

Research & Development and Employees Productivity in Public Service of Nigerian Fourth Republic

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Abstract: *This study examines the impact of research & development on employees' productivity in public service of Nigerian fourth republic from 1999 to 2023. The annual data for the study is sourced from World Bank's Development Indicators (WDI) and Central Bank of Nigeria Statistical Bulletin. The dependent variable is employee's productivity proxied by total factor productivity while the explanatory variables are research & development expenditure as percentage of GDP, employee compensation proxied for income and institutional quality components of governance effectiveness and regulatory quality. The preliminary test of Augmented Dickey Fuller (ADF) unit root test reveals mixed order of integration among the series under consideration, which reinforces the choice of Autoregressive Distributive Lag (ARDL) as estimation technique. The ARDL bounds result reveal the existence of long-run among the series under consideration. On the result, the series of research & development exhibit negative and significant relationship with employee productivity in the Nigerian public service. The complementary series of employee compensation exert negative effect and significant impact on employee productivity. Also, governance effectiveness further exerts negative and insignificant nexus while regulatory quality demonstrates significant positive effect on employee productivity. This study concludes that research & development has not enhanced employee productivity in the Nigeria public service within the period considered. Therefore, the research recommends the need for government agencies and parastatals to make adequate provision for resources to fund high-quality training programs for public sector employees. This can include providing on-the-job training, skill development workshops, and opportunities for continuous learning and professional development.*

Keywords: research, development, employee's productivity, public service

INTRODUCTION

The public service sector plays a crucial role in the effective functioning and development of any nation (Ogundiya, 2010). In Nigeria, the public service has been a subject of extensive discourse, particularly in the Fourth Republic, which began in 1999 after a prolonged period of military rule (Olaopa, 2008). During this era, the Nigerian government has recognized the need for reforms and modernization to enhance the efficiency and productivity of its public service employees (Omotoso, 2014). Despite the Nigerian government's efforts to revitalize the public service during the Fourth Republic, concerns have been raised regarding the productivity and efficiency of public sector employees (Adeyemi, 2012). The purpose of employees' training and development is to improve their knowledge, skills, competence and their ability to discharge their duties and responsibilities more effectively and efficiently (Naveed et al. 2014; Ugbonhe et al., 2016). Therefore, training is one of the most effective tools to enhance the employee performance and to achieve the organizational objectives and goals effectively and efficiently (Afroz, 2018; Garavan et al., 2020)

In Nigeria, several there existing several training institutions such as industrial training fund (ITF) in 1971; the Nigerian council for management development (the training arm of the institution is known as centre for management development (CMD) in 1973; the Nigeria institute for policy and strategic studies (NIPSS) in 1979; administrative staff college of Nigeria (ASCON) in 1973, Michael Imoudu national institute of labour studies (MINILS) in 1992, Institute of Personnel Management (IPM) amongst other. The essence of these institutions is to providing excellent management training for performance improvement in all sectors of the economy (Igbaekemen & Odivwri, 2014; Abba, 2018). Despite the plethora of existing training institute domiciled across various government agencies/parastatals and institutions of learning, the productivity of Nigeria's labour force is still considered inefficient to engender significant growth of the economy. More importantly, as job become more complex, the importance of employee development has greatly increased (Igbaekemen & Odivwri, 2014). Training and development also have an impact on the return on investment (Halidu, 2015).

One of the key factors that can contribute to improved employee productivity in the public sector is research and development (R&D). Substantiating this, Gamage and Imbulana, (2013) allude that the level of the productivity and the efficiency of employees should be increased to take maximum output. R&D activities are essential for generating new knowledge, fostering innovation, and developing effective strategies to address emerging challenges (OECD, 2015). Human resource practices include training and development, which aids in developing workers' competencies, abilities, and knowledge in order to increase workers' capacity for more effective performance (Palo & Padhi, 2003; Gupta & Bostrom, 2006; Jagero, Komba, & Mlingi, 2012). Human resource is very important and the backbone of every organization and it is also the main resource of the

organization (Anam, Rashi, Rad & Mizana, 2013). Training is therefore necessary to enhance the knowledge, skills and attitude of employees (Abdullahi, Gwadabe & Ibrahim, 2018).

According to Oladele et al. (2019), low productivity in the public sector can have a variety of negative effects, such as ineffective resource utilization, poor service delivery, and slowed economic growth. Global research and development are currently facing a crisis, mostly as a result of the challenging economic environment (Ugbomhe et al., 2016). Employee productivity may suffer as a result of this (Ohunakin et al., 2020). Because of this, organisations are compelled to lower training costs as one of their first areas of expense reduction (Joshua & Olla, 2023). Some firms suffer significant losses in the form of waste due to errors committed by employees who lack the specialized skills necessary to carry out their duties well (Al Karim, 2019). According to Ebong, Nte and Obot (2019), various interventions and programmes towards effective staff training in Nigeria in the public sector's score-card has remained poor and inefficient due to shortage of skilled manpower, lack of adequate fund and facilities needed for effective staff training and development.

Literature emphasized on the inadequate career development opportunities available to employees across different organisations and sub-national government across the globe (Delbari, Rajaipour & Abedini, 2021; Firman, 2021; Wau & Purwanto, 2021; Ebong, Nte & Obot, 2019; Odesanya, 2020; Efenji, 2023). Existing studies are limited to banking sector, manufacturing sector, government agency or parastatal with little or no study focusing on public service. For instance, manufacturing (Olayinka et al. (2021), academia (Efenji, 2023; Abdulrahman & Mshelia, 2022; Halidu 2021; Delbari, Rajaipour & Abedini, 2021; Igatta, Onodugo & Ezeamama 2020; Abdullahi, 2018; Gambo, 2015), agencies/parastals (Oluabunwa et al. 2023; Joshua & Olla, 2023), banking and insurance sub-sector (Muogbo & Obananya, 2022; Odesanya, 2020), public service (Ebong, Nte & Obot, 2019; Igbaekemen & Odivwri, 2014), oil companies (Ekundayo, 2015). Most of the findings reveal that research & development engender employee productivity. However, few studies (Ebong, Nte & Obot, 2019; Igbaekemen & Odivwri, 2014) focus on public sector particularly sub-national government. This current study considered expanding this scope by considering how research & development impact on employee productivity in public service in Nigeria. This is important as Nigeria's Fourth Republic has witnessed significant changes in governance, policies, and economic conditions, which may have influenced significant government budgetary allocation for research & development with expected influence on employee's productivity. This study therefore seeks to examine the impact of R&D on employee productivity in the Nigerian public service within the fourth public.

LITERATURE REVIEW

Conceptual Clarification

This section dwell on the concept of research and development (R & D) which can be used interchangeably with training and development. According to Onasanyo (2005) training is captured as a form of specialized education intended to improve an employee's knowledge, skill and attitude. Similarly, Ezeani and Oladele (2013) viewed training as a set of exercises and dietary plans designed to help individuals build their effective cognitive and psychomotor skills that help employees grow toward greater productivity. On the other hand, development is seen as actions that result in the acquisition of novel knowledge or abilities in order to advance (Nda & Fard, 2013). Training and development are regarded as a very important tool that is effective and essential towards achieving organizational mission, objectives and goals which in turn result to increased productivity (Colombo & Stanca, 2008; Sepulveda, 2010). Put together, R & D comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture, and society – and to devise new applications of available knowledge (OECD, 2015). Adeniyi (1995) describes it as a composite of training and development activities aimed at significantly making the employees to be more effective and profitable to their organizations.

The term R & D commonly used to describe the activities undertaken by corporations, governments, and other institutions in advancing knowledge for the purpose of developing new or improved products, processes, and services (Mohr et al. 2020). R & D refers to the investigative activities a business conducts to improve existing products and procedures or to lead to the development of new products and processes (Gitman et al. 2018). Other scholar describes R & D as the activities undertaken by firms, research institutes, and governments to generate new knowledge that can be applied to the development of new products, processes, and services (Romer, 2019). Also, R & D comprises creative and systematic work aimed at increasing knowledge resources and devising new applications using available knowledge (European Commission, 2020). It can be observed that employee productivity can be influenced by numerous factors either behavioural or environmental as disclosed by several scholars ranging from enhanced working environment, management-subordinate relationship, reward systems, safety and equipment (Mohammed, Mohammed, & Gana, 2022).

The term productivity is described as the capacity to deliver certain work-related task in accordance to a specified predetermined standard with accuracy of speed, cost, and completeness (Sultana, Irum, Ahmed, & Mehmood, 2012). The International Labour Organization has defined productivity as the ratio connecting the output and input of resources used up in the production process (Kato, 2016). Kaur (2016) asserts that employee productivity is concern with the ability of an employee to complete assigned task which is highly related to work output, timeliness and quality. Employee productivity is a measure of the efficiency with which an employee converts

inputs into useful outputs (Heathfield, 2021). Employee productivity refers to the value of goods or services that an employee produces per unit of labor input (Boundless Management, 2020). The institution further viewed employee productivity as a measure of the efficiency with which an employee converts time and effort into valuable goods or services. According to Samson and Daft, (2021), employee productivity is conceptualized as a measure of output produced by an employee in a given time period. Other scholars like Yadav and Dabhade, (2022) viewed employee productivity as the quantification of the rate at which an employee produces goods or services. Society for Human Resource Management, (2022) defined employee productivity as the measure of how efficiently an employee converts inputs (such as time, effort, and resources) into valuable outputs (such as goods and services). The group emphasized that it is a critical factor in determining an organization's overall productivity, profitability, and competitiveness. Employee productivity is calculated by dividing the total output produced by the total number of employee hours worked.

Theoretical Framework

This section center on the theoretical underpinning guiding this study. This is anchored on the human capital theory developed by Adam Smith (1776) and later modified by Theodore Schultz (1961) and later by Becker (1994). Human capital theory posits that education and training constitute an investment in human beings (Schultz, 1961). Human capital theory suggests that education or training raises the productivity of workers by imparting useful knowledge and skills, hence raising workers' future income by increasing their lifetime earnings (Becker, 1994). Put differently, education creates assets in the form of knowledge and skills, consequently increasing the productivity of the worker (Olaniyan & Okemakinde, 2008). Schultz (1961) argued that skilled human resources acquire these skills through staff development programs or investments in existing human resources via appropriate on-the-job training, such as seminars, workshops, conferences, and by creating a conducive environment through appropriate welfare measures like promotion. As proposed by Flamholtz and Lacey (1981), the human capital theory suggests that people's skills, experience, and knowledge represent a form of capital, and returns are earned from investments made by the employer or employee to develop these attributes. The human capital theory holds that employees should invest in specific training, and employers should initiate more promotion opportunities to enhance employees' career path prospects (Lawler, 2008).

Similarly, Social Exchange Theory (SET) is among the most influential conceptual paradigms for understanding workplace behaviour (Malinowski, 2002). One of the basic tenets of SET is that of reinforcement principles in which relationships evolve over time into trust, loyalty, and mutual commitments. To do so, the parties must abide by certain "rules" of exchange. Rules of exchange form a "normative definition of the situation that forms among or is adopted by the participants in an exchange relation" (Emerson, 1976). In this way, rules and norms of exchange are "the guidelines" of exchange processes. The theory as it relates to the present study shows that employees of the public service have their own interests such as aspirations to attain higher ranking

and positions through enhanced growth on the job as well as the need for trainings for enhanced capabilities and competencies.

Empirical Review

This section focuses on the existing works relating to research and development on employee production in the Nigeria's public service. Efenji (2023) evaluate the effect of career training and career advancement on employee productivity of Cross River University of technology. The study employed population of both academic staff and non-academic staff made up of 499. The variables include, career training, career advancement and employee productivity. The multiple linear regression technique and result shows that that career training significantly increases on employee productivity while career advancement insignificantly decreases the productivity of employees in University of Cross River State. Ohuabunwa, Ekuma, Onyebuwa, Ugochukwu, Babalola and Clark (2023) conducted an assessment of the factors affecting government employees' productivity in Nigeria using electronics development institute (ELDI), Awka as a case study. The study used a total of 98 ELDI staff via a random sampling technique while regression analysis result reveal that there is a strong correlation between leadership and productivity. It also revealed that training is the most influential factor of boosting government employees' productivity in Nigeria.

Joshua and Olla (2023) conduct a study on the effect of training and development on employees' performance at forestry research institute of Nigeria. The study used a multi-stage sampling technique selecting 226 respondents. The regression results indicated that there was a significant relationship between employees' job performance and the benefits of employees' training and development, enhanced employees' competency levels through the training and development and employees' perceived contributions of training and development to job performance respectively.

Muogbo and Obananya (2022) examined the effect of training and development on employee performance and productivity in First Registrar Nigeria. The study selected 8 first registrar companies in Nigeria. The questionnaire distributed among the respondents was 80 in number. The study employed descriptive statistics and Pearson Correlation Coefficient and the results show that First Registrar Limited established an existing program and policy that finance their staff development and training; organizes staff training courses periodically to enable their employees to be up-to-date with their knowledge and talents and to guarantee that extreme competence is in their organization. Hence, it is evidence that various training conducted in First Registrar Limited has an impact on the employee's productivity. Yiman (2022) examine the impact of training on employee's performance among the staff of Bahir Dar university, Ethiopia. The sample size is 316 and the data were analyzed using descriptive and inferential statistics. Results show that training design, training needs assessment, training delivery style and training evaluation have significant positive effect on employees' performance.

Abdulrahman and Mshelia (2022) examine the impact of training and development on employee performance among the staff of Ramat Polytechnic, Maiduguri and Federal Polytechnic, Damaturu. The study sample size is 364 drawn out 3989 population through Taro Yamani sample size formula. The study employed mean, standard deviation and independent samples t-test and finding revealed among others that that training and development have positive impact on employees' (lecturers) performance. Mohammed, Mohammed and Gana (2022) assessing the impact of training and development on employees' productivity using critical conceptual reviews (synthesis). The study reveals that employees who are trained are likely to be more skillful, competent, and more proficient in performing their jobs than the employees' that are not trained.

Idiaro and Abubakar (2022) examine the impact of human capital development on employees' productivity in Nigeria. The population of the study is 135 out of which 75 was randomly selected using simple random selection technique. The finding show that organization has qualified and well-educated staff which will enhance productivity in the organization through the enhanced training and development of staff.

Halidu (2021) investigate the impact of training and development on workers' productivity via the tertiary education trust fund (TETFund) using content analysis. Results revealed that training and development programmes improve employees' skills and performance at work place. Hence, this serves as an effective tool for sustaining and enhancing workers productivity in the academia. Delbari, Rajaipour and Abedini, (2021) investigated the relationship between career development and productivity of university staff with the mediating role of self-regulation in Iran. The population consisted of the staff of two Iranian universities in 2018 out of which 331 participants were selected using Cochran's formula and a proportionate stratified random sampling method. Regression analysis result indicates that the staff self-regulation had a positive and significant effect on individual, organizational and environmental productivity factors. It was found that self-regulation had a mediating role in the relationship between career development and staff productivity. Firman, (2021) aimed to determine the effect of career development toward employee performance at Aswin Hotels and Spa Makassar in Indonesia. The study used sample size of 53 staff of Aswin Hotels and Spa Makassar. The finding from the simple regression method reveals that career development had a positive and significant effect towards employee performance at the Aswin Hotel and Spa Makassar.

Wau and Purwanto (2021) determined the effect of career development, work motivation, and job satisfaction on employee performance in Indonesia. The study sample size consisted of 265 employees at MNC Studios company. The study adopts Structural Equation Model (SEM) using Lisrel. Finding reveals that career development had a positive effect on employee performance and job satisfaction, job satisfaction had a positive effect on employee performance, and work motivation had a positive effect on job satisfaction and employee performance. Indra, Nabilah, Heru, Nawangand Arif, (2021) examine whether vocational training has an influence on employee

career development in Indonesia. Out of the total population 135 employees, the study relied on the sample size of 100 employees using Slovin formula to arrive at this estimate. The result of the multiple linear regressions showed that job training significantly influences the career development of employees in companies.

Odesanya (2020) assesses the impact of training and development protocols implemented by Management of First Bank Nigeria Plc, Osogbo Branch for its 132 employees spread across four of its branches situated in the Osogbo area in Osun state, Nigeria. The study employed descriptive analytical approach using the variables of employees' productivity, training cum development strategies. The finding reveals that the current training and development strategies in the bank have not had a significant impact on enhanced employees' job performance owing to the overbearing impacts of resistance to novel changes to existing operational protocols that should require acquisitions of new IT systems. Igatta, Onodugo and Ezeamama (2020) investigate the perceived effect of training and development on employee's performance among academic staffs Etex Group Nigeria. The study adopts Multiple regression for the analysis of the data collected and findings reveal that training and development ultimately improve not only the productivity of employees but also of the organization.

Ebong, Nte and Obot (2019) examined the impacts of staff training and development on the organizational performance and productivity using Akwa Ibom State Ministry of Finance. The population of the study comprise of all the staff of Akwa Ibom State Ministry of Finance and the data collected were analysed using descriptive statistics. The major findings of the study revealed among others that: poor staff training and development lead to poor organizational productivity. The study therefore emphasized on the need for staffs training and development to enhance organization performance.

Abdullahi, Gwadabe and Ibrahim, (2018) investigate the perceived effect of training and development on employee's productivity among academic staff of Kano State Polytechnic, Nigeria. The study employed primary data analysis using sample size of 233 respondents randomly selected out of 590 academic staffs that serve as the population of the study. The variables include employee's performance, training method, training design and training delivery style. The result of the multiple regression analysis revealed that training method, training design and training delivering style has significant and positive effect on employee's productivity among academic staffs of Kano State Polytechnic, Nigeria. Abdullahi (2018) investigate the perceived effect of training and development on employee's productivity among academic staff of Kano State Polytechnic, Nigeria. The sample size used is 233 respondents randomly selected out of 590 academic staffs that serve as the population. The result of the multiple regression analysis revealed that training method, training design and training delivering style has significant and positive effect on employee's productivity among academic staffs of Kano State Polytechnic, Nigeria.

Kwahar and Onov (2017) examine the impact of growth on the job and development of human capabilities on employee productivity among selected Nigerian five-star hotels. The variables used include productivity, growth on the job, and development of human capacities. Regression analysis and Partial Correlation reveals that both growth on the job and development of human capabilities have significant impact employee productivity. However, employees' productivity reduced when the development of human capabilities was not accompanied by growth on the job. This means employee growth enhances productivity more than development in Nigerian five-star hotels. Attah (2017) examines the impact of human resources development on workers' productivity in Federal Polytechnic Idah, Kogi State Nigeria. The study used table, mean and five point's likert scale for the analysis. The finding reveal that human resources development programme is carried out in Federal Polytechnic Idah and enhances workers' productivity.

Fejoh and Faniran (2016) investigated the impact of in-service training and staff development on workers' job performance and optimal productivity in public secondary schools in Osun State, Nigeria. The population of the study is 152 respondents while 134 questionnaires were returned. The study employed Analysis of variance (ANOVA) and multiple regression analysis and findings show that results showed that in-service training and staff development had insignificant combined effects but significant relative effects on workers' optimal job productivity.

Gambo (2015) study relationship between training and workers' productivity via the Tertiary Education Trust Fund (TETFund) Academic Staff Training & Development 2010 Sponsorship of some selected Nigerian higher institutions. The results revealed that training and development programmes improve employees' skills and performance at work place, enhance their technical know-how to withstand the challenges of contemporary times. Ekundayo (2015) examines training and development practices of selected oil services companies in Port Harcourt to determine their impact on workers productivity. The population of the study is 150, while the sample size is 109.109 with questionnaires distributed among the employees of the ten selected oil service companies. The study used regression analysis of ANOVA and finding show that there is significant positive relationship between training/development and workers productivity.

Asfaw, Argaw and Bayissa (2015) The impact of training and development on employee performance and effectiveness: A case study of district five administration office, Bole Sub-City, Addis Ababa, Ethiopia. The focus of the study is five district councils in Ethiopia and with a sample size of 100 employees, the Pearson correlation and linear regression tests showed that training and development influenced employment performance. Nganga, Manjere and Egessa (2015) investigated the influence of technical training on organizational performance of the sugar industry in the South Nyanza zone of Kenya. The study was based on 48 management personnel and the Pearson's correlation tests and the descriptive statistics showed that training led to organizational performance.

Dabale, Jagero and Nyauchi (2014) examined the relationship between training and employee performance in the Mutare City Council in Zimbabwe. They used 132 employees and the linear multiple regression tests showed that training enhanced employees' performance in terms of employees' knowledge, skills, ability and competencies. Moreover, training reduced learning time of employees starting new jobs, employees on transfer or those on promotion. In general, the results indicated that training enhanced organizational performance. Onyango and Wanyoike (2014) studied the effects of training on employee performance regarding health workers in the Siaya county in Kenya. Based on a sample size of 56, the Pearson correlation test showed that training influenced employees' performance. Uthman (2014) investigated training and manpower development, employee productivity and organizational performance of banks in Nigeria. Three hundred employees were used for the study and the chi-square test showed that training and development led to employees' efficiency and productivity and organizational performance.

Igbaekemen and Odivwri (2014) investigate the impact of human capital development on workers productivity in Nigeria public sector using Chi square for the analysis. The study distributed 250 questionnaires out of which only 240 were returned. Finding reveal that there is relationship between human capital development and organizational productivity. Therefore, human capital development has impact on employees' productivity. Sila (2014), researched into the relationship between training and performance of Women Finance Trust in the Eastern Nyanza region in Kenya. The study used 36 employees for the study and the descriptive analysis revealed that training influenced employees' performance in terms of employees' attitudes, service delivery and job satisfaction.

Gap in Literature

This study examined the effect of research & development on employee productivity in public service of the Nigerian fourth republic. From the review of empirical literature, the following gaps were unraveled. It was discovered that, most of the existing studies were conducted in different government agencies or parastatals, private organization in Nigeria and other countries. Most of the studies reviewed have focused on various sectors, including higher education institutions, private organizations, and specific government agencies or ministries (Efenji, 2023; Oluabunwa et al. 2023; Joshua & Olla, 2023; Muogbo & Obananya, 2022). Similar studies conducted outside Nigeria were identified (Yiman, 2022; Delbari, Rajaipour & Abedini, 2021; Asfaw, Argaw & Bayissa, 2015). Again, most of the studies used primary data analysis (Igbaekemen & Odivwri, 2014; Gambo, 2015; Fejoh & Faniran, 2016; Kwahar & Onov, 2017; Abdullahi, Gwadabe 7 Ibrahim, 2018; Ebong, Nte & Obot, 2019; Odesanya, 2020; Halidu, 2021; Abdulrahman & Mshelia, 2022; Efenji, 2023). Given government commitment through investment in research & development in recent time, it becomes imperative to use secondary data to ascertain how R&D impact on employee productivity within the broader public service sector of Nigeria during the Fourth Republic is lacking. Secondary data were sourced from World Bank's Development Indicators relating to research & development, while employee productivity measured by total

factor productivity and other related determinants were obtained from International Labour Organisation database and National Bureau of Statistics covering the period of 1999 to 2023.

METHODOLOGY

The study was carried out in Nigeria focusing on the public services sector. Data for the study were sourced from National Bureau of Statistics (NBS), International Labour Organisation (ILO) and World Bank's Development Indicators (WDI) covering the period of 1999 to 2023. In order to achieve the objective of this study, the models of Efenji (2023) who evaluate the effect of career training and career advancement on employee productivity of Cross River University of technology using multiple linear regression. The functional form of the model by Efenji (2023) is expressed in equation [1]:

$$[1] \quad \textit{Employee Productivity} = f(\textit{career training}, \textit{career advancement})$$

Similar studies conducted in Nigeria use different variables. For instance, Abdullahi, Gwadabe and Ibrahim, (2018) employed employee's performance, training method, training design and training delivery style. Kwahar and Onov (2017) considered the series of productivity, growth on the job, and development of human capacities. However, studies from other country such as Wau and Purwanto (2021) job satisfaction, work motivation and employee performance. Most of these studies variables are based on primary information gotten from field survey.

In this study, the model of Efenji (2023) is adapted and modified where germane variables incorporated into the model. These series include research & development expenditure as percentage of GDP, employees' compensation, and employee productivity proxied by total factor productivity is measured by the sum of labour force (total) plus gross capital formation (current US\$) divided by nominal gross domestic product (current US\$). The study further incorporates institutional quality components of governance effectiveness and regulatory quality to ascertain how it influences efficacy of research and development. The functional form of this study model is expressed in equation [2]:

$$TFP = f(R\&D, EMC, RGQ, GOV)$$

Where: TFP = Total Factor Productivity (Index), R& D = Research & Development Expenditure (% of GDP), EMC = Employees Compensation proxied for Income, RGQ = Regulatory Quality (Index) and GOV = Government Effectiveness (Index).

This study incorporates the series in equation [2] into the ARDL model and is expressed in mathematical form in equation 3.

$$\begin{aligned} \Delta TFP_t = & \delta_0 + \delta_1 TFP_{t-1} + \delta_2 R\&D_{t-1} + \delta_3 EMC_{t-1} + \delta_4 RGQ_{t-1} + \delta_5 GOV_{t-1} + \sum_{i=0}^p \varphi_1 \Delta TFP_{t-1} \\ & + \sum_{i=0}^q \varphi_2 \Delta R\&D_{t-1} + \sum_{i=0}^q \varphi_3 \Delta EMC_{t-1} + \sum_{i=0}^q \varphi_4 \Delta RGQ_{t-1} + \sum_{i=0}^q \varphi_5 \Delta GOV_{t-1} \\ & + \lambda ECM_{t-1} + \varepsilon_t \end{aligned}$$

Eqn. 3

where $\delta_1 - \delta_5$ are the long-run parameters; $\varphi_1 - \varphi_5$ are the short-run parameters; δ_0 and ε are the intercept term and the white noise stochastic term respectively; λ is the parameter of the error correction mechanism (ECM); \ln is the natural logarithm of the variables, and; Δ is the difference operator. A shock to any of the regressors may not result in an immediate long-run effect on total factor productivity (TFP), which creates disequilibrium in the system and requires that the short-run adjusts to its long-run equilibrium through the error correction mechanism (ECM_{t-1}). The ECM_{t-1} is a one lag error correction term that accounts for the speed of adjustment to the long-run equilibrium.

RESULTS AND DISCUSSION

The first stage is to the presentation of the summary statistics, representation of the individual variables, and descriptive statistics, while the second stage of the preliminary analysis is mainly centered on the unit root testing of the variables.

Descriptive Statistics

Essentially, for better presentation, the raw data were used for the descriptive statistics (Ehigiamusoe and Lean, 2019; Balogun, Okafor, and Ihayere, 2019).

Table 1: Descriptive Statistics

	TFP	R_D	EMC	GOV	RGQ
Mean	0.295437	0.619022	16771.68	-1.01959	-1.12846
Median	0.271522	0.64224	14599.01	-1.00281	-1.15611
Maximum	0.665525	0.80567	56078.63	-0.84756	-0.79311
Minimum	0.000153	0.376496	239.7302	-1.20482	-1.57505
Std. Dev.	0.166557	0.126391	16324	0.094055	0.202547
N_Std. Dev.	0.563765	0.204179	0.973307	-0.09225	-0.17949
Skewness	0.635749	-0.29098	0.854383	-0.35042	-0.31932
Kurtosis	2.679631	1.942407	2.764833	2.299867	2.65088
Jarque-Bera	2.364096	2.003621	4.090882	1.349368	0.72841
Probability	0.30665	0.367214	0.129323	0.509317	0.694749

Std. Dev. denotes standard deviation NStd. Dev. is the normalized variant of the standard deviation statistic computed as standard deviation/mean. The values in parenthesis are probability values associated with the reported Jarque-Bera (JB) statistics.

Source: E-Views Output

From Table 1, starting with total factor productivity (TFP), the mean statistic showed that the average annual TFP in Nigeria is 0.29 for the period between 1999 and 2023. However, the average for research and development (R&D) proxied by the research and development expenditure as percentage of GDP was 0.61 while the average employee compensation proxied for income was 16771.68 billion. Also, the governance effectiveness and regulatory quality proxied for quality institutions average was -1.01 percent and -1.12 percent respectively.

Considering other relevant statistics, starting with the standard deviation. Specifically, for the normalized version of the statistic (N_Std. Dev.), the amplitude of variation in the series appeared to be usually small for all the series considered. On the statistical distribution of the series, TFP, and EMC appeared to be positively skewed while R&D, GOV and RGQ exhibited negative skewness. That said, the Kurtosis statistic is platykurtic (thin tailed) for the five series. Similarly, the probability values associated with the Jaque-Bera statistics are statistically insignificant. The null hypothesis was statistically accepted for all the series under consideration.

Preliminary Results

This study first performed a unit root test on each of the individual variables before analyzing time-series data. The primary goal is to ascertain the order of integration of the variables, which is an essential step in assessing the suitability of the chosen estimating method. We took into account the fundamental Augmented Dickey-Fuller (ADF) test in order to ensure consistency and robustness. It is also important to note that, unit root test was run on the natural logarithm of the series, with the exception of the total factor productivity (TFP), research and development expenditure as percentage of GDP (R&D), regulatory quality (RGQ), and governance effectiveness (GOV), which was initially given as percentages and index.

Table 2: ADF unit root test results

Augmented Dickey Fuller Unit Root					
Variable	Level	Prob.	First Difference	Prob.	I(d)
TFP	-3.464856**	0.0301	-5.375346***	0.0000	I(0)
R&D	-3.632667***	0.0001	-5.612517***	0.0000	I(0)
EMC	-1.351071	0.5993	-5.266705***	0.0000	I(1)
GOV	1.174515	0.9976	-7.626184***	0.0000	I(1)
RGQ	0.928298	0.9952	-5.487060***	0.0000	I(1)

Note: The exogenous lags were selected based on SIC while ***, **, * imply that the series is stationary at 1%, 5%, and 10%, respectively. The null hypothesis for ADF is that an observable time series is not stationary.

Source: E-Views Output

Starting with the ADF unit root test, the results in Table 2 shows that irrespective of whether the unit root testing is based on the model with constant only or with constant and trend, the null hypothesis of unit root tends to hold for employee compensation, governance effectiveness and regulatory quality with total factor productivity and research and development expenditure as percentage of GDP the only notable exception. Again, irrespective of whether the ADF includes constant only or constant and trend, the order of integration appears to be mixed. Among others, it re-enforces our preference for the ARDL technique for objective as the most appropriate to accommodate the mixed order of integration exhibited by the series under consideration.

To Ascertain the Impact of Research & Development on Employee Productivity

The empirical estimates in Table 3 focus primarily on the dynamics of research & development on employee productivity in Nigeria over the long and short terms. However, the first approach is the ARDL bounds test to establish the existence of long-run co-integration, which is presented on Panel A, Table 3.

Table 3: ARDL estimates

<i>Panel A: Bounds Test Cointegration Result</i>				
Level of Significance	F-Statistics		Lower Bound I(0)	Upper Bound I(1)
10%			1.80	2.80
5%	6.723574		2.04	2.08
1%			2.50	3.68
<i>Panel B: Short run estimates</i>				
	Coefficient	Std. Error	T-Stat.	Prob.
Constant	7.506078	5.429307	1.382511	0.1786
ΔTFP_{t-1}	-0.420039	0.192589	-6.334921	0.0000
$\Delta R\&D_{t-1}$	-1.918342	0.661592	3.358185	0.0012
ΔEMC_{t-1}	-0.954910	0.285044	-3.350050	0.0025
ΔGOV_{t-1}	-1.761806	2.665979	-0.660847	0.5145
ΔRGQ_{t-1}	0.654362	0.231001	3.419194	0.0085
ECT_{t-1}	-0.420039	0.175915	-6.935374	0.0000
<i>Panel C: Long run estimates</i>				
R&D	-1.211654	0.261669	3.545560	0.0122
EMC	-0.782689	0.198014	-3.952702	0.0005
GOV	-0.444057	2.469546	-1.665603	0.1115
RGQ	1.536345	0.275533	3.420487	0.0076

Source: Extract from EViews 12 Output

Table 3 panel A hold the result of the ARDL bound test. F-statistic of 6.723574 for the model on employee productivity, is greater than the critical values at 1 percent, 5 percent, and 10 percent. This implies that long-run relationship is established among the variables under consideration. Therefore, the decision on whether to reject the null hypothesis of no long-run relationship is rejected. The lag selection criterion used is determined by whether the study is for forecasting or impact analysis. If the study is for forecasting, the Akaike Information Criterion is appropriate, whereas the Schwarz Information Criterion is appropriate for impact analysis. Besides this, when the data is annual, a dynamic model like the ARDL used in this study, works with lag lengths ranging from 1 to 4. Going by this submission, and this study is impact analysis, the Schwarz Information Criterion (SIC) lag length selection criteria select the ARDL order of model maximum lags for the variables.

The results on Table 3 show that variables of research & and development failed to conformed to a prior and statistically significant at 1 per cent. This means that an increase in the value of a research & development proxied by research and development expenditure as percentage of GDP will result in a -1.91 percent and -1.21per cent decrease in the value of the employee productivity proxied by total factor productivity in the short run and long run. The finding of this current is agreeing with earlier submission in literature that career training failed to improve employee productivity in public service (Odesanya, 2020; Ebong, Nte & Obot, 2019; Fejoh & Faniran, 2016). Many public sector organizations in Nigeria face budget constraints and do not allocate sufficient resources for staff training and development programs (Akanji et al., 2020). Even when training programs are offered, they may not be of high quality or aligned with the specific needs and challenges faced by public sector employees (Akhakpe, 2017; Adedeji & Bada, 2021). Therefore, Ebong, Nte and Obot, (2019) emphasized on the need for staffs training and development to enhance organization performance among public service in Nigeria.

However, other studies conducted most among academia demonstrate that research and development enhance employee productivity and this could be attributable to tertiary education trust fund made available for training of academic staff (Efenji, 2023; Oluabunwa et al. 2023; Joshua & Olla, 2023; Abdulrahman & Mshelia, 2022; Attah, 2017). As such, human capital development has impact on employees' productivity (Igbaekemen & Odivwri, 2014).

The variable of employee compensation proxied for income has also failed to conformed to a priori in both short run and long run but statistically significant at 1 percent. The estimated elasticities indicated that an increase in income would decrease the employee productivity by -0.95 percent and -0.78 percent in the short run and long run, respectively, which is in line with the finding in literature (Odukoya et al., 2021). It is important to note that public sector employees in Nigeria often receive low salaries and wages compared to their counterparts in the private sector (Salami et al., 2021). This disparity in compensation can lead to job dissatisfaction, high turnover, and a lack of motivation among public servants (Ojo & Abolade, 2014). For instance, high inflation rates

in Nigeria can erode the purchasing power of public sector salaries, leading to a decline in the real value of employee incomes (Adedeji & Bada, 2021). Therefore, there is a lack of a robust performance management system that links employee compensation to their productivity and contributions (Garba & Mamman, 2019).

Similarly, governance effectiveness (GOV) did not agree with a priori and statistically insignificant. This means that an increase in governance effectiveness would decrease employee productivity by -1.76 per cent and -0.44 percent. This result undermines the trust of public servants in the system and can negatively impact their motivation and productivity (Akanji et al., 2020). Therefore, poor leadership and weak supervision in the public sector can result in a lack of clear direction, inadequate performance management, and a lack of support for employees (Odukoya et al., 2021). Thus, this can contribute to a sense of disconnect between management and employees, hampering productivity and service delivery (Adedeji & Bada, 2021).

However, sign of coefficients of the regulatory quality (RGQ) conformed to a priori expectation and statistically significant at 1 per cent level. This shows that an increase in regulatory quality leads to increase in employee productivity in Nigeria in the short run and long run by 0.65 per cent and 1.53 per cent. This finding substantiates how employees better understand their roles and responsibilities, leading to improved productivity (Akanji et al., 2020). Essentially, high-quality regulations can promote the streamlining of administrative processes, reducing bureaucratic delays and improving the efficiency of service delivery (Ojo & Abolade, 2014; Garba & Mamman, 2019; Abdulkadir et al., 2020).

The F-statistic of 51.00068 and the error correction term (ECT) value of -0.420039 show that the rate of adjustment to the long-run horizon is significant. However, while the choice and appropriateness of ARDL as the preferred estimation technique was motivated by the outcome of the unit root testing where the order of integration was both I (0) and I (1), this study considered the accuracy of the estimated models via several post estimation and/or diagnostic tests. Thus, this study presents post-estimation results to ascertain the accuracy or viability of the estimated models.

Table 4: Diagnostic Test for Model Two

Diagnostic and Post-Estimation Results				
<i>Adj. R²</i>	<i>F-statistics</i>	<i>Linearity Test</i>	<i>Autocorrelation Test</i>	<i>Heteroscedasticity test</i>
		Ramsey RESET	LM Test	ARCH
0.607065	51.00068	2.134636 (0.1386)	0.527012 (0.4741)	0.739443 (0.3936)

Source: Extract from EViews 12 Output

Note that probability values for the post-estimation test are in parentices

Source: E-Views Output

Table 4 presents the diagnostic and post-estimation results for model two. F-statistics specifies whether the independent variable(s) are jointly significant in explaining the dependent variable. R^2 measures how well the estimates have explained the actual dependent variable – it is a measure of the strength of the model. Adjusted R^2 is particularly used to assess if the addition of an independent variable has contributed to increased strength of the model. The null hypothesis of linearity is maintained and the model is appropriately stated as the Linearity RESET test verifies that the model is stable. The presence of autocorrelation and the rejection of the serial correction null hypothesis, which appears to be consistent with the employee productivity proxied by total factor productivity model, were further investigated in this work. Also, this study discovered that the employee productivity proxied for total factor productivity model's null hypothesis of heteroscedasticity was repeatedly rejected. This among others is an indication that the empirical estimates obtained from the estimated model are efficient and robust for policy inference.

CONCLUSION AND RECOMMENDATIONS

This study examines the effect of research & development on employee productivity in the Nigeria public service covering the period of 1999 to 2023. Achieve the objective of this study, Autoregressive distributive lag (ARDL) was adopted based on the outcome of the stationarity test. The ARDL bounds test reveal existence of long-run relationship between research & development and employee productivity in the Nigeria public service. On the estimate for both short run and long run, research & development exert negative effect and significant relationship on employee productivity in the Nigeria public service in the fourth democratic regime. Substantiate this further, the complementary series of employee compensation further implies that income of staff of public service is not adequate given the negative effect it has on employee productivity. Also, the role of quality institution demonstrates that there is weak governance in public service that hinders efficiency of public service staff. Based on these findings, the study makes the following recommendations:

- i) The government should allocate adequate budgetary resources to fund comprehensive and high-quality training programs for public sector employees. Public sector training programs should be designed based on a thorough needs assessment, ensuring that they are tailored to the specific skills and competencies required for efficient service delivery. This can include providing on-the-job training, skill development workshops, and opportunities for continuous learning and professional development.
- ii) The civil service and other government agencies and parastatals need to conduct a comprehensive review of public sector salaries and allowances to ensure they are competitive and align with the cost of living, as well as comparable to the private sector, taking into account factors such as qualifications, experience, and performance.
- iii) There is an urgent need for government agencies and parastatal to provide training and capacity-building programs for human resource managers to enhance their skills in fair and ethical personnel management. This could be enhanced through revised recruitment, promotion,

and performance evaluation policies to ensure they are based on merit, competence, and equitable treatment of employees

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