Journal of Pol Dev Studies

An Open Access Journal
• ISSN: 0189-5958

ARABIAN GROUP OF JOURNALS

Journal of Policy and Development Studies

JPDS Journal Pol Dev Studies

Research Article | Homepage: www.arabianjbmr.com | AGJ

ADVANCING PRODUCTIVITY AND EQUALITY IN NIGERIA: A DUAL CHALLENGE

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ABSTRACT

This study explores the node between productivity and income inequality in Nigeria. Data on labour productivity, inequality, level of development admits other variables were employed for the period 1990 to 2018. A simultaneous equation mode was employed while the ARDL and TSLS were used for the estimation given the possible feedback impact between the variables and the flow of causality among the variables were also examined. The upshot of the study revealed that the Kuzenets' hypothesis was not substantial and productivity positively affects inequality while inequality increases productivity. Human capital development was found to increase productivity and reduce inequality, technology had no substantial impact on productivity although it was positively related to it while population growth substantially increases productivity. One way causality flows from productivity to inequality, development and human capital on the one hand and from human capital to technology. We thus call attention to advancing human capital development through increasing government expenditure in the educational sector, as well as incorporating the secondary and tertiary education in the policies of the SDGs for Nigeria. Also, the population growth can be harnessed by adopting appropriate labour technology to increase productivity and reduce income inequality.

KEYWORDS: Education, Income inequality, Productivity, Simultaneous equation model

1. INTRODUCTION

Productivity and inequality are issues that are central to the social and economic life of every country. In most cases, developing countries are associated with low levels of productivity which results in low Gross Domestic Product, (GDP), affecting the individuals, different sectors of the economy, businesses, and even industries. Inequality in these developing countries are often associated with inequity in the distribution of resources given the effects of their market failures. Low productivity to some extent is an aspect of the vicious circle of poverty in which many developing countries are trapped. More so, improvement in the standard of living which is a major priority of every government is reduced by the low productivity. Growth in productivity provides a significant basis for adequate supply of goods and services thereby improving the welfare of the people and enhancing social progress **(**De Michelis, Estevão & Wilson, 2013**).** In analysing productivity, labour productivity is often considered because of the role of labour in the production process and the economy at large.Human Development Report of United Nation Development report (UNDP) (2017), showed that Nigeria is among the 30th most unequal countries in the World which has lingered for more than four decades. It is further stated that Nigeria has the highest number of people living in multi-dimensional poverty (88.4 million) in the world. Some policies have been put in place towards enhancing the Nigerian's productivity (National productivity Centre (NPC) and National Manpower Board (NMB). The Center for Management and Administration (CMD), Industrial Training Fund (ITF)) yet, the country is still characterized with low level of productivity and high level of inequality.

Data showed that given Nigeria's GDP worth of $481.07 billion in 2015 with an average of $87.05 billion from 1960 to 2015; reaching an all-time high of $568.51 billion in 2015 (World Bank, 2018), total labour productivity declined consecutively from N5.53 in 1977 to N3.36 in 1983 with the highest rate of decline experienced in 1982 (-29.53 percent) and an average growth rate of -0.7 percent between 1977 and 1983 (Obadan and Odusola, 2010). An

average labour productivity growth rate of 1.2 percent was recorded between 2000 and 2008, which was lower than 1.9 percent of Sub-Saharan African countries (World Bank, 2009). CEIC (2019) stressed that an average productivity growth rate of 1.14 percent in Nigeria was recorded in Nigeria between 2013 and 2018. Inequality measured with the Gini index rose continuously from 34.28 in 1980 to 46.50 in 1995/1996, 48.81 in 2010 and stands at 40 .0 in 2017 while the ratio of the richest 10 percent have a share of 31.09% of the national income in 2016 (NBS, 2018; UNDP, 2017). The trend analysis seems to suggest that there is a relationship among the rate of inequality and productivity in Nigeria.

Understanding the link between productivity and inequality is a major challenge both in research and policy debates. This linkage is still to be fully explored. Although each of them may have their own solutions, but given the nexus between them, policy interventions on both issues may be the answer in Nigeria. As noted by OECD, high level of inequality hampers growth resulting in low human capital investment thereby reducing productivity (OECD, 2019). Several studies have been carried out on the links on regional, cross country and country specific basis with contradicting conclusions. For instance, Adegboye, (2016) examined the direct and indirect link between productivity and inequality and showed that productivity growth reduces income inequality in Nigeria. **I**t may be examined if exchange rate volatility is of consequence for productivity growth for developing countries as observed by Aghion, Bacchetta, Ranciere, and Rogoff (2009). This has been neglected by previous studies in Nigeria. However, given low level of productivity and high income inequality in Nigeria, we may like to ask, **could they be impacting each other?** Is productivity a significant reaction function of inequality in Nigeria? Reducing the inequality gap and increasing productivity growth can best be achieved by looking at the synergies and /or trade-off between these variables. Policy measures to increase productivity growth may adversely impact on inequality. Hence this study will be guided on the result of the synergies and trade-off among these variables in the formulation of appropriate policy measures to accommodate these towards Nigeria's development.

2. LITERATURE REVIEW

2.1 Concept of productivity

According to the Productivity Commission News (2015), Productivity is the efficiency with which firms, organizations, industry and the economy as a whole, converts inputs into (labour capita and raw materials) into output while King, Plosser, & Rebelo, (1988), noted that productivity is the amount of output produced given the per unit of input used. Taking all factors of production into consideration, we have total factor productivity (TFP), which is defined as the ratio of total output to a measure of the total input. However, the labour force is an asset in its capability to enhance productivity and growth (Nigeria Vision, 2020). Prevalence of redundant labour results in low income growth, lack of training, low level of technology, low level of capacity utilization among others which are major factors for low labour productivity in Africa (Mordi and Mmieh, 2008).

2.1.1 Concept of inequality

Inequality is the unfair situation in society when some people have more opportunities, money and others than other people. It is the difference found in various measures of economic well-being among individuals in a group, among groups or among countries. Inequality is of two basic dimensions, income inequality; and gender inequality. Income inequality is the unequal distribution of income and wealth between the various members of the society. As observed by the neoclassical school, the differences in the productive capacity of individuals in a society or economy leads to differences in wage levels and income levels and this result in income inequality (Ogbeide-Osaretin & Agu, 2015). Gender inequality on the other hand is the social process by which people are treated differently and disadvantageously, under similar circumstances, on the basis of gender (Kolo, 1999). Inequality is commonly measured with the Lorenz curve or the Gini Coefficient. We will make use of the Gini coefficient which measures inequality across the whole of society rather than simply comparing different income groups. There is perfect equity in income when Gini is 0 and otherwise if 1. The lower the Gini value, the more equal the society is.

2.1.2 The theoretical link between inequality and productivity

A very important theory of growth and inequality is the popular Simon Kuznets' curve which is an inverted U-shaped curve. It shows that as income grows, distribution initially becomes more unequal, but as the benefits of productivity become more widely shared, inequality diminishes (Todaro & Smith, 2011). Given that growth is expected to be directly proportional to productivity, this theory can be extended to link productivity and inequality.

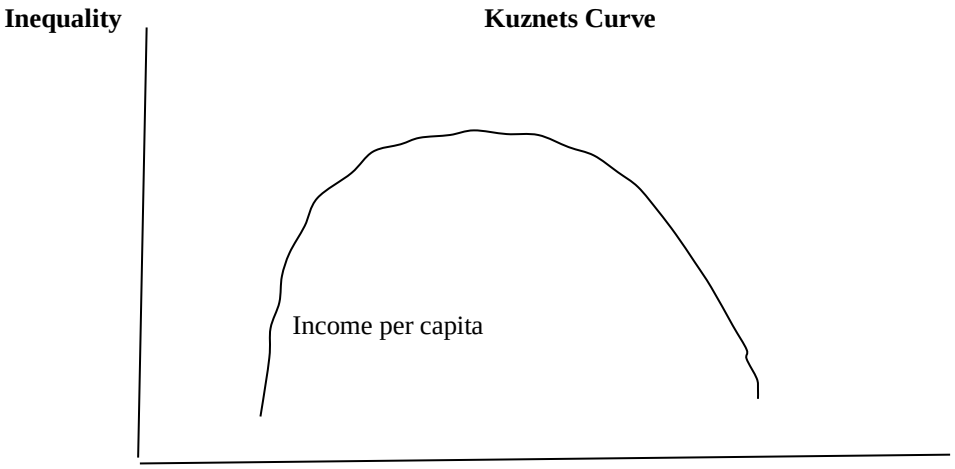

Figure 1: inequality and productivity (income per capita) linkage

Source: Todaro and Smith, 2011

However, other theories have contradicted the Kuznets model arguing that productivity increases inequality continuously. For instance, Piketty and Saez, (2003) updating the Kuznets' model by adding the third stages. This recognized the role of globalization and financial integration of the leading economies resulting in rise in inequality as income per capita rises. Piketty and Saez, (2003) further noted that the rise in earnings in the financial sector allows for a further concentration of wealth in the hand of the higher income group.

2.2 Empirical literature

Studies on income inequality had been more of cross-sectional analysis until recent times because of the dearth of data on inequality. However, with the availability of time series data in recent times, panel and annual analysis are being carried out. Hayes, Nieswiadomy, Slottje, Redfearn and Wolff (1994), investigated the connectivity and causality between income inequality and factor productivity. Evidence showed that they are inversely related and policies of enhancing productivity and income inequality should be simultaneously put into consideration while Hanson and Adam (1997) developed a computable general equilibrium model of productivity and income distribution. Increasing income inequality in the face of growing economic growth was attributed to the changes in labour-augmenting technology Loko and Diouf (2009) investigated on the potential sources of total productivity growth utilizing generalized method of moment (GMM) estimator on an unbalanced panel of sixty-two countries over the period 1970 through 2005. They found that trade openness, education, and female labour forces participation are positive forces for productivity growth, while inflation, as a proxy for economic instability, and the size of the government are negative forces.Aghion, et. al (2006) using a dynamic (GMM) estimation method on a panel of 83 countries over the time 1960 to 200 noticed that volatility of exchange rate negatively affected productivity growth when financial development is low, government size and price stability affects productivity negatively while education and trade openness positively impacted on productivity growth. Analyzing the determinant of total factor productivity for 118 countries, Islam (2008) engaged ordinary least squares and instrumental variable estimators and discovered that human capital, the size of the government, and black market premium are accountable while political stability and appropriation risk do not count for productivity.

Bahmani-Oskooee, Hegerty and Wilmeth (2008) on an annual data in a determinant of income inequality re-examined the Kuznets "inverted-U" hypothesis using the cointegration. Result found no support for the Kuznets' hypothesis while effect of income and openness differs with countries. In concurrence with the above studies, Frederiksen and Poulsen (2010) used an equilibrium framework in analyzing the causes of income inequality in USA and outcome revealed that shocks in the relative income of employees have a greater probability in increasing inequalityDiPietro (2014) employing a cross country analysis examined the connectivity between the productivity of labour and income inequality over period 2001 to 2010, postulated that given the assumption of most countries going beyond the inequality threshold, inequality in income reduces the growth of labour productivity in agreement with the general notion. Recent studies on the relationship between productivity growth and income inequality in Nigeria was carried out by Adegboye, (2016). The study employed a simultaneous equation framework of human capital as a dynamic linking factor for the period 1980 to 2012 and estimated by the Generalized Method of Moment (GMM) technique. Productivity growth led to the reduction of income inequality in Nigeria while income inequality was found to have a positive impact on productivity growth. This positive relationship is found to be linked to the indirect impact

of income inequality through the channel of human capital. The result however confirmed that income inequality can be reduced especially through human capital development (higher educational enhancement).

Sharpe and Uguccioni (2017) decomposing the productivity-wage gap into: inequality, data sources, deflators and changes in labour shares, studied 11 OECD economies over the 1986-2013 years. They conclude that, while there is no common cause for decoupling, most countries experienced inequality upturns and falling labour shares while in a panel study, Policardo, Punzo and Edgar (2019), examined the harm of wage inequality on productivity growth in a dynamic panel model of 34 OECD countries from 1995 to 2007 and found that wage inequality lowers labour productivity. Working population, total population and GDP per capital significantly affect labor productivity.

3. METHODOLOGY

To capture the objectives of the study we built a simultaneous equation model. This is because most economic variables are interrelated and its capacity capture the feedback effect of a variable that is an endogenous variable when it becomes an exogenous variable on the other endogenous variables.

3.1 Model specification

The productivity equation follows the study of Junankar, (2013) and DiPietro, (2014) while the equation of inequality follows the study of Barro (2000). However, unlike these models we specified an autoregressive distributed lag model for the inequality equation given that most economic models are implicitly or explicitly dynamic in nature (Baltagi, 2007) and inequality entails a spill over. The equations is given as:

Pt = b10 + b11Pt-1+ b12Inet + g1X1t + e1t----------3.1
Inet = b20 + b21Inet-1+ b22Pt + g3X2t + e3t----------3.2
where Pt is a measure of productivity,
Inet is a measure of income inequality,
X1t, and X2t are matrices of additional explanatory variables following previous studies and their role in the determination of the endogenous variables while few additions were also made while e1t and e2t are classical error terms, all for period t.
The X variables used for the equations are included into the equation 3.3 and 3.4
Pt = b10+b12Inet+g11Hct+g12GEXEDUt+g13DEVPt+g14POPGRt+g15EXCr+g16WWTt+e1t------3.3
Inet = b20 + b21Inet-1+ b22Pt + g21GEXEDUt +e2t----------3.4
Where:
Pt= productivity at time t captured by labour productivity
Inet= Inequality at time captured by Gini
Hc= Human capital at time t proxied by the percentage of secondary gross enrollment in line with Seetanah (2009)
GEXEDU= Total government expenditure in the educational sector
DEVP= Development captured by Human capital Development Index
POPGR= Population growth rate
EXC= Exchange rate
WWT= worldwide technological frontier, proxy by investment-GDP ratio
e1t and e2t are the error term for the three equations respectively.
b12. g13 g15<0; g11, g12, g14, g16 >0
g22<0; b21, b22, g21 >0

3.2 Estimation procedures

Variables were tested for multicollinearity and diagnostic tests were conducted to ascertain stochastic properties of our variables. The level of stationary of the variables were also tested and cointegration carried out using the Bond testing method given its applicability irrespective of whether the regressors in the model are purely I(0), purely I(1) or mutually cointegrated. In its basic form, an ARDL regression model is specify thus:

$$\Delta y_t = \alpha_0 + \beta_i y_{t-1} + \lambda_k \sum_{k=1}^{k} \Delta SR_{k,t-1} + \sigma_k \sum_{k=1}^{k} LR_{k,t-1} + \mu_t \qquad 3.4$$

Where: Δ denotes first difference of variable, μt is a random "disturbance" term, yi is the dependent variable, while SR is the short-run dynamics of explanatory variables, LR is the long-run dynamics of the explanatory variables. $\beta, \lambda \text{ and } \sigma$ are the parameters to be estimated; α_0 is the constant parameter. The estimation techniques employed is the Instrumental Variables (IV)/2SLS and the ARDL estimations for promising simultaneity.

3.3 Data

Secondary data obtained from the CBN Statistical Bulletins, (2018), UNDP report (various years) and World Bank (WDI), (2018) and span the period from 1991 to 2017. The choice of the variables used for the study was majorly based on the availability of the data. E-views 9 econometric package was used.

4. PRESENTATION AND DISCUSSION OF RESULT

4.1 Correlation

The degree of multi-collnearity was accounted for using the group correlation matrix. Result as displayed in table 4.1 indicated no perfect multicollinearity among the variables. Productivity and income inequality were negatively correlated and technology was negatively correlated with productivity. Development was negatively related with inequality showing that inequality reduces with increase in development as expected. Nevertheless, the outcome of a simple bivariate correlation do not account for the degree of the connectivity among the variables. Therefore, we will draw our policy using the estimates from multivariate models.

Table 1: Correlation matrix

	PRO	INE	HC	DEV	POPG	EXPEDU	WWT	EXCR
PRO	1							
INE	-0.319503	1						
HC	0.868401	-0.035527	1					
DEV	0.761806	-0.661359	0.512539	1				
POPG	0.2006492	0.0965228	0.2194207	-0.290345	1			
EXPEDU	0.8496019	-0.2908220	0.868796	0.700883	0.234645	1		
WWT	-0.5715627	0.002979	-0.6825433	-0.410617	-0.088446	-0.563942	1	
EXCR	0.8011191	-0.4953781	0.6872728	0.765174	0.196526	0.872519	-0.3229597	1

Source: Authors' computation using data on Eviews

4.2 Unit Root Test

The Augmented Dicky Fuller test and KPSS test were used to examine the stationarity state of the variables and they were found to have different levels of stationarity. Inequality, technology (investment to GDP ratio) and population growth rate (POPg) were found to be stationary at levels while government expenditure in educational (EXPEDU), development, exchange rate, and human capital were integrated of order one. Productivity was integrated of order two, I(2) using ADF while it was order one with KPSS. However, given the superiority of KPSS over the method in the face of conflicting results in comparisons of their respective strengths and weakness, the study adopted the result of KPSS for the analysis.

Table 2: summary presentation of stationarity test

Variables	ADF		Remarks	KPSS		Remarks
T-Stat.		Critical Values		LM-Sat	Critical Values	
PRO	-7.278195	-2.981038	I(2)	0.128150	0.146000	I(1)
INE	-3.951714	-2.991878	I(0)	0.150670	0.463000	I(0)
POPg	-4.391065	-2.971843	I(0)	0.248905	0.463000	I(0)
DEVP	-5.208606	-2.976263	I(1)	0.453557	0.463000	I(0)
EXPEDU	-4.403155	-2.976263	I(1)	0.352192	0.463000	I(1)
EXCR	-3.783301	-2.976263	I(1)	0.262084	0.463000	I(1)
HC	-5.381334	2.976263	I(1)	0.055878	0.463000	I(1)
WWT	-5.417664	-2.981038	I(0)	0.365753	0.463000	I(0)

Source: Authors' computation using data on Eviews

4.3 Cointegration Test

The unit root result showed that the variables were a mixture of order one and zero, hence, the bounds testing technique for cointegration was used to determine the existence of cointegration among the variables for the two models. Upshot revealed that we do not fail to accept the null hypothesis of no cointegration for the inequality equation given the F sat of 1.860768 which is lower than the 5% critical value of 3.79 at the lower bound and 4. 85 at the upper bounds (table 1 of the appendix). For the productivity model, outcome showed that we do not fail to reject the null hypothesis and conclude that cointegration exist among the variables with an F-sat of 10.73233 which is higher than the 2.45 critical value at the lower bound and 3.61 of upper bound (table 2 of the appendix. Hence, we proceed to determine the flow of the causality among the variables.

4.4 ARDL and TSLS estimation results

Table 3: TSLS for Productivity

Dep. Var. = Productivity (PRO)			
Method = TSLS;			
R2 = 0.813130 F-Stat. = 193.4544 DW =1.6343 Instrument rank: 9 J-Statistics= 18.97611(0.00000)			
Variable	Coefficient	t-Statistic	Prob.
INE	18471.30	2.437314	0.0243
DEV	138.5669	3.738193	0.0013
HC	10881.92	2.006405	0.0585
POPG	584050.1	2.268717	0.0345
EXCR	1187.226	1.784038	0.0896
WWT	432.5479	0.068616	0.9460
EXPEDU	2346.218	5.692612	0.0000
C	-2675099.	-2.922654	0.0084

Source: Authors' computation using data on Eviews

Table 4: TSLS and ARDL for inequality.

Dep. Var. = inequality (INE)						
Method = TSLS;				Method = ARDL;		
R2 = 0.508600 F-Stat. = 8.44240 DW =1.620182 Instrument rank: 5 J-Satistics= 15.45687(0.00411)				R2 = 0.519630 F-Stat. = 8.653813; DW = 1.613942		
Variable	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.*
INE(-1)	0.695018	4.599583	0.0001	0.710515	4.887120	0.0001
LOG(PRO)	-0.442020	-0.104317	0.9178	0.608208	0.422236	0.6766
LOG(EXPEDU)	-0.054524	-0.015399	0.9878	-0.766952	-0.705295	0.4874
C	18.99650	0.451222	0.6559	7.789803	0.475847	0.6385

Source: Authors' computation using data on Eviews

The TSLS and ARDL estimation methods were used for the estimation of the inequality equation, while only the TSLS was used in estimating the productivity equation while the ARDL bond testing was used to test for the existence of long run relationship. Table 3 shows the outcome of the productivity equation. The result revealed that human capital (HC), government expenditure in education (EXPEDU), population growth, exchange rate (EXCR) and technology (WWT) were positively related with productivity in line with expectation while on the other hand, level of development (DEVP) and inequality were found to be positively related with inequality contrary to our expectation and calls for concern in Nigeria. The results revealed specifically that 1 unit rise in inequality increases productivity by 18471 units all factors kept constant. This is contrary to expectation that inequality will reduce productivity given the high acquisition of income by the wealthy group which will reduce the growth of productive output because the lower income class will not be willingly to engage in productive activity which will make them unemployed, lack income thereby increasing inequality level rate. This outcome was found to be consistent with some studies (Hanson & Adam, 1997; Adegboye, 2016) while contrary to the findings of some other studies (DiPietro, 2014; Sharpe & Uguccioni, 2017; Policardo, et. al, 2019). Development level was expected to be negatively related with productivity as found by Policardo, et.al, (2019) because, countries with lower level of economic development have the tendency of absorbing and borrowing technology which will increase productivity.

The positive and considerable impact of education on productivity which is expected to increase growth and development was supported by some studies (Loko and Diouf, 2009). POPg and HC were found to contribute more to determinant of productivity given their magnitude of 584050 units and 10881 respectively. This suggests that the rising population growth which seems to be a concern for the development of the country can actually be a spring board towards the enhancing the productivity of the country through the increase in technological advancement as confirmed by the studies of Policardo, et. al, (2019). The exchange rate volatility was found to positively influence productivity as against expectation nevertheless not substantial. The result also showed that all the variables in the model has substantial impact on the productivity level in Nigeria with the exception of WWT and EXCR. The unsubstantial impact of WWT shows the low level of technological advancement. This tends to strengthen the outcome of the impact of inequality that it was not the high level of inequality that is obstructing the productivity but the low level of technology given by the low ability to absorb technology given the low infrastructural facility in the country.

The model was well fitted as confirmed by value of multiple determinant of variation R^2, F-statistics and DW-statistics as presented in table 4.3. 81% of the variation in productivity level was explained by the included regressors and the DW-statistics confirmed the absence of autocorrelation of concern.

In the inequality model, the TSTL and ARDL result of the estimation revealed major differences. Previous levels of inequality (INE) showed a positive connectivity with current levels of inequality in line with expectation of the spillover effect of inequality as observed by World Bank, (2018). On the outcome of productivity, while the TSLS showed a negative connectivity in line with our expectation that productivity is expected to reduce inequality by increasing the income of the people while the ARDL showed a positive connectivity linking inequality and productivity. Adegboye, (2016) found that productivity growth subordinates inequality. The upshot points that 1% increase in productivity reduces inequality by 44% for the 2SLS and increase inequality by 42% in the ARDL. On the outcome of the connection of government expenditure on inequality, the result shows that 1% increase in EXPEDU brings about 5% and 70% surge in inequality respectively for the two estimations. The result however showed that only previous levels of inequality had a substantial impact on current levels of inequality in the model. The model was well fitted and confirmed by the value of multiple determinant of variation R2 showing that 50% and 52% of the variation in inequality was explained by the regressors in the model for the TSLS and ARDL respectively. Also, the DW-statistics of 1.620182 and 1.613942 showed the absence of autocorrelation in the models. The F-statistics and the J-statistics showed the appropriate instruments and good fit of the model.

4.5 Causality

The causality outcome showed a one-way directional causality flowing from productivity and inequality as expected. Productivity was also found to Granger cause human capital, government expenditure in education and development. Development and population growth were found to granger causality inequality without a feedback. Human capital proxied by the gross secondary enrollment was found to granger cause technology and this can explain why technology had no substantial impact on development given the low rate of enrollment as compared to other development countries.

5. POLICY COROLLARIES OF EMPIRICAL FINDINGS

5.1 Policy suppositions

From the empirical estimates the following policy suppositions are drawn from the result:

While productivity positively affects inequality widening the income gap although not substantial, inequality positively and substantially impacts on productivity. The result of the Granger causality test also elucidated the result showing a flow from productivity to inequality. This shows that while the inequality is not obstructing production as recommended of the inequality threshold ((UNDP, 2020) for productivity, productivity is widening the inequality gap in Nigeria. So, policy measure towards closing the inequality gap should also consider enhancing productivity. One of such tools to achieve this fulling engaging the available population as shown by the result.Following the policy recommendation above is the recommendation of the labour intensive technology which will reduce the inequality gap as more people will be employed and earn income. The result of the productivity model showed that population growth have a substantial impact on productivity.

Inequality spillover was confirmed by the result. Hence we recommend that policy measures towards poverty and unemployment reduction should be long-run policy measures. Closing the inequality gap is not going to be automatic with the evidence of inequality cycle (World Bank, 2018). Government expenditure in the educational sector optimistically and substantially impacted on productivity as expected and at the same time, supportively showed its ability to reduce inequality. This study therefore pungently recommend increasing government involvement in the educational sector and this should go beyond the primary education to the secondary and tertiary educational level.Exchange rate volatility had no substantial impact on productivity which was contrary to outcome of exchange rate volatility negatively affects productivity of Aghion, et. al, (2009). However, policy measures to stabilize the exchange rate is also recommended.

5.2 Conclusion

Enhancing productivity and reducing inequality are two major tools that will enhance development. However, there seems to be a trade-off in their connectivity. Results of this study showed that while inequality is not harming productivity growth in Nigeria, the drive towards increasing productivity is widening the income inequality gap. However, increasing human capital development and effective use of the high population growth was found as means of linking the policy of productivity growth and inequality reduction. This study thus, concludes that policy measures towards increasing productivity and reducing income inequality should be considered together for effective achievement

of the goals. Enhancing the secondary and tertiary educational levels, and increasing government expenditure in the educational sector are imperative intervention tools.

5.3 Limitations and future directions for research

Availability of data was the major limitation of this study. We recommend that for further studies, the transparency of be included as this will reveal the rate of the implementation of the various policies towards enhancing the productivity with little or result

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Appendix

Table 1: ***ARDL Bounds Test for productivity equation***

ARDL Bounds Test
Date: 02/14/20 Time: 23:51
Sample: 1991 2018
Included observations: 28
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	10.73233	6

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

Source: Authors' computation using data on Eviews

Table 2: ***ARDL Bounds Test for inequality equation***

ARDL Bounds Test
Date: 02/14/20 Time: 23:54
Sample: 1991 2018
Included observations: 28
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	1.860768	2

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	3.17	4.14
5%	3.79	4.85
2.5%	4.41	5.52
1%	5.15	6.36

Source: Authors' computation using data on Eviews

Table 3: ***Granger causality test***

Pairwise Granger Causality Tests
Date: 02/15/20 Time: 00:08
Sample: 1990 2018
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
INE does not Granger Cause PRO	27	0.53070	0.5955
PRO does not Granger Cause INE		6.72145	0.0053

HC does not Granger Cause PRO	27	2.12620	0.1431
PRO does not Granger Cause HC		3.66057	0.0424
EXPEDU does not Granger Cause PRO	27	1.57927	0.2286
PRO does not Granger Cause EXPEDU		12.4442	0.0002
DEV does not Granger Cause PRO	27	1.07252	0.3594
PRO does not Granger Cause DEV		6.07785	0.0079
POPG does not Granger Cause PRO	27	0.86259	0.4359
PRO does not Granger Cause POPG		1.61323	0.2219
WWT does not Granger Cause PRO	27	1.48680	0.2479
PRO does not Granger Cause WWT		2.40246	0.1138
HC does not Granger Cause INE	27	0.68786	0.5131
INE does not Granger Cause HC		0.23014	0.7963
EXPEDU does not Granger Cause INE	27	2.17142	0.1378
INE does not Granger Cause EXPEDU		0.19587	0.8235
DEV does not Granger Cause INE	27	24.8237	2.E-06
INE does not Granger Cause DEV		0.05243	0.9490
POPG does not Granger Cause INE	27	17.1068	3.E-05
INE does not Granger Cause POPG		0.33683	0.7176
WWT does not Granger Cause INE	27	0.58696	0.5645
INE does not Granger Cause WWT		1.27485	0.2993
EXPEDU does not Granger Cause HC	27	2.09465	0.1470
HC does not Granger Cause EXPEDU		0.20860	0.8133
DEV does not Granger Cause HC	27	0.93766	0.4066
HC does not Granger Cause DEV		14.8873	8.E-05
POPG does not Granger Cause HC	27	1.77407	0.1931
HC does not Granger Cause POPG		5.74846	0.0098
WWT does not Granger Cause HC	27	0.94511	0.4039
HC does not Granger Cause WWT		5.80686	0.0094
DEV does not Granger Cause EXPEDU	27	1.50536	0.2439
EXPEDU does not Granger Cause DEV		9.61363	0.0010
POPG does not Granger Cause EXPEDU	27	0.39741	0.6768
EXPEDU does not Granger Cause POPG		2.87262	0.0779
WWT does not Granger Cause EXPEDU	27	0.08389	0.9198
EXPEDU does not Granger Cause WWT		2.30007	0.1239
POPG does not Granger Cause DEV	27	0.86509	0.4349
DEV does not Granger Cause POPG		1.73834	0.1991
WWT does not Granger Cause DEV	27	0.99705	0.3850
DEV does not Granger Cause WWT		0.27716	0.7605

WWT does not Granger Cause POPG	27	0.17792	0.8382
POPG does not Granger Cause WWT		0.17946	0.8369

Source: Authors' computation using data on Eviews