criteria, e.g. Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hannan-Quinn Information Criterion (HQ) etc. The maximum lag in the ARDL model in this study was set equal to 4 for all models based on Schwarz information criterion.

Table 4.3: Cointegration Results and Critical Values

Estimated Model	F-Statistics	K	90% level		95% level		99% level	
			I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Model 1	10.16	6	4.04	4.78	4.94	5.73	6.84	7.84
Model 2	6.73	7	3.17	4.14	3.79	4.85	5.15	6.36
Model 3	6.42	8	1.83	2.94	2.06	3.24	2.54	3.86

Source: Author's computation: underlying data from WDI, CBN, and NBS database

Table 4.4: Lag Length Selection Criteria for the Two Models

Lag	LogL	LR	FPE	AIC	SIC	HQ
Model 1: F_{GDPPC} (LPROD, LF, LFPR, THWPA, AS, POP, UR)						
0	-76.09818	NA	54.80324	6.807855	7.246650	6.929558
1	-75.58227	0.619101	57.74299	6.846581	7.334132	6.981807
2	-74.75241	0.929433	59.54770	6.860193	7.396499	7.008941
3	-74.56432	0.195618	64.92528	6.925146	7.510206	7.087417
4	-74.55054	0.013226*	72.15712*	7.004043*	7.637859*	7.179837*
Model 2: F_{GDPPC} (LPROD, EMPLOY, LF, LFPR, THWPA, AS, POP, UR)						
0	-76.09818	NA	54.80324	6.807855	7.246650	6.929558
1	-75.58227	0.619101	57.74299	6.846581	7.334132	6.981807
2	-74.75241	0.929433	59.54770	6.860193	7.396499	7.008941
3	-74.56432	0.195618	64.92528	6.925146	7.510206	7.087417
4	-74.55054	0.013226*	72.15712*	7.004043*	7.637859*	7.179837*

Source: Author's computation with underlying data from World Bank Development Indicator (WDI)
Note: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error; AIC: Akaike information criterion; SIC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

4.2 Analysis of the Relationship among Productivity, Employment and Output Growth

This section discusses the results of the empirical investigation of the relationship among labour productivity, employment and output growth. This is systematically presented in line with the objectives of the study. The first subsection presents the results of the granger causality test, which is followed by the ARDL-ECM result of the relationship between labour productivity and output growth. Finally, the last subsection presents the ARDL-ECM results of the link among labour productivity, employment and output growth.

4.2.1 Granger Causality Test Result

In achieving the first objective of the study, the causal relationship between labour productivity and employment in Nigeria was evaluated. Ascertaining the existence and type of relationship among these variables precedes any meaningful analysis. Thus, the Granger causality is used to test the relationship between labour productivity and employment. The Granger causality test result is presented in Table 5.6.

As shown in Table 5.6, in the country, labour productivity Granger-causes employment at an estimated statistical significance of 5% while employment Granger-causes labour productivity at a 5% level of statistical significance. This result indicates an existence of a bi-directional causality between employment and labour productivity in Nigeria. In the case of employment-GDP relation, the F-test and probability value show strong evidence of Granger causality from employment to output growth. This indicates a unidirectional causality between employment and output growth in Nigeria. Also, given the value of F-test and coefficient statistical insignificance, there is no evidence that labour productivity Granger-causes output growth and vice versa. Thus, no causality exists between labour productivity and output growth in Nigeria.

The implication of this result is that, there is a Granger causality with a positive effect from labour productivity to employment in Nigeria and vice versa. This econometric evidence offers a strong support that increase in employment leads to increase in the level of productivity and vice versa. The feedback from employment to labour productivity indicates a trade-off between the two variables in Nigeria. Hence, increase in the level of productivity can lead to increase in employment level due to its ripple effects on output growth. These are the possible channels between employment and labour productivity in Nigeria. This finding is similar to Junankar (2013), Palazuelos and Fernández (2009) who stablished a trade-off between employment and labour productivity. The results also support the findings of McCullough (2018), Folawewo and Adeboje (2017), Klein (2012), Meager and Speckesser (2011) which emphasised productivity growth as prerequisite for employment growth both in the short-run and long-run.

The unidirectional Granger causality between employment and output growth reflects the type of output growth in Nigeria which precludes employment generation. Also, the Granger causality hypothesis is rejected strongly for the connection between labour productivity and output growth implying that the level of labour productivity is not sufficient enough to boost output growth in Nigeria. Using other econometric approaches, the following sub-sections further examines the relationship among labour productivity, employment and output growth in Nigeria as stated in the other objectives of this study.

Table 4.5: The Granger Causality Test Result

Variable	Observation	F-Statistic	Prob.
LPROD does not Granger Cause GDPGR	114	0.28846	0.7500
GDPGR does not Granger Cause LPROD		0.10752	0.8982
EMPLOY does not Granger Cause GDPGR	114	0.39142	0.0308
GDPGR does not Granger Cause EMPLOY		0.03531	0.9408
EMPLOY does not Granger Cause LPROD	114	5.36752	0.0531
LPROD does not Granger Cause EMPLOY		1.23159	0.0458

Source: Author's computation

4.2.2 Analysis of Labour Productivity and Output Growth Relations in Nigeria

The long-run and short-run ARDL results for the effect of labour productivity on output growth are reported in Table 5.7. The long-run result represents the estimates from the parsimonious specification of the relationship between labour productivity and output growth while the ECM result shows the speed of adjustment and incorporates the existence of convergence in long term equilibrium.

As shown in Table 5.7, in the long run, labour productivity has a positive and significant effect on output growth. Thus, with a coefficient of 0.655, a 1% increase in labour productivity led to about 65.5% increase in output growth. The result further shows that, in the long run, labour force does not have any significant effect on output growth since the coefficient is not statistically significant. This could be due to labour loss emanating from high unemployment rate in the country. Moreover, labour force participation rate has a positive and significant effect on output growth. Given the coefficient of 0.320, a 1% increase in participation rate resulted into about 32% increase in output growth. Also, the long run coefficient of all other control variables show that hours worked, age structure and population growth have positive and significant relationship with output growth whereas there is no significant relationship between output growth and unemployment rate based on the estimates presented in Table 5.7.

This result implies that, in the long run, output level responds significantly to growth in labour productivity in Nigeria. This result conforms to basic production theory which adduces output growth to increase in the productivity of factor inputs. However, output growth in Nigeria during the study period was not affected by labour force growth. This caused output growth to have a weak impact on unemployment rate in the country. This scenario could be best explained in two ways.

First, distilling the full potentials of output growth depends on the nature of labour productivity growth. Whenever output growth does not reflect its true opportunity costs, it could lead to poor performance of major macroeconomic variables such as high unemployment rate. Second, differences in labour productivity may reflect the observed and unobserved differences in the individuals or workers participating in economic activities rather than intrinsic differences in the productivity of the economic activities themselves. When this happens, the impact of productivity growth may be subjective, as the Nigerian case depicts. This result corroborates the findings of Lee and McKibbin (2018), Nakamura *et al* (2018), Marattin and Salotti (2011), Mahadevan and Kim (2003) that output growth is driven by labour productivity growth.

Furthermore, the long run estimates of the control variables imply that output growth is greatly influenced by labour force participation rate, age structure, population growth and worked hours while the level of labour force and unemployment rate have no significant effect on output growth in the country.

Consistent with the long-run results, the short run results show that labour productivity has positive and significant effect on output growth. Thus, given the coefficient of 0.255, a 1% increase in labour productivity increased output growth by 25.5%. This implies that positive relationship is established between labour productivity and output growth in Nigeria. The coefficient of labour force and labour force participation rate had positive and significant effect on output growth in the short run. Thus, with the coefficients of 0.653 and 0.444, a 1% increase in labour force and labour force participation contributed to an increase in output growth by about 65.3% and 44.4% respectively.

This implies that these two variables are essential for output growth in Nigeria. Furthermore, the coefficients of age structure and total hours worked exerted positive and significant effect on output growth. Hence, given the coefficients of 0.341 and 0.184, a 1% increase in dependency ratio and total hours worked increased output growth by 34% and 18.4% respectively. This implies that the age structure of the workforce and the total hours worked significantly determined the level of output in the country.

Furthermore, the short-run results show that population growth was positive and significant in determining the level of output growth in Nigeria. Thus, given the coefficient of 0.257, a 1% increase in population growth resulted into about 25.7% increase in the level of output growth. This implies that output growth was driven by population growth in Nigeria during the study period. Lastly, the short-run result shows a negative and significant relationship between unemployment and output growth. This result establishes the existence of Okun's law in the Nigerian context and suggests that output growth is negatively influenced by unemployment rate in the country.

Results also show that for Model 1, the ECM has the value of -0.3491 with a probability value of less than 5%. The coefficient is negative and significant. The ECM shows the speed of adjustment, this implies the existence of convergence in long-term equilibrium. Given the coefficient of -0.349, the ECM suggests that about 35% deviation from the long run equilibrium level of output is corrected annually.

Further diagnostic test shows that the Coefficients of Multiple Determination (R^2) for both short run and long run models are high, indicating that an average 75% of total variation in the dependent variable (GDPGR) is accounted for by the explanatory variables (i.e. LPROD, LF, LFPR, POP AS, UR THWPA). This result remains robust even after adjusting for the degrees of freedom. Thus, the regression has a good fit. The F-statistics, which test the explanatory power of the short run and long run models are statistically significant at 1%. This implies that the explanatory variables have joint significant effect on the output growth. The Durbin-Watson statistics of 2.007 and 1.7362 respectively indicate that the models are not prone to autocorrelation.

Table 4.6: Long-run and Short-run ARDL-ECM results for Labour Productivity and Output Growth Relation

Long-run		Short-run	
C	7.4777(0.4795)	D(GDPPC(-1))	0.2046(0.0157)***
GDPPC(-1)	0.5848(5.8920)*	D(LPROD(-1))	0.2549(-8.2940)*
LPROD	0.6554(4.5320)*	D(LF(-1))	0.6528(3.0269)**
LF	0.2104(0.2080)	D(LFPR)	0.4441(4.9919)*
LFPR	0.3198(2.3745)***	D(THWPA(-1))	0.1841(6.4221)*
THWPA	0.1176(2.8458)**	D(AS(-1))	0.3406(3.5068)**
AS	0.3402(2.4440)***	D(POP)	0.25704(3.007)**
POP	0.2048(3.3076)**	D(UR(-1))	-0.3068(-2.7127)**
UR	-0.1292(-0.9422)	ECM(-1)	-0.3491(-3.1664)**
D(LPROD)	0.2025(0.5616)*	-	-
D(LF)	0.6283(2.8899)**	-	-
D(LFPR)	0.4750(0.1008)*	-	-
D(THWPA)	0.1717(0.7432*)	-	-
D(UR)	-0.3080(-2.5865)*	-	-
R-SQUARE	0.7569	R-SQUARE	0.7834
Adj. R-SQUARE	0.6778	Adj. R-SQUARE	0.7095
F-STATISTICS	9.5737***	F-STATISTICS	10.5938*
AIC	4.7301	AIC	5.3238
SBC	5.4136	SBC	5.7876
DW-STATISTICS	2.0075	DW-STATISTICS	1.7362

Source: Authors' computation; underlying data from World Bank World Development Indicator (WDI).
Note: *,** and*** denote significance at 1%, 5% and 10% levels respectively while values in parenthesis are the t-statistics

ARDL (4, 0, 0, 4, 0, 1, 4, 0) for long-run and (4,0, 0, 4, 0, 1, 4,0) for short-run are selected based on Schwarz Bayesian Criteria.

4.2.3 Result of Labour Productivity, Employment and Output Growth Relations in Nigeria.

The long-run and short-run results for the analysis of labour productivity, employment and output growth relations in Nigeria are presented in Table 5.8. The results of the long run model reveal that labour productivity has positive and statistically significant effect on output growth. Thus, with the coefficient of 0.554, a 1% increase in labour productivity leads to 55.4% increase in output growth. This implies that output growth in Nigeria is significantly influenced by labour productivity. The long run result further shows that the relationship between employment and output growth is not statistically significant. This implies that the employment-output growth relation in Nigeria does not offer any empirical validity to any known theoretical underpinnings such as Okun's law.

The coefficients of all the control variables are statistically significant. For instance, in the long run, labour force and labour force participation rate have positive and significant relationship with output growth. Given the coefficients of 0.791 and 0.428, a 1% change in these variables led to about 7.9% and 42.8% increase in output growth respectively. Similarly, the long run result shows that total hours worked and dependency ratio have positive and statistically significant effect on output growth in Nigeria. As shown in Table 5.8, with the coefficients of 0.065 and 0.558, a 1% change in total hours worked and dependency ratio led to about 6.4% and 55.8% rise in output growth in the country. In the same vein, population growth has positive and significant effect on output growth while unemployment has a negative and significant effect on output growth. Hence, given the coefficients of 0.436 and 0.264, a 1% increase in population growth caused about 43.6% increase in output growth while 1% increase in unemployment rate caused about 26.4% decrease in output growth in Nigeria.

The short run results are similar to those of the long run in which all the explanatory variables, except employment rate, are statistically significant. Labour productivity has a positive and significant effect on output growth while employment rate does not have any significant relationship with output growth. Also, all other control variables such as labour productivity, labour force participation rate, total hours worked, dependency ratio and population growth are positive and statistically significant in determining output growth in the short run while unemployment rate is negative and statistically significant in the short run.

The results suggest that, with the coefficients of 0.755, a 1% increase in labour productivity led to about 75.5% increase in output growth while employment rate did not have any significant effect on output growth in Nigeria. Likewise, given the coefficients of 0.697, 0.047 and 0.796 1% rise in labour force, labour force participation and total hours worked increase output growth by 69.7%, 4.7% and 79.6% respectively. Also, given the coefficients of 0.663 and 0.845, a 1% rise in age structure, and population growth increased output growth by 66.3% and 84.5% respectively. However, the short-run report shows that, with the coefficient of 0.409, a 1% increase in unemployment rate led to about 40.9% reduction in output growth during the years under study.

Essentially, the findings suggest that output growth is influenced by labour productivity in Nigeria, whereas, labour force does not determine output growth in the country. This Nigerian situation can be best explained by the Solow analysis of output growth-labour productivity parity. Output growth reflects growth in labour force and labour productivity; thus, output can increase from total labour hours and output per hour. However, as the finding shows, output growth in Nigeria came more from increases in labour productivity rather than from increases in the labour force. Whenever this happens, output growth may not yield good performance of labour market outcomes such as employment, wages, unemployment etc.

This position is further corroborated by the finding of no significant relationship between output growth and employment in the Nigeria. This result opposes the standard growth theory, Okun's law and the theoretical framework of this study. This implies that output gains have not positively impacted the employment situation in Nigeria. This type of output growth has been styled jobless growth (Adeboje and Folawewo, 2017; Ajakaiye et al 2017; Asaleye, et al, 2017).

This is plausible because a simple paradigm in economic growth theory is that output growth can only be accompanied by employment growth if it is driven by structural changes. However, the employment trajectory in Nigeria is mostly driven by labour reallocation from agriculture and manufacturing towards low productive service and subsistent informal sector rather than productivity enhancement. Since aggregate employment is the ratio of aggregate output and the average productivity of labour from various sectors, there would be no change in unemployment level whenever output growth is not driven by structural changes. Thus, in consistence with growth theories, labour productivity growth is essential for both employment growth and output growth.

The ECM value for Model 2 has a probability of less than 5%. The coefficient is negative and significant. The ECM shows the speed of adjustment which implies the existence of convergence in long-term equilibrium. Specifically, the coefficient of the ECM suggests that about 29.7% deviation from the long run equilibrium level of output is corrected annually. Additional analysis of the results also shows that the Coefficient of Multiple Determination (R^2) for both short run and long run models were high, indicating that an average 80% of total variation in the dependent variable (GDPGR) is accounted for by the explanatory variables (i.e. LPROD, EMPLOY, LF, LFPR, POP AS, UR THWPA).

This result remains robust even after adjusting for the degrees of freedom. Thus, the regression has a good fit. The F-statistics, which test the explanatory power of the two models are statistically significant at 1%. This implies that the explanatory variables have joint significant effect on output growth. The Durbin-Watson statistics of 1.6630 and 2.005 for the short run and long run models indicate that the model is not prone to autocorrelation.

Table 4.7: Long-run and Short-run ARDL-ECM results for Labour Productivity, Employment and Output Growth Relations

Long-run		Short-run	
C	5.3441(0.3813)	D(GDPPC(-1))	0.1361(1.9873)***
GDPGR(-1)	0.1361(1.9873)***	D(LPROD(-1))	0.7575(0.8067)*
LPROD	0.5541(0.5320)*	D(EMPLOY(-1))	0.6974(0.2838)
EMPLOY	0.3325(0.1811)	D(LF(-1))	0.0473(3.5701)**
LF	0.0791(1.6609)	D(LFPR)	0.7946(0.2113)*)
LFPR	0.4281(3.3624)***	D(THWPA(-1))	0.6638(0.3995)*
THWPA	0.0647(1.9955)***	D(AS)	0.8451(0.5915)*
AS	0.5580(4.1852)**	D(POP)	0.4646(0.5471)*
POP	0.4361(0.5298)*	D(UR(-1))	-0.4095(-3.7736)*
UR	-0.2643(-2.1982)***	ECM(-1)	-0.2974(-2.8623)**
D(LPROD)	0.6128(0.4354)**	-	-
D(EMPLOY)	0.0118(0.7312)		
D(LF)	0.5532(0.3.5216)**	-	-
D(LFPR)	0.6543(0.4166))*	-	-
D(THWPA)	0.5410(0.6884)**	-	-
D(UR)	-0.4171(3.6799)*	-	-
R-SQUARE	0.8053	R-SQUARE	0.8242
Adj. R-SQUARE	0.7257	Adj. R-SQUARE	0.7488
F-STATISTICS	10.0948***	F-STATISTICS	10.9399*
AIC	4.5973	AIC	4.2143
SBC	5.4029	SBC	5.3442
DW-STATISTICS	1.6630	DW-STATISTICS	2.005

Source: Authors' computation; underlying data from World Bank World Development Indicator (WDI).
Note: *,** and*** denote significance at 1%, 5% and 10% levels respectively while values in parenthesis are the t-statistics

ARDL (4,0,4,0,4,4,4,4,0) for long-run and (4,0,4,0,4,4,4,4,0) for short-run are selected based on Schwarz Bayesian Criteria.

4.3. Post Estimation Diagnostic Tests

The post estimation diagnostic tests become essential in time series because of the inherent possibilities that such models could be susceptible to spurious outcomes. Therefore, in order to check the reliability of the estimates generated from the analysis, the models developed for the study are subjected to various diagnostic tests. The three important diagnostic tests conducted on the models include the Breusch-Godfrey Serial Correlation LM, Heteroskedasticity Test based on ARCH, and Stability Test. The serial correlation test is out to establish whether or not there is serial correlation among the models, the heteroscedasticity determines the presence of possible causal effect among variables while stability test tests whether the models converge in the long run, i.e. the heteroscedasticity show that the residual is constant over time.

4.3.1 Breusch-Godfrey Serial Correlation LM for Model 1

Table 5.9 presents the Breuch-Godfrey serial correlation LM, from the result the prob. Chi-Square is 0.5743 which is greater than 0.05, therefore the null hypothesis that there are no serial correlations between the variables cannot be rejected. Hence, there is no serial correlation in model 1 which shows the effect of labour productivity on output growth in Nigeria.

4.3.2 Heteroskedasticity Test: ARCH for Model 1

Table 5.10 below presents the Heteroskedasticity, from the result the prob. Chi-Square is 0.7733 which is greater than 0.05, therefore the null hypothesis that there is no Heteroskedasticity between the variables will be cannot be reject.

4.3.3 Stability Test for Model 1

Figure 5.1 shows the stability test for Model 1, using CUSUM test, when the line of the variables is in-between the upper and the lower boundaries this means that is stability at 5% level of significance; therefore, the graph above satisfies the above stated condition.

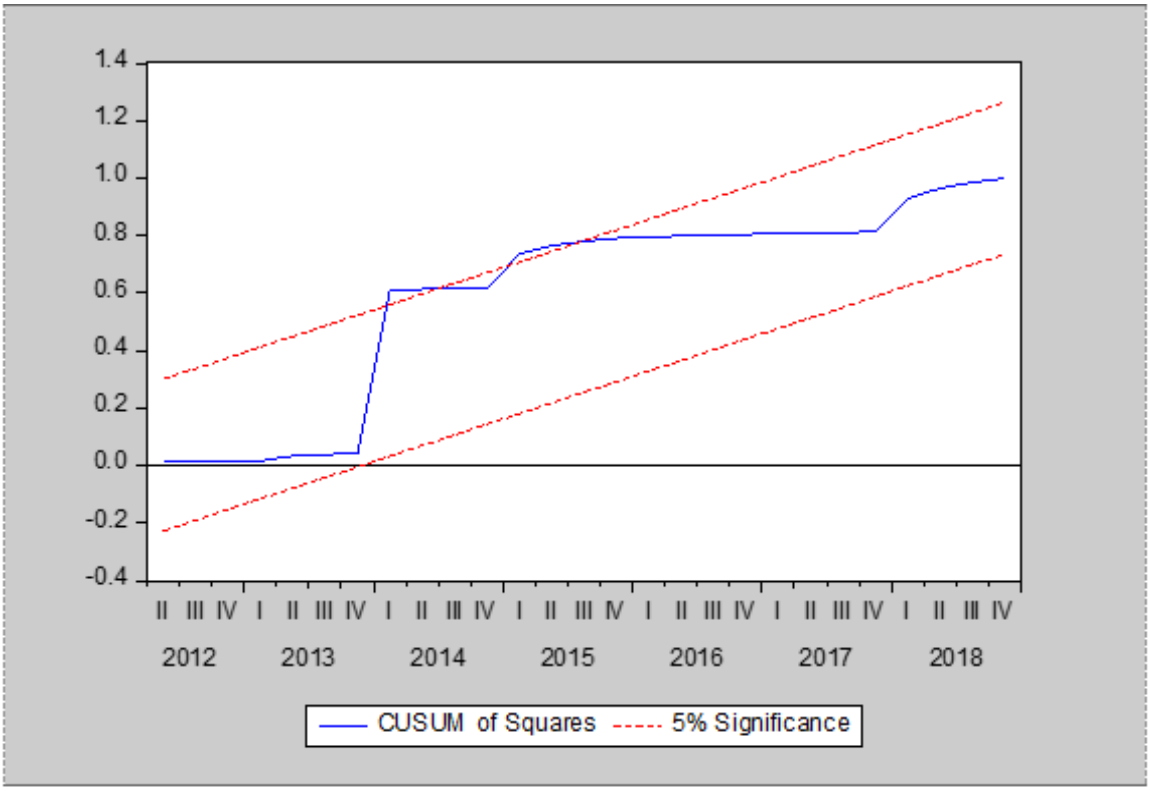
Table 5.9: Breusch-Godfrey Serial Correlation LM for Model 1			
F-statistic	12.85783	Prob. F(2,80)	0.7015
Obs*R-squared	27.00109	Prob. Chi-Square(2)	0.5743

Source: Author's computation

Table 5.10. Heteroskedasticity Test: ARCH for Model 1			
F-statistic	0.005783	Prob. F(2,80)	0.8017
Obs*R-squared	0.001091	Prob. Chi-Square(2)	0.7733

Source: Author's computation

Figure 4.1. Stability Test for Model 1



Source: Author's computation, 2019

4.3.4 Breusch-Godfrey Serial Correlation LM for Model 2

Table 5.11 presents the Breuch-Godfrey serial correlation LM, from the result the prob. Chi-Square is 0.1507 which is greater than 0.05, therefore the null hypothesis that there are no serial correlations between the variables cannot be rejected. Hence, there is no serial correlation in model 2 which shows the relationship among labour productivity, employment and output growth in Nigeria.

4.3.5 Heteroskedasticity Test: ARCH for Model 2

Table 12 below presents the Heteroskedasticity test for model 2, from the result the prob. Chi-Square is 0.4231 which is greater than 0.05, therefore the null hypothesis that there is no Heteroskedasticity between the variables will be cannot be reject.

4.3.6 Stability Test for Model 2

Figure 5.2 shows the stability test for Model 2, using CUSUM test, when the line of the variables is in-between the upper and the lower boundaries this means that is stability at 5% level of significance; therefore, the graph above satisfies the above stated condition.

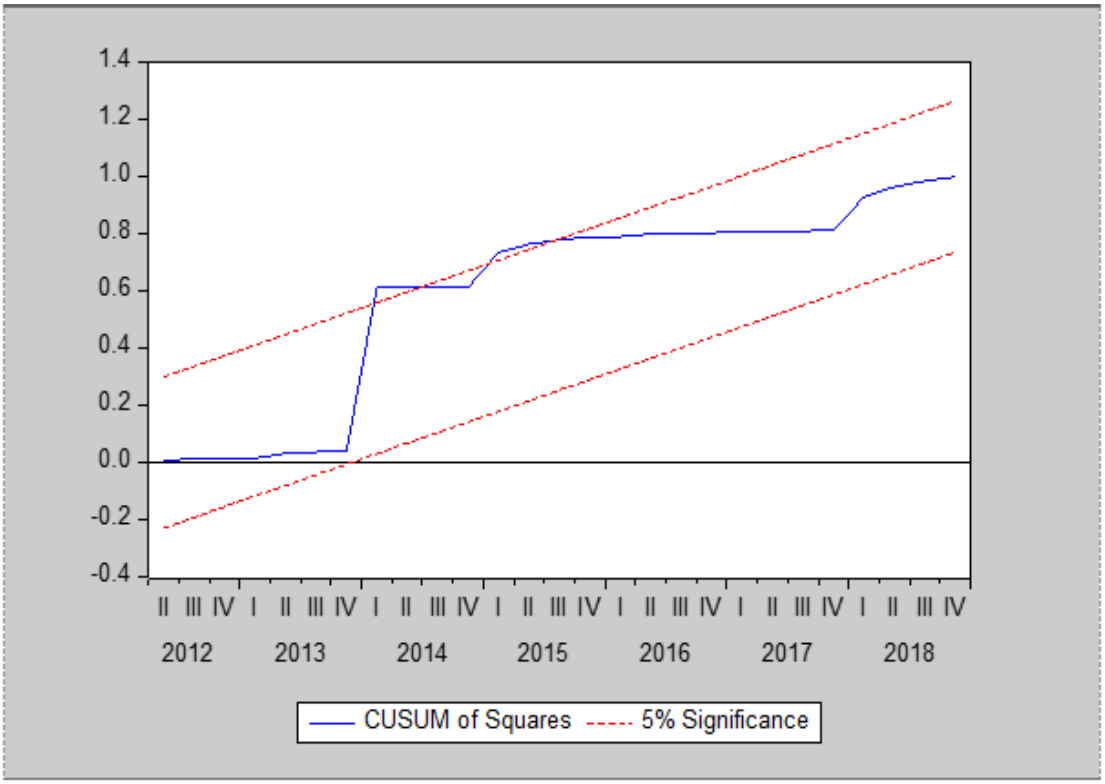
Table 5.11. Breusch-Godfrey Serial Correlation LM for Model 1			
F-statistic	12.85783	Prob. F(2,80)	0.1303
Obs*R-squared	27.00109	Prob. Chi-Square(2)	0.1507

Source: Author's computation

Table 5.12. Heteroskedasticity Test: ARCH for Model 2			
F-statistic	0.005783	Prob. F (2,80)	0.2117
Obs*R-squared	0.001091	Prob. Chi-Square (2)	0.4231

Source: Author's computation

Figure 4.2. Stability Test for Model 2



Source: Author's computation, 2019

4.4 Discussion of Findings

This study set out to examine the empirical linkage among labour productivity, employment and output growth in Nigeria. To achieve this, the study was sub-divided into three specific objectives namely, to (i) examine the long run and short run causality between labour productivity and employment, (ii) analyse the relationship between employment and output growth, and (iii) investigate the link among labour productivity, employment and output growth in Nigeria. The aim is to verify whether or not there is a trade-off between labour productivity and employment in Nigeria, confirm or repeal the validity of the concept of jobless growth in Nigeria and finally, check if there is an interdependence among labour productivity, employment and output growth in Nigeria.

Based on the first objective, the Granger causality results show that a bi-directional causality exists between labour productivity and employment, indicating a feedback effect between the two variables. This result implies that when there an increase in labour productivity, the scale of production of an organization would increase. Such productivity gains may also come from decreasing costs per unit of output over time. The attained economic benefits can be channelled to consumers through purchasing power gains from lower prices or higher wages. The increased purchasing power leads to increased consumer spending, which translates into greater aggregate demand that in turn leads to employment growth.

Furthermore, the results show a unidirectional Granger causality between employment and output growth reflects the type of output growth in Nigeria which precludes employment generation. This confirms the jobless growth phenomenon in Nigeria whereby economic growth does not generate meaningful employment. This could be due to the fact that economic growth in Nigeria is perhaps driven by capital accumulation such as increase in investments in the country instead of increase in output per labour. This is confirmed by the no causality results which exists between labour productivity and output growth in Nigeria.

Findings further show that in the long and short run, output level responds significantly to growth in labour productivity in Nigeria. However, output growth in Nigeria during the study period was not affected by labour force growth. This pattern of output growth has weak impact on unemployment rate in the country. When this happens, output growth is not productivity induced but rather due to labour reallocation from declining

sectors (e.g., agriculture and manufacturing) to low productive service sector. The long and short run results again show that the relationship between employment and output growth is not statistically significant. This implies that the employment-output growth relation in Nigeria does not offer any empirical validity to any known theoretical underpinnings such as Okun's law. However, the results show that there is a net positive and significant effect of labour productivity and employment on output growth in Nigeria.

Therefore, this study has identified the pattern of economic growth in Nigeria which precludes employment generation. This confirms the jobless growth phenomenon. The study empirically established the causal relationship among labour productivity, output growth and employment in Nigeria. Specifically, the study showed that a bi-directional causality existed between labour productivity and employment, indicating a feedback effect between the two variables, unidirectional causality between employment and output growth while no causality existed between labour productivity and output growth in Nigeria.

The study provided empirical validity to the concept of jobless growth in Nigeria. The study showed that output growth that emanated from increase in labour productivity did not boost employment because it was influenced by labour reallocation from one sector to another, rather than increase in the level of economic activities. Thus, output growth in Nigeria precluded the creation of decent employment.

The study also provides evidence on the net effect of labour productivity and employment on output growth in Nigeria. By this result, the positive net effect of labour productivity and employment on output growth in Nigeria has been empirically demonstrates. This implies that aggregate employment strategies and macroeconomic policies to be formulated should take cognizance of the pattern of labour productivity and in Nigeria.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

5.1 Summary

This study set out to examine the relationship among labour productivity, employment and output growth in Nigeria. This broad objective was unbundled into three specific objectives, which include to; (i) evaluate the causal relationship between labour productivity and employment in Nigeria, (ii) analyse the relationship between labour productivity and output growth in Nigeria and (iii) examine the relationship among labour productivity, employment and output growth in Nigeria.

To achieve the stated objectives, the study was organized into six chapters. Chapter one presented the general introduction which essentially underscored the need for the study. The chapter further articulated the problems associated with the behaviours of these macroeconomic variables and offered to empirically examine their relations in the Nigerian context, citing the paucity of specific study that examined this relation in the country as justification.

Chapter two provided the contextual analysis of the relationship among labour productivity, employment and output growth. The first section provided the overview of labour productivity in Nigeria in order to assess the interconnectivity of labour productivity with other macroeconomic variables. This was followed by the trend of labour force and employment in Nigeria, which sought to highlight the nature of the Nigerian labour market and the extent of labour force participation in Nigeria. The last section gave an overview of output growth which described the basic characteristics of GDP growth in Nigeria.

Chapter three presented a review of relevant literature for the study. The chapter covered the conceptual issues, theoretical review, methodological review, and empirical literature. The first section provided clarification on the concept and measurement of labour productivity, employment and output growth in order to have a better understanding of these concepts as used in this study. The second section reviewed the relevant theories important to the study with the purpose of adopting the most suitable for the present study. After the review, the neoclassical growth theory was chosen as the most suitable theoretical anchor for this study. The third section reviewed the methodologies and estimation techniques that have been used in the literature so as to select the most appropriate for the study. The last section reviewed the empirical literature in order to know the current knowledge regarding the link among labour productivity, employment and output growth relation, and identify the existing gap that necessitates this study.

Chapter four presented the theoretical framework and the methodology adopted in this study. Specifically, following the theoretical review in chapter three, the study derived its structure from the basic Cobb-Douglas production function and Solow growth model synthesized to build a neoclassical framework for estimating the link among labour productivity, employment and output growth. The study specified the Granger causality model and the ARDL-ECM models to capture both the short run and long run dynamics while the associated ECM models took sufficient number of lags to capture the data generating process to the specified framework based on Schwarz information criterion. This was also necessary to prevent the Gaussian error in the ARDL models.

In terms of estimation technique, the Granger causality test was employed in estimating model 1 while model 2 and model 3 were estimated using the autoregressive distributed lag (ARDL) framework of Pesaran and Shin (1999) and Pesaran (2001). A time series data ranging from 1990-2018 (which were disaggregated into quarterly data to meet the requirement of ARDL model estimation) were sourced form the World Development Indicator (WDI, 2019) and the National Bureau of Statistics Bulletin (NBS, 2019).

The empirical results were presented in Chapter five. Preliminary analysis showed that the null hypothesis that all the variables used in the study were normally distributed was strongly rejected. However, during the study period, variability was highest for per capita GDP, labour productivity and unemployment rate, while the variability was moderate for labour force, labour force participation rate and age structure, whereas the variability was lowest for employment rate, hours worked and population growth. The augmented dickey-fuller and Philips-Perron technique were used in testing the unit root properties of the series. The unit root tests showed that some of the series used were non-stationary at 5% level of significance. However, the nonstationary series attained stationarity after the first difference.

Concisely, the results of the Granger-causality test revealed an existence of a bi-directional causality between employment and labour productivity in Nigeria. This result implied that increase in employment led to increase in the level of productivity in Nigeria and vice versa. The feedback from employment to labour productivity indicated a trade-off between the two variables in Nigeria. The finding was similar to Junankar (2013), Palazuelos and Fernández (2009) who established a trade-off between employment and labour productivity. The results also supported the findings of McCullough (2018), Folawewo and Adeboje, 2017, Klein (2012), Meager and Speckesser (2011) who emphasised productivity growth as prerequisite for employment growth both in the short-run and long-run.

Empirical analysis of the second objective based on the auto-regressive distributed lag (ARDL) results revealed that in the long run, output level responded significantly to growth in labour productivity in Nigeria. Also, the long run results of the control variables showed that hours worked, dependency ratio and population growth had significant relationship with output growth whereas output growth had no significant relationship with labour force and unemployment rate. This result suggested that, in the long run, output level responded significantly to growth in labour productivity in Nigeria. However, output growth in Nigeria during the study period was not affected by growth in the labour force growth ostensibly due to high rate of unemployment. in the country. This result corroborated the findings of Lee and McKibbin (2018), Nakamura

et al (2018), Marattin and Salotti (2011), Mahadevan and Kim (2003) that output growth is driven by labour productivity growth.

In addressing the third objective of the link among productivity growth, employment and output growth in Nigeria, findings from the auto-regressive distributed lag (ARDL) revealed that in the long run, output growth in Nigeria came more from increases in labour productivity rather than from increases in the labour force, reflecting a poor performance of labour market variables such as employment, wages, unemployment etc. Findings also showed no significant relationship between output growth and employment in the Nigeria which suggested that output gains have not positively impacted the employment situation in Nigeria. This confirmed the 'jobless growth' phenomenon found in the literature concerning the output growth-employment relation in Nigeria (Adeboje and Folawewo, 2017; Ajakaiye et al 2017; Asaleye, et al, 2017).

The most plausible reason adduced for this was that, the employment trajectory in Nigeria was mostly driven by labour reallocation from agriculture and manufacturing towards low productive service and subsistent informal sector rather than productivity enhancement. Since aggregate employment is the ratio of aggregate output and the average productivity of labour from various sectors, there would be no change in unemployment level whenever output growth is not driven by structural changes.

5.2 Conclusions

This study examined the relationship among labour productivity, employment and output growth in Nigeria. In concluding the study, the results obtained empirically established the interdependence among labour productivity, employment and output growth in Nigeria. However, the link between employment and output growth in Nigeria defied theoretical underpinning since it negated the notion that output growth created jobs and thereby increased the employment growth trajectory. Ideally, if output grows according to the Keynesian theory- where output movements are driven by changes in aggregate demand, then in the short-run, employment is determined by wages. In the long run, employment is driven by labour productivity which is an offshoot of technological shock.

Conversely, labour productivity significantly affected output growth in Nigeria. Since the full potentials of output growth depends on the nature of labour productivity growth, increases in labour productivity in Nigeria reflected the observed and unobserved differences in the individuals or workers participating in economic activities rather than intrinsic differences in the productivity of the economic activities themselves. This explained the poor performance of major macroeconomic variables in the country.

Based on the findings of this study, the following recommendations are made:

i. Since there is interdependence among labour productivity, employment, and output growth in Nigeria, government should formulate policies that would ensure that this structure is beneficial. This would include providing a good framework that would make such relationship work

ii. Given that output growth that emanated from increase in labour productivity did not influence employment in Nigeria, government should intensify efforts to change this narrative. This would involve assessing the pattern or source of output growth in order to harness the employment potentials fully.

iii. The study showed that labour productivity was low in the country because increase in labour productivity emanated labour reallocation from declining sectors to growth sectors rather than due to increases in economic activities. Thus, government should revamp this trajectory to create employment opportunities.

iv. There is also a need for a policy that would allow labour productivity induced growth to boost employment generation in Nigeria.

5.3 Contributions to Knowledge

The study empirically contributes to knowledge on labour productivity-output growth-employment literature in three areas. First, the study empirically established the causal relationship among labour productivity, output growth and employment in Nigeria.

Specifically, the study showed that a bi-directional causality existed between labour productivity and employment, indicating a feedback effect between the two variables, while no causality existed between labour productivity and output growth in Nigeria.

Second, the study provided empirical validity to the concept of jobless growth in Nigeria. The study showed that output growth that emanated from increase in labour productivity did not boost employment because it was influenced by labour reallocation from one sector to another, rather than increase in the level of economic activities. Thus, output growth in Nigeria precluded the creation of decent employment.

Third, the study provided evidence on the net effect of labour productivity and employment on output growth in Nigeria. The study empirically demonstrated that the two variables (i.e., labour productivity and employment) had a positive net effect on output growth in Nigeria.

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