Unemployment and Productivity Nexus: Empirical Evidence from Nigeria

Ogbeide-Osaretin, Nwamaka Evelyn[1]PhD & Ishiwu NkirukaVictoria[2]

Abstract

This study scrutinized the unemployment and productivity nexus in Nigeria drawn on time series data on unemployment, labour productivity as a measure of productivity, population growth, labour productivity rate and government expenditure in the educational sector for the time1990 to 2017. The VAR model was employed when co integration was not found amidst the variables confirmed by the bound testing result. The outcome revealed that unemployment responds unsubstantially and positively to jolt in productivity in the short run but negatively in the long run while previous levels of unemployment had a positive inconsequential impact on current productivity levels. Productivity reacts negatively to jolts in educational sector's expenditure while population growth noteworthy and positively affects unemployment. We therefore advocate intensification of expenditure in the educational sectors and population reduction towards enhancing productivity for long run reduction of unemployment.

Keywords: Human capital, Productivity, VAR, Unemployment,

JEL Classification: O33, E20, J23

Contribution to Knowledge and Originality

This study has contributed to knowledge by accounting for the endogeneity of unemployment as well as introducing demographic variables ignored by previous studies in the evaluation of the unemployment and productivity nexus.

Introduction

The traditional theory acknowledges the changes in total factor productivity (TFP) are a brawny force towards intensifying the growth and the well-being of diverse aspects of the economy (Agbodike, Igbokwe-Ibeto & Umeifekem, 2015). However, improving the output growth of a country over time relies almost totally on the magnitude of the labour force and employment rate which further increases productive capacity and productivity. Developing countries are often characterized by low level of productivity, high unemployment level and high inequality level although growth seems to be high in most of them. The world unemployment rate as at 2015 stood at 6.1 % while for Sub-Saharan Africa, unemployment has increased steadily to 16.5 % in 2015 and 30% when combined with underemployment (CIA World Factbook, 2012; United Nation Development Report, (UNDP), 2016). In Nigeria, the low productivity and unemployment levels are of a major interest. Data certified that although economic growth has been high and stable in recent years, except the times of general global econcomic recession, labour productivity growth is not encouraging particularly when compared with other developing countries with lower economic growth. Various development plans and policies have been carried out since independence towards increasing productivity and reducing unemployment and there seems to be no noticeable success (for instance, the National Productivity Centre (NPC), Industrial Training Fund (ITF)) the 60:40 ratios in favour of science related courses in the Universities admission guideline, National Directorate for Unemployment (NDE), Entrepreneurship Clinic Development (ECD), Youth Empowerment in Agricultural Programme (YEAP) among others).

[1] Department of Economics, Edo University Iyamho, Edo State, iyokoevelyn@gmail.com
[2] Department of Economics, University of Nigeria, Nsukka, Enugu State

For instance, the GDP in Nigeria was worth $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, 2017) yet total labour productivity declined consecutively from N5.53 in 1977 and documented an average growth rate of -0.7% between 1977 and 1983 (Obadan & Odusola, 2010). World Bank (2009) showed an average labour productivity growth rate of 1.2% from 2000 to 2008 below 1.9% recorded in the Sub-Saharan African countries while CEIC (2019) stressed thatgrowth rate of productivity in Nigeria was on an average of 1.14% between 2013 and 2018. Although with the rebasing of GDP output was accounted for by 51% tertiary level of educated labour, National Bureau of Statistics (NBS) (2016) noted that labour productivity declined by 12.8% between 2015 and 2016. This presents a paradox as the high level of tertiary education is expected to translate into increased efficiency in production and productivity. NBS data also showed that the periods of low productivity coincided with periods of high unemployment rate (see fig 1). Unemployment rate rose from 4.3 percent in 1976 skyrocketing to 11.7% in 1999 and continued 18% in 2016 (NBS, 2012, Trading Economics, 2016). These tend to raise a question on the theoretical postulation of a positive connectivity between employment growth and higher productivity.

Fig 1.1: Trend of unemployment and productivity.
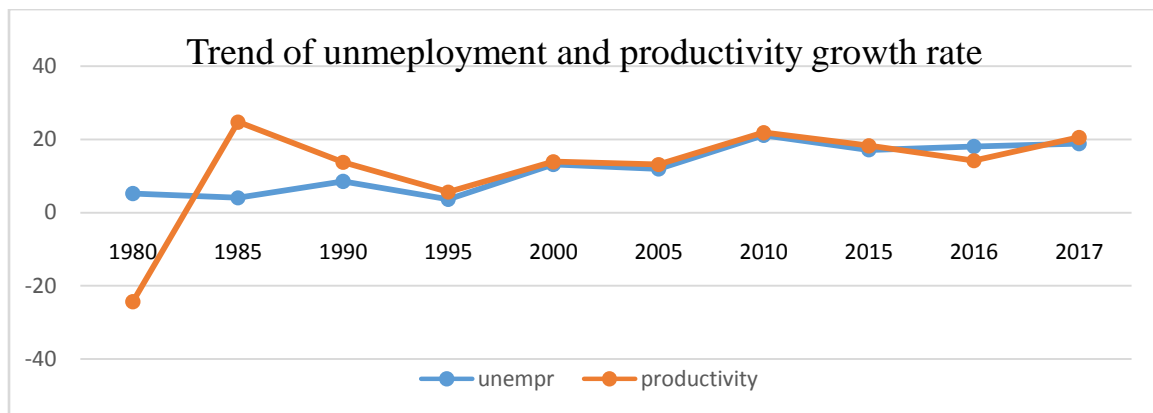
Source: Authors chart using data from Obadan and Odusola, 2010; NBS (2016); and WDI, 2017.

Understanding the productivity, unemployment linkage is a major challenge both in research and policy debates and theories (particularly Real Business Cycle theory (RBC) and Keynesian theory) are not conclusive on this. Studies on different countries have tried to show that there is neither a systematic link between productivity and unemployment (Dedola & Neri, 2007). Unemployment and productivity have been found potentially negatively related implying a trade-off remarkably in the short-run with employment negatively impacting on productivity (Beaudry & Collard, 2002;Van der Horst, Rojas-Romagosa & Bettendorf, 2009) while others found productivity increasing unemployment (Dew-Becker & Gordon, 2012). Others have also argued that productivity could increase employment (Bottazzi & Peri, 2007, Canova Lopez-Salido, & Michelacci, 2008). A major weakness of previous studies particularly for Nigeria is the negligence of the role of endogeneity of unemployment in analyzing the relationship as acknowledged by some studies outside the country (Beaudry & Collard, 2002; Van der Horst, Rojas-Romagosa & Bettendorf, 2009). There are also issues of whether the researcher is estimating a model for economic growth, per capita economic growth, or productivity given the measures used for productivity. Past productivity measures have been examined using GDP growth rate (Amassoma and Nwosa, 2013). The use of labour productivity can mitigate the conclusion on the productivity-unemployment relationship in Nigeria. Therefore, the objective of this study is to ascertain the significant relationship between unemployment and productivity both in the long run and the short run. This study therefore contributes to knowledge in three important ways: First, evaluating the affiliation between productivity and unemployment in a simultaneous equation framework. Second, we investigated the function of human capital development in the connectivity. Third, the prospect of a short run and long run connectivity is investigated.

Literature Review

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 (Productivity Commission News (2015).

Productivity can be measured as a single factor (labour), multifactor (labour and capital) or total factor. Unemployment on the other hand is a status quo where people of working age, willing and able to work are unable to get work. The international Labour Organization (ILO), (1998) cited in Iyoko (2013), defined the unemployed as numbers of the economically active population who are without work, and however are available for and seeking for work.

Theoretical Link between Unemployment and Productivity

Various theories have been put forward on the association between productivity and unemployment. The model by Manuelli (2000), noted that technological improvement lowers the market value of existing firms, which makes firms reduce investment and job creation, therefore, unemployment rate increases. With the new technology in place, firms start to increase investment and job creation resulting in reduction of unemployment rate. The Keynesian structure as examined by Hussian and Nadol, (1997), assumed that increase in employment, stock of capital and technological change are largely endogenous. The productivity growth should increase labour demand, therefore reducing unemployment. Demand for labour is a derived demand and efficiency in the aggregate demand is important. The Theory of Real Business Cyclecontends that growth of productivity of input which revolutionizes technology determines the employment state. Increase in output growth more than growth of inputs increase total factor productivity or the Solow's residual which will reduce unemployment through the reallocation of labour and capital (Chatterjee, 1999).

Empirical literature

Some empirical studies on the unemployment and productivity affiliation have been carried out. Beaudry and Collard (2002), employed a cross country regressions associating the change in output-per worker (over 15 year periods) to employment changes and the initial level of output per worker in an OECD countries panel study for the period 1960 to 1997. They found the change in employment resulting in large and efficient reduction of labour productivity. Ayoyinka, (2008), investigated the factors of growth and determinants of employment for the period 1981-2006in Nigeria. The Ordinary Least Squares technique was used with the stationarity of the data corrected. Outcome revealed that a positive and noteworthy relationship existed between economic growth and employment in addition to public expenditure while a negative and significant relationship was observed between employment growth rate and growth rate of GDP in the economy. Van der Horse, Rojas-Romeos and Bettendorf (2009) investigated on the reality of mutuality between employment and labour productivity using a panel of 20 OECD countries for the period 1970-2003 and tested for the endogeneity of employment. They found that employment tends to boost productivity. This was however contrary to the findings of Junankar (2013) still on OECD countries where he examined the likelihood of a switch between employment and productivity. Employing a panel data framework on some developed and developing OECD countries and various estimation method, result suggested the presence of a trade-off. De Michelis, Estevão, and Wilson (2013) also found productivity and unemployment positively related confirming the findings of Junankar (2013) as they analyzed the impact of shocks to total factor productivity (TFP) on employment using cross country study of 20 OEC member economies. Findings showed strong evidence of negative correlation between productivity growth and labour inputs both in the short-run and long-run.

However on the impact of productivity growth and unemployment rate in Nigeria, Amassoma, and Nwosa (2013), used a scale-by-scale basis in annual data of 1986 to 2010. Employing the error correction model, result showed insignificant influence of unemployment on growth of productivity in Nigeria in the short-run and long-run. Gallegati, Gallegati, Ramsey, and Semmler (2018), analyzed the consequences of a surge in productivity on unemployment using annual data of unemployment and labour productivity for G7 countries from 1962-2012 on different time scale components. Employing the wavelet analysis within a panel data framework to separate the short, medium and the long-term effects of the changes of productivity on unemployment, they found that productivity leads to unemployment in the short-run while productivity enhances employment in the he long-run. Ngutsav and Ijirshar (2018) examined the productivity of labour and economic growth in Nigeria over period of 1980 to 2015. They engaged the Auto-regressive Distributed Lag (ARDL) model and the result showed that labour productivity is significantly related with agricultural sector growth and the growth of the service sector while manufacturing sector growth and oil and gas sector had no significant relationship with labour productivity.

3.1 Theoretical Framework

This study is built on the endogenous growth which showed that unemployment has impact on long-run productivity growth. This was extended from the augmented Solow growth model adapted from Bräuninger and Pannenberg, (2000). Assuming a Cobb-Douglas type: $Y = K^{\alpha}L^{1-\alpha}$ with $0 < \alpha < 1$. --------------------------------(3.1)
Y is output, K is capital, L is Labour In the short-run unemployment reduces labour input in production: $L = (1 - u)$ N.----------(3.2) Where N is the measure of labour supply with capital and technological state given. The production frontier is assumed to be for profit maximization, the marginal product of capital is equivalent to the interest rate $r = \alpha$ Y/K and the marginal product of an efficient labour is the counterpart of the wage of labour $W_1 = (1 - \alpha)$ Y/L

.Effectiveness of labour units comprise of inexperience labour (given the labour force size of workforce $\bar{\bar{N}}$ and the economy's technological state,E) as well as human capital H. Given units of labour supply in efficiency as: N = H$^{\beta}$ (E $\bar{\bar{N}}$) $^{1-\beta}$, with $0 \leq \beta \leq 1$. The production frontier is:$Y = (1 - u)^{1-\alpha} K^{\alpha}H^{\beta(1-\alpha)} (E \bar{\bar{N}})^{(1-\alpha)(1-\beta)}$ -------------------------------(3.3)
From 3.3, when $\beta = 0$, we have unproductive human capital and efficiency of labour is based on the number of workers only as well as the economy's state of technology as it is in the traditional Solow growth model; when $\beta = 1$, unskilled labour is unproductive and supply of labour depends on human capital only and this is theLucas (1993)'s endogenous growth model. Thus if $0 < \beta < 1$ augmented Solow model stands as brought in by Mankiw/Romer/Weil (1992).
In defining productivity, we use production per worker, hence,

$P = Y/\bar{L},$ ---(3.4)

with $\bar{L}$ as the amount of employed workers and $\bar{L} = (1 - u) \bar{N}$ -------------------------(3.5).

Incorporating the worth of L and Y in equation 3.3 and 3.5 into 3.4 we obtain:

$$P = \frac{E}{(i-u)^{\alpha}}\left(\frac{K}{E\bar{N}}\right)^{\alpha}\left(\frac{H}{E\bar{\bar{N}}}\right)^{\beta(1-\alpha)}$$ -----------------------------------(3.6)

To establish the wage of a worker the labour share is divided by the amount of workers

w = w$_1$ L/$\bar{\bar{L}}$. Therefore, the wage is proportional to productivity w = $(1 - \alpha)$ P. Assuming a surge in unemployment, productivity will increase, given capital stock labour efficiency.

Labour supply surges at an exogenous rate n = $\bar{N}$ and exogenous technological progress results in growing efficiency
e = É. Thus, efficient units of unskilled labour supply $E\bar{N}$ grows at an exogenous rate of n + e. In any given time, physical capital is intensified by investment K = I, where the dot denotes the time derivative K = dK/dt. Thus, long-run unemployment (having business cycle constant), I = S and savings are relative to income, S = sY. Hence, K = sY. Divide both sides by K and incorporating equation 3.3; the physical capital growth rate is given as:

$$\dot{K}= s(1-u)^{1-\alpha}\left(\frac{H}{K}\right)^{\beta(1-\alpha)}\left(\frac{E\bar{N}}{K}\right)^{(1-\alpha)(1-\beta)}$$ ----------------------------(3.7)

Furthermore, human capital is augmented by education and its spending is relative to income. Hence, we have $\dot{H} = $ zY, where z is the educational spending rate. Use the production function to substitute Y and divide by H to obtain the growth rate of human capital:

$$\hat{K}= z(1-u)^{1-\alpha}\left(\frac{H}{K}\right)^{-\alpha}\left(\frac{E\bar{N}}{K}\right)^{(1-\alpha)(1-\beta)}$$ ------------------------(3.8)

From (3.7) and (3.8), a surge in unemployment reduces the physical and human capital growth rate. Productivity growth can be obtained from (3.6) as

$$\hat{P}= \hat{E} + \alpha(\hat{K}-(\hat{N}+ \hat{E}))+ \beta(1-\alpha)(\hat{H} - (\hat{N} + \hat{E})).$$ --------------------------------(3.9)

Hence, growth of productivity accessed by technical progress as well as physical and human capital per capita growth. Since growth rates of physical and human capital are diminished by unemployment, productivity growth also falls.

The economy converges to a steady state in the long run, where capital and production grows at equal rates $\hat{Y} = \hat{K}$

and $\hat{E} + \bar{N}$ e + n; thus $\hat{K} = \beta \hat{H} + (1-\beta)(e+n)$. this will lead two scenarios:

- when β < 1 the steady state growth rate is accessed by technological progress exogenous rate and population growth $\hat{Y} = \hat{K} = \hat{H} = n + e;$ 2)

- when β = 1 we have constant returns to factors that can be gathered and therefore a balanced endogenous growth path with $\hat{Y} = \hat{K} = \hat{H}$.

Given that $\hat{K} = \hat{H}$ holds in both cases (β < 1 and β = 1), the steady state ratio connecting human and physical capital can be obtained from (3.7) and (3.8):

$$\frac{H}{K} = \frac{z}{s}$$ --(3.10)

Therefore in the long-run analysis of productivity the above two scenarios holds and treated separately; With β < 1, the steady state growth rate of output is $\hat{Y}$ = n + e and growth rate of productivity is $\hat{P}$ = e. Hence, unemployment has no influence on the long-run growth rate. However, it might influence the level of productivity. In the steady state, K and H grow with the rate $\hat{K} = \hat{H}$ = e + n and therefore physical capital per efficiency unit of raw labour k and human capital per efficiency unit of raw labour h are constant. Insert k = K/$\overline{EN}$ and h = H/$\overline{EN}$ as well as (3.10) into equation (3.7) and (3.8) and use the steady state condition to solve for k and h:

$$k = (1-u)^{\frac{1}{1-\beta}} \left(\frac{s}{e+n}\right) \frac{1}{(1-\alpha)(1-\beta)} \left(\frac{z}{s}\right)^{\frac{\beta}{(1-\beta)}}$$ --(3.11)

$$h = (1-u)^{\frac{1}{1-\beta}} \left(\frac{z}{e+n}\right) \frac{1}{(1-\alpha)(1-\beta)} \left(\frac{z}{s}\right)^{\frac{-\alpha}{(1-\alpha)(1-\beta)}}$$ --(3.12)

3.2 Model Specification

The objectives of this research was captured adopting the Vector Autoregressive Model (VAR)following the models of Cogley and Sargent (2005), Sargent and Surico (2011). The statistical model of a VAR (p) model assumes the form:

$$Y_t = B_{0,t} + B_{1,t}Y_{t-1} + \ldots 1 + B_{p,t} Y_{t-p} + \varepsilon_t$$

(3 13)

where $X_t^{'}$ collects the first p lags of Y_t, ε_t are reduced-form errors, Y_t represents each of the series and yt-i is the lag of every single series and p is the set of the optimal lag.
where the series used are
Un= unemployment rate
Pro= productivity captured by labour productivity
GEXEDU= government expenditure in educational sector
LPR= labour force participation rate
POPg= Population growth rate to account for demographic effect
The use of VAR/ VECM modeling is because it does not require much knowledge about the forces influencing a variable and allows us accounts for the delayed response with parsimonious lag structure (Agenor, Mabli and Youset, 2005). An important feature of VAR model is its use in estimating residuals called VAR innovations. The transformation of the VAR into VECM is to account for the speed of adjustment in the model's long run and short-run dynamic. It also has a co-integration restriction embedded in the specification. Thus it can also be used on co-integration non-stationary series.

3.3 Estimation Procedures

The variables are tested for stationary and the degree of multicollinearity is determined. The optimum lag length for the model is also determined; cointegration test was carried out using the ARDL bound testing.

This method is better than the Maximum Likelihood (LM) because it is appropriate irrespective of the regressors being purely I(0), purely I(1) or mutually cointegrated. In its basic form, an ARDL model is specify thus:

$$\Delta y_t = \alpha_0 + \beta_i y_{t-1} + \lambda_k \sum_{k=1}^{k} \Delta SR_{k,t-1} + \sigma_k \sum_{k=1}^{k} LR_{k,t-1} + \mu_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots 3.14$$

Where: Δ denotes first difference of variable, μ_t is a random "disturbance" term, y_t is the determined variable, while SR is the short-run dynamics of repressors, LR is the long-run dynamics of the repressors. $\beta, \lambda\ and\ \sigma$ are the parameters to be estimated; α_0 is the constant. The VAR estimation was carried out along with the impulse response function test and the variance decomposition test.

3.4 Data

The data for the research covers the time 1990 to 2017 given the availability of the data. The data were sourced National Bureau of Statistics, Central Bank of Nigeria Statistical Bulletin and the World Development Indicators. The analysis was carried out using the E-views 9.0 version of the econometric package given it is user-friendly and makes interpretation of results easy.

4. Result

4.1 Preliminary test

4.1.1 Correlation Result

We accounted for the degree of multi-collnearity using the group correlation matrix. Result as presented in table 4.1.1 revealed the absence of perfect multicollinearity among the variables. In terms of the correlation among the variables, unemployment (Unempr) was discovered to be positively correlated with productivity (Pro), population growth (POPg) and government expenditure (Expedu) in educational sector while the rate of labour force participation was discover to be negatively correlated with all the other variables used for the study. The result of the correlation showed that unemployment and productivity increases at the same time. Unempr was also found to increase with increase in Expedu. These are rather contrary to our expectation. However, examining the simple bivariate correlation in a conventional matrix does not take account for the degree of the association among the variables. Hence, our principal analysis for policy was drawn from the appropriate multivariate models estimated.

Table 4.1.1 Pearson's Correlation Matrix

	UNEMPR	PRO	POPG	LPR	EXPEDU
UNEMPR	1.000000				
PRO	0.822796	1.000000			
POPG	0.382398	0.200649	1.000000		
LPR	-0.542864	-0.475174	-0.360074	1.000000	
EXPEDU	0.828370	0.979602	0.234645	-0.429783	1.000000

4.1.2 Unit Root Test

The stationary level of the variables were examined using the Augmented Dicky Fuller test and and KPSS test for unit root. The result as presented in table 4.1.2 reveals that the variables were of different order of integration at 5% level of significance. Population growth rate (POPg) was found to be stationary at levels while government expenditure in educational (EXPEDU) and Unemployment rate (UNEMPR) were stationary after first differencing for the two methods of test used. For the level of stationarity for the other variables, the outcome showed that labour force participation rate (LPR) was stationary after first differencing using the ADF method while it found stationary at levels using the KPSS. Also, while productivity was found integrated of order two, I(2) using ADF while with KPSS, it was found integrated of order one, I(1). However, given the superiority of KPSS over the other three methods 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 4.1.3 VAR Lag Order Selection Criteria						
Endogenous variables: UNEMPR PRO POPG LPR EXPEDU						
Exogenous variables: C						
Date: 11/14/19 Time: 11:10						
Sample: 1990 2018						
Included observations: 27						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-601.2107	NA	2.19e+13	44.90450	45.14447	44.97585
1	-435.3838	257.9530	6.69e+08	34.47287	35.91269*	34.90101
2	-398.8390	43.31236*	3.52e+08*	33.61770*	36.25737	34.40261*
* shows lag order selected by the condition						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						

Table 4.1.1: Abridged Presentation of Unit-Root Tests using ADF

VARIABLES	ADF		Remarks	KPSS		Remarks
	T-Stat.	Critical Values		LM-Sat	Critical Values	
UNEMPR	-4.042721	-3.004861	I(1)	0.077090	0.463000	I(1)
PRO	-7.278195	-2.981038	I(2)	0.128150	0.146000	I(1)
POPg	-4.391065	-2.971843	I(0)	0.248905	0.463000	I(0)
LPR	-4.265508	-2.976263	I(1)	0.411863	0.463000	I(0)
EXPEDU	-4.403155	-2.976263	I(1)	0.352192	0.463000	I(1)

Source: Author's computation using Eviews 9 on the data

4.1.3 VAR Lag Order Selection Criteria

VAR lag selection criteria was applied to determine the appropriate lag for the model. The result presented in table 4.1.2 shows that LR, FPE, AIC, and HQ approved lag two as the appropriate lag while SC selected lag one. Hence this study will employ lag two with the majority approval as the optimum lag for the assessment of the model.

4.1.4 Cointegration Test

The upshot of the unit root test revealed that the variables are of different order of integration, therefore we used the bounds testing cointegration procedure to establish the existence of cointegration among the variables. The result as presented in Table 1 of the appendix shows an F sat of 0.774459 which is lower than the 5% critical value of 2.86 at the lower bound and 4. 01 at the upper bounds. Therefore, we do not fail to accept the null hypothesis of no cointegration among the variables. Since there exist no cointegration among the variables, we used VAR for the estimation of the model.

4.2 Estimation of the model

4.2.1 VAR result

Sequel to the upshot of the co integration, VAR was employed for the estimation of the model. The result is shown in Table 2 of the appendix and it points out that previous levels of UNEMPR had a substantial impact on current UNEMPR which was positive in lag one but negative in lag two. This points out that the current rate of unemployment is affected by previous unemployment rate.

PRO, EXPEDU and LPR showed no noteworthy impact on UNEMPR and were negatively related to it in lag one but positively related to it at lag two. The positive relation of productivity with unemployment in the long run is contrary to the Real Business Cycletheory.

Analyzing the impact of the variables on productivity, the result showed that previous levels of UNEMPR and PRO has a positive and inconsequential relationship on the current levels of productivity as confirmed by the studies of Amassoma, and Nwosa (2013). This shows that a surge in unemployment rate advances productivity but this is however contrary to our expectation. Government expenditure in the educational sector was found to have a negative and substantial impact on productivity. This tends to portray that the needed attention for the educational sector to bring about productivity has been neglected. LPR was found not to have a considerable impact on productivity while POPg show a positive substantial impact at lag one indicating that as the population grows, the rate of productivity increase in the short run but in the long run, the increasing growth rate of the population reduces productivity as shown by the result at lag two. UNEMPR, LPR and POPg were found not to have meaningful impact on EXPEDU while previous levels of EXPEDU and PRO were found to have a positive relevant impact on current levels of EXPEDU at lag one but were not relevant at lag two. Previous levels of POPg and LPR at lag one were found to be positive and noteworthy impact on current levels of LPR while UNMPR was found to have a positive and substantial impact on POPg. Thus, the poverty rate reduces the educational ability resulting in early birth giving, thereby increasing the population. The R² and the R² adj were good with each equation be well fitted.

Impulse Responses to Shocks

The response of the individual variables to a shock in its self and collectively the others at 95% level of significance is discussed in Table 3 and figure 1 of the appendix. The results showed that UNEMPR responded positively to self-shock almost all through the period. This shows that over time the unemployment rate of year 1 will fuel the unemployment of the next year leading to an increased unemployment rate. UNEMPR responded positively to shocks in PRO and POPg in the first three periods whereas, in the later periods it responded negatively. This showed that in the short run productivity results in a surge in unemployment and this findings is supported by Junankar (2013), De Michelis, Estevão, and Wilson (2013). But in the long run, productivity brings about a reduction in unemployment. This is in agreement with the RBC theory and the empirical findings of Gallegati, Gallegati, Ramsey, and Semmler (2018).The positive response of UNEMPR to POPg shows that a major cause of the rising unemployment rate in Nigeria is the high population growth rate. UNEMPR responded negatively to LPR and EXPEDU all through the period. This is in line with our expectation. As the government increases expenditure in education, more people are educated which gives them opportunity to be employed, labour force participation rate increases and unemployment is reduced unemployment. The response of PRO to self-shock and shock in other variables showed that PRO responded positively to self-shock for the first five periods and in the later five periods used for the study it responded negatively. PRO was found to respond positively to shocks in UNEMPR in almost all through the period with exception of the first two period. This shows that in the short run, unemployment reduces productivity as also found by the study of Van der Horse, Rojas-Romagosa and Bettendorf (2009) but in the long run unemployment tends to increase productivity. PRO responded negatively to shocks in EXPEDU all through the period. This is contrary to theoretical expectation. However, it shows the low human capital development level in Nigeria as seen from the low amount of government expenditure in educational in comparison to other sector. For instance, in 2017, only 5% of government recurrent expenditure was allocated to education as compared to 11% being allocated to administration (Central Bank of Nigeria, 2018), hence, the low level of productivity in the country. PRO also responded negatively to shocks in LPR and negatively to POPg in the very long run.

Variance Decomposition

Table 4 and figure 2 in the appendix shows the variables' forecast error variance decomposition for the variables respectively. For UNEMPR, the result revealed that own shock constituted the majority of the forecast error accounting for from 100% in the short run (first period) to 46% in the very long period (tenth period). Thus own shocks account more in the short run than the long run. LPR was revealed to be the next major contributor to the forecast error which was more in the long run. This ranged from 0% in the first period to 26% in the long run. POPg was also found to contribute reasonably to the variance decomposition of UNEMPR accounting for from 0% to 14%. The result showed that PRO accounted marginally for variance for caste decomposition of UNEMPR, accounting for from 0% to 3% over the period. Thus, PRO do not really account for the high unemployment rate in Nigeria.

Therefore the contributors to UNEMPR's forecast error in descending order are self, LPR, POPg, EXPEDU and PRO. On the variables' contribution to the forecast error of POR, the result in part B of table 4 and figure 2 showed that PRO contributed majorly to itself and its contribution ranging from 76% to in period one to 3% in the tenth period. UNEMPR was found to be the next major contributor to the forecast error in the short run accounting for from 24% in period one to 3% in period ten.

This confirms the result of the impulse response function and shows that productivity is affected by the unemployment rate. LPR was found to account for more of the forecast error of PRO in the long run accounting for 0% in period one to 64% in period ten. The contribution of EXPEDU to the forecast error increased from 0% in period one to 31% in period five and thereafter, began to fall falling to 8% in period ten. This shows a curve like contribution. Hence, the contributors to POR's forecast error in descending order are self, UNEMPR, LPR, EXPEDU and POPg.

5 Policy Inferences of Empirical Findings

5.1 Policy Inferences

Based on our empirical estimates, the following policy extrapolation are drawn from the result:

i. Productivity had no substantial impact on unemployment. Unemployment responded positively to shocks in productivity in the short run and negatively in the long run. Productivity lowers unemployment in the long run. This study consequently recommends enhancing the productivity of labour for effective long run reduction of unemployment rate.
ii. Unemployment responded negatively to rate of labour force participation and government expenditure and these variables were revealed to be negatively related to unemployment. This calls for an attention on the educational sector towards effective reduction of unemployment. Increase in government expenditure in the educational sector is necessity to enhance the quality of education
iii. Productivity responded negatively to shocks in government expenditure in the educational sector and to labour force participation rate. Thus, we recommend an intensification in government expenditure in the educational sector. Human capital growth is the key towards productivity.
iv. Unemployment responded positively to population growth and it was the major contributor to unemployment's forecast error. So policy measures towards reducing unemployment should stress on the reduction of population growth. Thus, this study recommends population reduction control measures such as fertility control as an important policy tool towards effective reduction of unemployment rate in Nigeria.

Conclusion

Increase in total factor productivity (TFP) has been acknowledged as a robust force towards increasing the well-being of the economy. This is however a function of the labour forces employment rate and the human capital development level. The results of this study revealed that productivity will result in a surge in unemployment in the short run but in the long run it will reduces unemployment. The low human capital level as seen from the low quantity of government investment in education has among other things hindered the productivity of labour in Nigeria, thereby productivity has not effectively reduced rate of unemployment in Nigeria. This study thus concludes that effective human capital development will increase labour productivity thereby reducing rate of unemployment in Nigeria.

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Appendix

Table 1: ARDL Bounds Test

ARDL Bounds Test				
Date: 11/14/19 Time: 11:14				
Sample: 1991 2018				
Included observations: 28				
Null Hypothesis: No long-run relationships exist				
Test Statistic	Value	k		
F-statistic	0.774459	4		
Critical Value Bounds				
Significance	I0 Bound	I1 Bound		
10%	2.45	3.52		
5%	2.86	4.01		
2.5%	3.25	4.49		
1%	3.74	5.06		
Test Equation:				
Dependent Variable: D(UNEMPR)				
Method: Least Squares				
Date: 11/14/19 Time: 11:14				
Sample: 1991 2018				
Included observations: 28				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	55.23141	50.08898	1.102666	0.2821
PRO(-1)	2.11E-06	3.43E-06	0.614608	0.5451
EXPEDU(-1)	-0.004345	0.015790	-0.275197	0.7857
LPR(-1)	-0.999986	0.816686	-1.224444	0.2337
POPG(-1)	1.263740	4.142590	0.305060	0.7632
UNEMPR(-1)	-0.226433	0.149125	-1.518415	0.1432
R-squared	0.149670	Mean dependent var		0.417857
Adjusted R-squared	-0.043587	S.D. dependent var		2.237733
S.E. of regression	2.285981	Akaike info criterion		4.678877
Sum squared resid	114.9656	Schwarz criterion		4.964349
Log likelihood	-59.50427	Hannan-Quinn criter.		4.766148
F-statistic	0.774459	Durbin-Watson stat		1.337327
Prob(F-statistic)	0.578447			

Table 2: Vector Autoregression Estimates
Vector Autoregression Estimates
Date: 11/14/19   Time: 11:15
Sample (adjusted): 1992 2018
Included observations: 27 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	UNEMPR	PRO	EXPEDU	LPR	POPG
UNEMPR(-1)	1.045011	3741.732	3.989087	-0.014645	0.025639
	(0.20209)	(2314.03)	(2.66988)	(0.01096)	(0.01012)
	[5.17110]	[1.61698]	[1.49411]	[-1.33639]	[2.53272]
UNEMPR(-2)	-0.532590	1553.462	-3.557694	0.017698	-0.009735
	(0.23022)	(2636.16)	(3.04155)	(0.01248)	(0.01153)
	[-2.31340]	[0.58929]	[-1.16970]	[1.41758]	[-0.84412]
PRO(-1)	-6.60E-06	0.495729	0.000903	-3.21E-07	-5.18E-07
	(2.4E-05)	(0.27827)	(0.00032)	(1.3E-06)	(1.2E-06)
	[-0.27175]	[1.78146]	[2.81248]	[-0.24350]	[-0.42572]
PRO(-2)	1.39E-05	0.685877	-0.000733	5.50E-07	6.35E-07
	(2.7E-05)	(0.30564)	(0.00035)	(1.4E-06)	(1.3E-06)
	[0.52163]	[2.24408]	[-2.07956]	[0.38026]	[0.47514]
EXPEDU(-1)	0.009097	-222.3098	0.451615	-0.001518	0.000736
	(0.01515)	(173.525)	(0.20021)	(0.00082)	(0.00076)
	[0.60031]	[-1.28114]	[2.25571]	[-1.84667]	[0.96944]
EXPEDU(-2)	-0.027582	-443.2471	-0.356040	0.000220	-0.001654
	(0.01654)	(189.435)	(0.21857)	(0.00090)	(0.00083)
	[-1.66724]	[-2.33984]	[-1.62898]	[0.24487]	[-1.99570]
LPR(-1)	-3.698104	5087.227	-85.95929	1.402904	0.231411
	(4.81199)	(55100.5)	(63.5738)	(0.26095)	(0.24105)
	[-0.76852]	[0.09233]	[-1.35212]	[5.37615]	[0.96002]
LPR(-2)	2.730742	-46333.36	115.9822	-0.396928	-0.297594
	(5.06851)	(58037.7)	(66.9627)	(0.27486)	(0.25390)
	[0.53877]	[-0.79833]	[1.73204]	[-1.44411]	[-1.17211]
POPG(-1)	4.167465	130613.5	-38.36805	2.176358	-0.163913
	(5.05406)	(57872.3)	(66.7719)	(0.27408)	(0.25317)
	[0.82458]	[2.25693]	[-0.57461]	[7.94069]	[-0.64743]
POPG(-2)	11.21222	-26892.84	120.1501	-0.695446	-0.544656
	(11.1395)	(127554.)	(147.169)	(0.60408)	(0.55801)
	[1.00653]	[-0.21083]	[0.81641]	[-1.15124]	[-0.97607]
C	18.87121	2060000.	-1933.611	-4.184337	8.008292
	(66.9161)	(766233.)	(884.064)	(3.62879)	(3.35203)
	[0.28201]	[2.68848]	[-2.18719]	[-1.15309]	[2.38909]
R-squared	0.931280	0.999284	0.980588	0.982613	0.595147
Adj. R-squared	0.888330	0.998836	0.968456	0.971747	0.342114
Sum sq. resids	65.92935	8.64E+09	11507.61	0.193884	0.165438
S.E. equation	2.029922	23243.95	26.81838	0.110081	0.101685
F-statistic	21.68278	2232.406	80.82443	90.42524	2.352055

Log likelihood	-50.36342	-302.7001	-120.0529	28.32914	30.47112
Akaike AIC	4.545439	23.23704	9.707619	-1.283640	-1.442306
Schwarz SC	5.073372	23.76498	10.23555	-0.755707	-0.914372
Mean dependent	13.57778	749159.9	155.7826	55.83074	2.595503
S.D. dependent	6.074495	681342.4	150.9989	0.654904	0.125367

Determinant resid covariance (dof adj.)	63750295
Determinant resid covariance	4658684.
Log likelihood	-398.8390
Akaike information criterion	33.61770
Schwarz criterion	36.25737

Table 3: Impulse Response Function

Response of UNEMPR:

Period	UNEMPR	PRO	EXPEDU	LPR	POPG
1	2.029922	0.000000	0.000000	0.000000	0.000000
2	2.037009	0.064298	0.086955	-0.276521	0.323846
3	1.269855	0.326956	-0.315159	-0.493844	0.437042
4	0.734562	-0.114649	-0.693869	-0.448383	0.277070
5	0.110185	-0.400854	-0.868987	-0.445496	-0.088922
6	-0.406078	-0.579425	-0.524622	-0.489775	-0.407364
7	-0.660834	-0.400018	0.027519	-0.748940	-0.778620
8	-0.563877	-0.175045	0.425515	-1.092791	-0.947948
9	-0.246915	0.039915	0.514135	-1.349551	-0.927182
10	0.076023	0.135919	0.361140	-1.395656	-0.724624

Response of PRO:

Period	UNEMPR	PRO	EXPEDU	LPR	POPG
1	-11475.59	20213.66	0.000000	0.000000	0.000000
2	-1908.825	14218.62	-5880.955	3681.666	10149.73
3	13842.51	10643.69	-13308.45	1130.260	4012.965
4	19389.91	3335.572	-19526.98	-4267.157	4680.148
5	19118.43	1029.087	-19230.50	-12380.11	-886.7969
6	16485.04	-1440.243	-17218.98	-24447.88	-8648.126
7	13823.59	-3049.884	-15769.27	-38815.71	-17841.54
8	11882.20	-4904.604	-14114.23	-53077.28	-26199.11
9	10132.24	-5366.633	-12126.01	-66519.49	-33719.52
10	8793.498	-5141.799	-10268.04	-78573.52	-39787.81

Response of EXPEDU:

Period	UNEMPR	PRO	EXPEDU	LPR	POPG
1	-6.541025	8.627743	24.53574	0.000000	0.000000
2	-2.192331	18.69299	8.522545	-9.701906	-2.981507
3	10.92108	2.425851	-7.497982	-5.005001	4.398280
4	10.22038	-0.178251	-14.45103	0.402705	4.846174
5	3.864217	-3.556401	-10.18265	4.101585	5.622753
6	-1.138303	-0.808010	-4.834245	0.910250	-0.443044

7	-1.341030	-1.440858	-2.021224	-4.847047	-4.323208
8	0.713553	-0.892579	-1.184158	-10.77762	-7.587217
9	2.793235	-0.989500	-0.757938	-15.13626	-8.469527
10	3.770517	-0.194553	-0.923202	-18.33331	-9.062467

Response of LPR:

Period	UNEMPR	PRO	EXPEDU	LPR	POPG
1	-0.017504	0.019647	0.031770	0.102059	0.000000
2	-0.126998	0.108228	-0.002464	0.195874	0.169121
3	-0.020286	0.075634	0.037038	0.277798	0.152022
4	0.029692	0.073401	-0.033792	0.269495	0.150755
5	0.065725	0.021608	-0.061255	0.283204	0.176349
6	0.065466	0.016742	-0.056642	0.269107	0.152258
7	0.051034	0.001336	-0.042969	0.234737	0.130515
8	0.038554	-0.003174	-0.031388	0.186907	0.093728
9	0.029758	-0.013656	-0.020559	0.139877	0.065159
10	0.020514	-0.015366	-0.008679	0.098106	0.039877

Response of POPG:

Period	UNEMPR	PRO	EXPEDU	LPR	POPG
1	-0.039663	0.046061	-0.004502	0.024212	0.077708
2	0.055630	-0.007130	0.026146	0.019649	-0.012737
3	0.023675	0.001889	-0.040888	-0.017590	-0.000251
4	0.014925	-0.028988	-0.023613	0.002322	0.012418
5	-0.007756	-0.007031	-0.003993	-0.006292	-0.012988
6	-0.016459	-0.009800	0.007839	-0.015897	-0.014111
7	-0.012598	-0.001387	0.011010	-0.025502	-0.023145
8	-0.005429	-0.002782	0.010393	-0.027848	-0.018323
9	-0.001172	0.001815	0.008234	-0.025944	-0.014457
10	0.000893	0.002143	0.005331	-0.020357	-0.007863

Cholesky Ordering: UNEMPR PRO EXPEDU LPR POPG

Table 4: Forecast Error Variance Decomposition

Variance Decomposition of UNEMPR:

Period	S.E.	UNEMPR	PRO	EXPEDU	LPR	POPG
1	2.029922	100.0000	0.000000	0.000000	0.000000	0.000000
2	2.909128	97.71908	0.048851	0.089344	0.903502	1.239226
3	3.273632	92.21634	1.036091	0.997387	2.989229	2.760948
4	3.468237	86.64389	1.032357	4.891156	4.334588	3.098014
5	3.628085	79.26948	2.164114	10.20648	5.468814	2.891110
6	3.787438	73.88898	4.326307	11.28437	6.690559	3.809790
7	4.013642	68.50595	4.845702	10.05297	9.439575	7.155809

8	4.328023	60.61250	4.330878	9.612155	14.49325	10.95121
9	4.662578	52.50673	3.738996	9.498152	20.86572	13.39040
10	4.936318	46.86845	3.411621	9.009167	26.60944	14.10132

Variance Decomposition of PRO:

Period	S.E.	UNEMPR	PRO	EXPEDU	LPR	POPG
1	23243.95	24.37418	75.62582	0.000000	0.000000	0.000000
2	29954.15	15.08304	68.07026	3.854621	1.510688	11.48139
3	37371.79	23.40942	51.84184	15.15773	1.061980	8.529035
4	46959.14	31.87597	33.33886	26.89163	1.498339	6.395208
5	55638.11	34.51449	23.78326	31.10272	6.018478	4.581052
6	65866.63	30.89118	17.01795	29.02695	18.07128	4.992635
7	81317.00	23.15749	11.30610	22.80513	34.64169	8.089605
8	102374.3	15.95788	7.362871	16.28921	48.73683	11.65321
9	127753.1	10.87644	4.904563	11.36111	58.40814	14.44974
10	155842.6	7.627371	3.404732	8.068801	64.67064	16.22845

Variance Decomposition of EXPEDU:

Period	S.E.	UNEMPR	PRO	EXPEDU	LPR	POPG
1	26.81838	5.948762	10.34974	83.70150	0.000000	0.000000
2	35.34275	3.810020	33.93342	54.00937	7.535526	0.711658
3	38.40416	11.31356	29.13801	49.55362	8.080460	1.914344
4	42.56579	14.97464	23.72067	51.86356	6.586605	2.854527
5	44.62681	14.37320	22.21535	52.39003	6.836989	4.184426
6	44.92099	14.24977	21.95769	52.86422	6.788794	4.139526
7	45.47570	13.99122	21.52567	51.77997	7.760231	4.942916
8	47.37584	12.91409	19.86909	47.77218	12.32548	7.119154
9	50.54369	11.65144	17.49486	41.99402	19.79704	9.062643
10	54.66270	10.43744	14.95888	35.93223	28.17455	10.49690

Variance Decomposition of LPR:

Period	S.E.	UNEMPR	PRO	EXPEDU	LPR	POPG
1	0.110081	2.528528	3.185361	8.329168	85.95694	0.000000
2	0.327008	15.36927	11.31475	0.949535	45.61934	26.74711
3	0.463379	7.845789	8.299051	1.111770	58.65980	24.08359
4	0.563459	5.583897	7.309773	1.111574	62.54827	23.44648
5	0.661308	5.041499	5.413423	1.664953	63.74765	24.13247
6	0.735326	4.870263	4.430288	1.940006	64.95332	23.80612
7	0.785680	4.687928	3.880906	1.998407	65.82081	23.61195
8	0.814551	4.585524	3.612186	2.007739	66.50273	23.29182
9	0.829939	4.545622	3.506550	1.995343	66.90000	23.05248
10	0.837106	4.528173	3.480461	1.972072	67.13291	22.88638

Variance Decomposition of POPG:

Period	S.E.	UNEMPR	PRO	EXPEDU	LPR	POPG

1	0.101685	15.21465	20.51895	0.196029	5.669719	58.40065
2	0.121315	31.71660	14.76133	4.782730	6.606656	42.13268
3	0.131387	30.28681	12.60544	13.76219	7.424955	35.92060
4	0.137996	28.62508	15.83982	15.40370	6.759130	33.37227
5	0.139200	28.44241	15.82210	15.22062	6.847001	33.66787
6	0.142327	28.54382	15.60873	14.86258	7.796992	33.18787
7	0.147393	27.34569	14.56293	14.41630	10.26381	33.41127
8	0.151596	25.97885	13.80041	14.09809	13.07712	33.04553
9	0.154712	24.94854	13.26382	13.81908	15.36775	32.60081
10	0.156352	24.43127	13.00586	13.64701	16.74236	32.17351

Cholesky Ordering: UNEMPR PRO EXPEDU LPR POPG

Figure 1: Impulse Response Function Graph.

Response to Cholesky One S.D. Innovations

Figure 2: Variance Decomposition Graph

Variance Decomposition