Interrelationships among Unemployment, Inflation and Economic Growth in Nigeria

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Abstract

The determinants of, and interrelationships among unemployment, inflation and economic growth in Nigeria in the period 1981-2013 were investigated. Two appropriate methodologies – simultaneous equations analysis involving the two-stage least squares (2SLS) estimation technique, and vector autoregression (VAR) analysis are used for the investigations. The analyses reveal inter alia that (i) the variables are indeed interrelated, (ii) a long run (equilibrium) relationship exists among them (iii) the proposition of the original Phillips curve is validated (iv) inflation contributed to the growth of per capita income in the period covered by the study (v) the growth of Nigeria's economy could not abate the unemployment problem, rather unemployment grew with economic growth (vi) broad money growth has been inflationary (vii) foreign direct investment (FDI) helped reduce unemployment within the sample period (viii) trade openness positively affects economic growth in Nigeria. The recommendations of the paper include greater but cautious integration of Nigeria's economy with the global market; tight money policy to control broad money growth and hence, inflation; infrastructural development, improvement in security and favourable tax regimes to enhance the attractiveness of the economy to FDI.

Keywords: Unemployment, inflation, economic growth

Introduction

Inflation and unemployment are macroeconomic variables that affect the growth of all economies. Inflation refers to appreciable rise in the general price level, while unemployment refers to a situation where able bodied men and women particularly those between the ages of 15 and 60 are actively seeking jobs but are unable to find meaningful ones (Aigheyisi, 2015b). Both are referred to as the twin macroeconomic evils in macroeconomic theory. While there is a consensus that unemployment which has been described as underutilization and waste of human resources adversely affects, or inhibits economic growth, the effect of inflation on the growth of an economy has been an issue much debated in recent times. Hitherto, inflation was thought of as being detrimental to the growth of an economy. However recent empirical studies on the effect of inflation on economic growth such as those of Salami and Kelikume (2010), Bassey and Onwioduokit (2011), Bawa and Abdullahi (2012), Danladi (2013) and Doguwa (2013) reveal that inflation only adversely affects economic growth beyond some threshold inflation rate. Below the threshold, inflation could positively affect growth; in other words it could be growth-promoting. Aigheyisi (2015a, b) attempts to explain the positive effect of inflation on economic growth with the original Philips Curve proposition. The Philips curve posits that a trade-off (that is an inverse relationship) exists between inflation and unemployment. This suggests that reducing the rate of unemployment requires some amount of inflation. As a matter of fact, deflation which refers to a situation of constantly falling prices is acknowledged in economic theory to adversely affect economic growth as it creates disincentive to produce, and adversely affects investment and employment, etc.

While it is acknowledged that inflation and unemployment affects economic growth, several economic theories have also shown that economic growth affects both variables. The Okun's law attributed to Okun (1967) suggests that increase in the rate of growth of an economy is associated with reduction in unemployment rate. Several empirical studies such as Aigheyisi (2015b), etc provides ample evidence in support of Okun's Law. The Balassa-Samuelson hypothesis suggests a causal link between economic growth and inflation with causality running from the former to the latter particularly in developing economies, as economic growth engenders improvement in productivity in both the tradable and non-tradable sectors of the economy, as well as increase in wage rate

(especially in the long run), leading to an appreciation of the currency (that is increase in real exchange rate) as well as increase in inflation. The original Philips Curve and the augmented Philips Curve relations suggest an inverse relationship between inflation and unemployment in the short run.

Apparent from the foregoing discussions is that interrelationships exist among the three macroeconomic variables: inflation, unemployment and economic growth. While known previous studies have investigated the relationship between inflation and economic growth (Gokal and Hanif, 2004; Omoke, 2010; Inyiama, 2013), the Philips curve proposition (Ola, 2012; Umaru and Zubairu, 2012; Umoru and Anyiwe, 2013) or the Okun's law (Oloni, 2013; Rosoiu and Rosoiu, 2014; Aigheyisi, 2015b), none to the best of our knowledge has examined the interrelationships among these variables for Nigeria. A gap therefore exists in the literature, and this study, by way of contributing to the extant literature intends to fill this gap. The objective of the study therefore is to investigate the interrelationships among the variables using appropriate methodologies with a view to recommending measures that would influence these variables towards moving the economy of Nigeria in a favourable direction. In addition, the paper has the objective of investigating the determinants of each of these economic variables in Nigeria.

Some stylized facts on unemployment, inflation and per capita income in Nigeria

The recent rebasing of Nigeria's GDP by the country's National Bureau of Statistics (NBS) placed the country among the top thirty largest economies in the world. Precisely, following the rebasing, Nigeria became the 26th largest economy in the world and the largest in Africa by GDP size, taking the place of South Africa in the continent. In terms of per capita GDP she is ranked the 126th largest economy in the World. She was also recently projected by Bloomberg (2015) to be among the top 20 fastest growing economies in the world in 2015**.** Figure 1 shows the trend in Nigeria's real per capita GDP (constant 2005 US$) between 1981 and 2013. It fell from 710.61 in 1981 to 605.76 in 1984. It rose the following year (1985) to 639.54 and then went down to 494.24 in 1987. In 1998, it was 517.69. It trended upwards to 590.05 in 1990. The trend was negative between 1991 and 1995, as it went down from 571.65 in 1991 to 533.41 in 1995 From 1996 to 2013, the trend was generally positive. The upward trend in the per capita real income was attributed to her huge oil export earnings (being the biggest

crude oil exporter in Africa) arising from favourable oil prices in the international crude oil market in most of the periods, before the recent drop in oil prices which adversely affected the nation's earning from oil export.

In spite of the rising trend in per capita real income, the country has had the problems of inflation and unemployment to grapple with. The World Bank (2015) recently noted that the pace of job creation in the country has been inadequate, and this has engendered increasing frustration among underemployed and unemployed Nigerian youth.

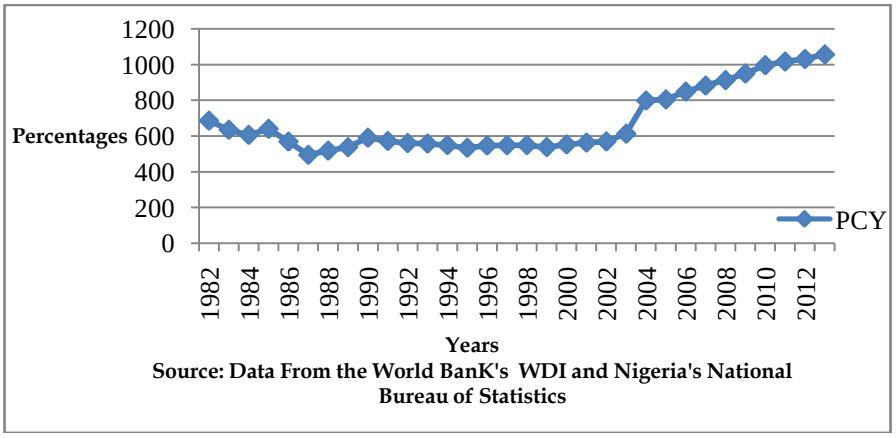


Figure 1: Trend's in real per capita income (PCY) (1981-2013)

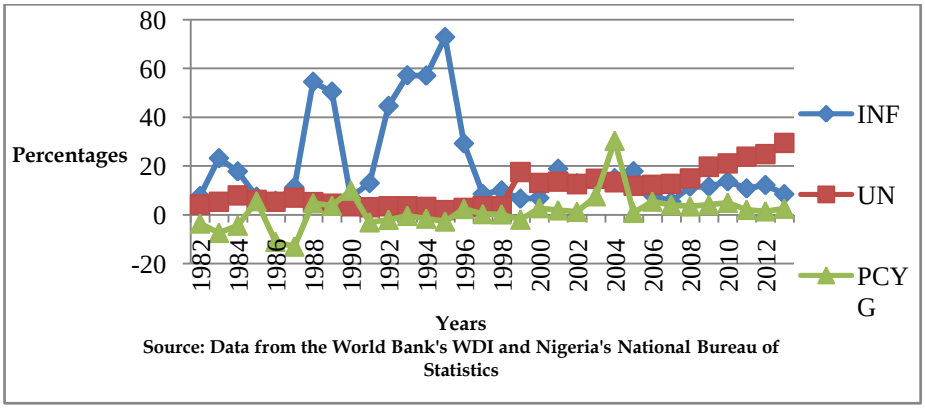


Figure 2. Trends in real per capita income growth (PCYG), inflation (INF) and unemployment (UN) (1981-2013)

Inflation rate and per capita real income appear to be positively related almost all through the period. Increase (decrease) in inflation rate has been associated with increase (decrease) in growth in per capita real GDP, though inflation appears to have grown faster than the per capita real income.

We also observe that unemployment rate appears to be generally low in the period preceding the country's return to democracy that is between 1981 and 1998. In fact annual unemployment rate was less than 10%, ranging from 1.9% to 7.9%, and averaging 4.32% in the period. However, between 1999 and 2013 (the democratic era), annual unemployment rate was more than 10%, and ranged from 11.9% to 29.5%, with an average of 17.06%.

The Philips Curve relation (or the expectations-augmented Phillips Curve), the Okun's Law and The Balassa-Samuelson Hypothesis provide the basic theoretical expositions on the interrelationships among inflation, unemployment and economic growth in Economic theory. The Philips Curve relation attributed to Philips (1958) suggests that an inverse relationship exists between inflation and unemployment. This was the observation using U.K data that spanned the period from 1861 to 1957. It was observed that reduction in the rate of unemployment in the U.K was associated with increase in inflation and vice versa. The increase in inflation engendered by the reduction in unemployment was attributed to the short run increase in employment and wages (and hence in aggregate demand). The rise in wages translates into increased cost for producers which are passed on to consumers in the form of higher output prices. Conversely, increase in unemployment rate engenders a decline in aggregate demand, which in the face of excess supply turn engenders a fall in price. The Phillips Curve proposition has been described as a short-run relationship between inflation and unemployment. Friedman and Phelps have shown (in the 1960s) that there is no relationship between inflation and unemployment in the long run, and that the Phillips curve is actually vertical at the natural rate of unemployment in the long run.

The Okun's Law relates economic growth to unemployment. It states that increase in the growth rate of the economy causes a fall in the rate of unemployment. This suggests that economic growth creates ample opportunities for employment of labour so long the growth does not cause displacement and replacement of labour by advanced technology in the

process of output expansion. In other words, economic growth can engender reduction in unemployment rate so long as it does not create structural unemployment (Aigheyisi, 2015). The various growth theories such as the basic Solow model, the endogenous growth model, etc can be used to explain the theoretical linkage between unemployment and economic growth. Labour (in addition to other factors such as capital, technological advancement, etc) is a key determinant of economic growth. The growth models predict a positive relationship between labour and economic growth. This suggests that high rate of employment of labour invariably engenders rapid growth. This implies that reduction in the rate of employment of labour (or increase in unemployment), could have adverse effect on economic growth.

Several theories have been developed to explain the effect of inflation on economic growth. By merging an endogenous growth model of learning by doing with a New Keynesian model which assumes sticky prices, Vaona (2010) has shown that the inter-temporal elasticity of substitution of working time is a key parameter for the shape of inflation-growth nexus. Specifically, when the inter-temporal elasticity of substitution of working time is set equal to zero, the nexus between inflation and growth is weak, whereas when it is greater than zero, inflation significantly, sizeably and adversely affects growth. Gillman, Harris and Matyas (2002) also present a monetary model of endogenous growth to prove that inflation has a negative effect on growth for a large panel of OECD and APEC member countries over the 1961-1997 period.

The Balassa-Samuelson (B-S) Effect, offers an insight into the link between economic growth and inflation. It stipulates that economic growth caused by high productivity growth (especially in less developed economies) ultimately engenders increase in inflation and appreciation of the real exchange rate as it engenders increase in wage rates (particularly in the long run) in both the traded goods and non traded goods sectors of the economy, though there would be differences in productivity growth in the sectors. This implies that as an economy grows, owing to improvement in productivity of factors of production (e.g. capital, labour), the reward for the factors of production (e.g. wages paid to labour) also increases, the increase in wages being more pronounced in the traded goods sectors of the economy than in the non traded goods sectors. The increase in productivity also engenders improvement in the real exchange rate of the domestic currency. The increase in wages translates into increase in cost of

production which are ultimately transferred to the consumers in the form of higher prices.

Ola (2012) investigates the nature of the relationship between unemployment and inflation in Nigeria using the ordinary least squares estimation technique, Johansen cointegration test and the Granger-causality test. Unemployment is regressed on inflation in the simple regression model. The study finds that inflation is negatively and significantly related to unemployment. The Johansen test for cointegration indicates that the variables are cointegrated (that is a long run relationship exists between them), while the Granger-causality test shows no evidence of causality between the variables.

Orji et al (2015) investigates the validity of the original Phillips Curve proposition using Nigeria's annual time series data that covers the period from 1970-2011 to examine the inflation-unemployment nexus. Consumer price index used as proxy for inflation is regressed on unemployment and other variables identified in economic theory and relevant literature as affecting inflation (such as growth rate of money supply, budget deficit, real GDP, etc). The study finds that unemployment positively and significantly affects inflation in Nigeria, thus invalidating the original Phillips Curve proposition and pointing to existence of the phenomenon of stagflation (coexistence of inflation and unemployment) in the country.

Umoru and Anyiwe (2013) examine the dynamic linkages between inflation and unemployment in Nigeria using the vector error correction methodology (VECM). The study also finds evidence of stagflation in Nigeria's economy. Umaru and Zubairu (2012) employ various econometric methodologies (cointegration, Granger-causality test, etc) to analyse the relationship between unemployment and inflation in Nigeria in the period from 1977 to 2009. The analysis reveals finds that inflation impacts negatively on unemployment. The cointegration test finds evidence of a long-run relationship between the variables, while the causality test finds no evidence of causality between them.

In Jordan, Al-Zeaud (2014) employs the methodology of Johansen cointegration and Granger-causality tests to examine the trade-off between unemployment and inflation using data that spanned the period from 1984 to 2011. The result of study shows no evidence of long-run and causal

relationship between unemployment and inflation in the country during the study period.

Unemployment and economic growth

The first attempt to investigate the relationship between economic growth and unemployment empirically was by Okun (1962) who used simple regression analysis to analyse U.S. data. The result of the investigation reveals that economic growth is inversely related to unemployment rate in the country. The outcome of his research became known as the Okun's law in Economic Theory, and several studies have been conducted to investigate the validity of this law in other countries.

Rosoiu and Rosoiu (2014) employ least squares estimation technique to re-investigate the validity of the Okun's law for the U.S. economy using data that covers the period from 1977 to 2012. The study yields evidence that strongly upholds the Okun's law: a significant inverse relationship exists between economic growth and unemployment and, a 1% increase in the rate of economic growth was associated with about 0.3% decline in the rate of unemployment in the sample period.

In a study to investigate the validity of Okun's law in Nigeria, Aigheyisi (2015b) employs the methodology of cointegration and error correction modeling to examine the effect of economic growth on unemployment in the country using data that spanned the period from 1982 to 2012. The empirical results yields evidence in support of the Okun's law as it finds that economic growth significantly reduces unemployment in the short run. Specifically, an Okun's coefficient of 0.6 was estimated, indicating that a 1% rise in the growth rate of real GDP is associated with 0.6% decline in the rate of unemployment. Similar result was found in the Akeju and Olanipekun (2014).

Amassoma and Nwosa (2013) employs the methodology of cointegration and error correction to examine the relationship between unemployment and productivity growth in Nigeria in the period from 1986-2010. The estimation results indicate that the effect of unemployment on productivity growth in the country is not statistically significant.

Oloni (2013) employs the Johansen vector error correction model to investigate the impact of economic growth on employment in Nigeria. The

analysis reveals that the impact of economic growth on employment in the country has been positive, but not statistically significant. Further evidence from the analysis are that foreign private investment negatively impacted employment in the country, while public expenditure impacted positively and significantly on employment.

Kreishan (2011) employs the methodology of cointegration and simple regression analysis to investigate the relationship between unemployment and economic growth in Jordan using annual time series data that spans the period that 1970-2008. The analysis indicates that no significant relationship exists between economic growth and unemployment in the country, and thus the Okun's law could not be validated.

Phiri (2012) estimates a threshold autoregressive model to evaluate nonlinear equilibrium reversion between unemployment and economic growth for South Africa using data that covers the period from to 2013. The first difference and the gap model variations of Okun's specification were estimated. The empirical analysis reveals that the Okun's law holds for South Africa. Further indication from the results was that unemployment granger causes economic growth in the long run, pointing to the jobless growth phenomenon experienced by South Africa over the last decade.

Bayar (2014) employs the ARDL based bounds testing approaching to cointegration to examine the effect of economic growth, export and foreign investment inflows on unemployment in Turkey using data for the period 2000Q1 to 2013Q3. The analysis indicates existences of long run relationship among the variables. It also shows, consistent with the Okun's law, that increase in economic growth (proxy by real GDP) is associated with decrease in unemployment rate in the long and short run.

Inflation and economic growth

Gokal and Hanif (2004) test the relationship between inflation and economic growth in Fiji. The test reveals a weak negative correlation between inflation and economic growth in the country. The causality test result indicates unidirectional causality with causality running from GDP growth to inflation.

Hasanov (2011) examines the possibility of threshold effect of inflation on economic growth in Azerbaijani economy over the period from 2000-2009. The estimated threshold model reveals that the relationship between inflation and economic growth is non linear, and that the threshold level of inflation GDP growth is 13%. At inflation rates below the threshold level, inflation has significant positive effect on economic growths; at rates above 13% the effect of inflation on economic growth growth is negative and significant.

Kasidi and Mwakanemela (2013) employ correlation and cointegration techniques to investigate the effect of inflation on economic growth in Tanzania using data that spanned the period from 1990-2011. The study finds that inflation negatively impacts economic growth, though it found no evidence of long run (cointegrating) relationship between inflation and economic growth in the country.

Li (2006) examines the inflation-growth nexus in developed and developing countries by using data spanning the period from 1961 to 2004 for 90 developing countries and 28 developed countries. The empirical evidence indicates that the relationship between inflation and economic growth is non linear, and that for developing countries there are two thresholds in the function relating economic growth and inflation. The effects of inflation on economic growth at rates lower than those of the first threshold are positive, but not significant. At moderate inflation rate (between the two thresholds), the impact of inflation on economic growth is negative and significant. At extremely high rates of inflation (higher and above the second threshold), the marginal impact of additional inflation on economic growth is significantly negative, though it diminishes rapidly. For developed countries however, only one threshold is detected, and is significant. The magnitude of the negative effect of inflation on economic growth diminishes as inflation rate increases.

Barror (2013) also finds negative effect of inflation on economic growths in a panel data study that involves 100 countries using data that spanned that period from 1960 to 1990. Specifically, the study finds that a 10% increase in inflation rate was associated with a 0.2 to 0.3% reduction in the growth rate of real GDP per capita.

Using dataset that spans the period from 2005Q1 to 2012Q1, Doguwa (2013) examines the effect of inflation on economic growth in

Nigeria using three different approaches/procedures for estimating threshold level and inference, viz: the Sarel's, Khan and Senhadji's and the Drukker et al approaches. The Sarel's approach provides a threshold point estimate of 9.9% that was not adequately identified by the data; the Senhadji's approach identifies 10.5% inflation threshold statistically significant in explaining the inflation-growth nexus; Drukker et al's approach indicates a two threshold inflation rates or points – 11% and 12.0% in the relationship between inflation and economic growth. The study suggests that the threshold level of inflation above which it adversely affects economic growth is 10.5% to 12.0%.

Osuala et al (2013) examine the impact of inflation on economic growth in Nigeria in the period from 1970 to 2011 using ordinary least squares and Granger causality analysis. The empirical results indicate that uni-directional causality exists between both variables, with causality running from inflation to real GDP (proxy for economic growth). Evidence from the OLS analysis is that inflation positively affects economic growth.

Omoke (2010) also investigates the relationship between inflation and economic growth in Nigeria using data that spanned the period from 1970 to 2005 using cointegration and Granger causality analysis. The analysis indicates that there was no long run (cointegrating) relationships between the variables, and that causality runs from inflation to GDP.

Inyiama (2013) also investigates the link between inflation and economic growth in Nigeria using data covering the period from 1979 to 2010 using the multiple regression, cointegration and Granger causality analysis. The study finds that inflation negatively affects real gross domestic product (proxy for economic growth). The study also finds no causality between inflation and real GDP.

Theoretical framework and methodology

Equation explaining economic growth

Following the work of Adamu et el (2013), this paper also adopts and augments the basic Solow (exogenous) growth model, by incorporating policy variables that affect the rate of economic growth such as trade openness, domestic investment, FDI, government consumption

expenditure, inflation, and unemployment. Thus we specify our equation explaining economic growth as:

PCY = f (PC(-1), TOPEN, TOPEN(-1), DINV, FDI, HCE, UN, INF(-1)) (1)
$F_1, F_2, F_3, F_4, F_5, F_6, F_8 > 0$ and $F_7 < 0$
Where:
PCY= per capita real output (proxy for economic growth)
PCY(-1) = one period lagged value of per capital real output
TOPEN=trade openness (total trade (i.e. export plus import) as a % of GDP)
TOPEN(-1) = one period lagged value of index of trade openness
FDI(-1)= one period lagged value of foreign direct investment as percentage of GDP
HCE = Human capital expenditure
DINV(-1) = one period lagged value of real gross domestic capital formation as percentage of GDP
UN= unemployment rate
gce= government consumption expenditure as percentage of GDP

International trade theories posit that cross border trade engenders expansion in both domestic and global output of goods and services as a result of specialization and channeling of resources towards production of those goods for which countries have comparative advantage, technology transfer, greater competition, innovation, technology transfer and access to foreign savings (Adamu et al, 2013). Thus a positive relationship is expected between trade openness and economic growth. Foreign direct investment and domestic investment are both strong ingredients of economic growth. All things being equal, inflow of FDI into an economy is envisaged to supplement domestic investment thus increasing the level of capital stock therein. Considering that the basic Solow growth model predicts a positive relationship between capital stock and economic growth, FDI and DINV are therefore expected to be positively related to growth. Government expenditure according to the *Ram's* (1986) growth accounting theory and the Keynesian expenditure approach to measure the national income is a key determinant of economic growth. It is therefore expected to positively affect economic growth.

The predicted effect of unemployment on economic growth can be explained considering the effect of labour on economic growth. The basic Solow growth model predicts a positive relationship between labour and economic growth. This invariably implies that reduction in labour (i.e.

increase in unemployment) could adversely affect the growth of the economy as it causes a decrease in effective aggregate demand, which adversely affects output and economic growth.

Equation explaining inflation

The quantity theory of money predicts a positive relationship between price level and money supply especially in the long run. This suggests that the increase in the stock of money in the economy is a determinant of the rate of change in prices (inflation). The Keynesian expenditure theory also posits that excessive government expenditure could engender increase in prices in the long run, an indication that government expenditure is also a determinant of inflation. Furthermore, Okun's law predicts a trade-off (i.e. an inverse relationship) between inflation and economic growth. This also suggests that the unemployment rate is also a determinant of the rate of inflation in an economy. The Balassa-Samuelson hypothesis posits that for developing countries, economic growth engenders inflation, as a result of increase in wages occasioned by increase in productivity in the traded goods sector of the economy. However, given that economic growth engenders expansion in output, inverse relationship between economic growth and inflation rate would not be unexpected. Therefore the relationship between economic growth and unemployment is indeterminate, and it is therefore an empirical issue. The foregoing discussion suggests that economic growth could plausibly be incorporated in the inflation model (equation) as an explanatory variable.

In the light of the foregoing, the inflation equation can be specified as:

$$INF = g\ (BMG(-1), GCE, GCE(-1)\ UN, PCY) \quad (2)$$

Where INF, UN, PCY and gce are as previously defined, and MS is broad money supply G_1, G_2, $G_3 > 0$, $G_4 < 0$ and $G_5 </> 0$

In light of economic theories, expansion in broad money and government consumption expenditure (i.e. expansionary monetary and fiscal policies) could be expansionary, especially in the long run according to the Classicals (Quantity theorists) the Keynesians. Positive relationship between broad money supply, government consumption expenditure and, inflation are therefore not unexpected. The Phillips curve provides the

theoretical link between unemployment and inflation. It predicts an inverse relationship between unemployment and inflation. This suggests that reduction in the rate of inflation could be achieved at the cost of higher unemployment rate which engenders a fall in aggregate demand, ultimately bringing about a fall in prices, if supply remains unchanged or is increasing. The Balassa-Samuelson hypothesis predicts positive relationship between economic growth and inflation of emerging market/developing economies.

Equation explaining unemployment

The Keynesian model of unemployment provides a strong theoretical foundation for the analysis of determinants of unemployment as it identifies several factors affecting the rate of unemployment. According to the Keynesian model, low wages should result in higher employment levels as the demand for labour by firm will be high, but this does not transpire owing to recession characterized by low demands for goods and services. Unemployment resulting from fall in aggregate demand as a result of the economy being in a recession is known in economic theory as cyclical unemployment. The low level of aggregate demand manifests in low per capital real GDP. Inferred from the foregoing is that fall in real GDP per capita is associated with increase in the rate of unemployment. On the other hand, an increase in real GDP per capita is associated with a fall in the rate of unemployment. This in fact is the postulation of the Okun's law. The Phillips Curve hypothesizes an inverse relationship (i.e. a trade-off) between inflation and unemployment. This suggests that lower rate of unemployment can be achieved at the cost of higher inflation. Domestic investment is also a key variable that affects the rate of unemployment as it is instrumental to job creation in an economy.

In the light of the totality of the forgoing discussion on determinants of unemployment rate, the unemployment equation or model is specified as:

$$UN = g\ (dinv(-1), FDI(-1), INF(-1), RWAGES, PCY) \quad (3)$$

In the light of the theoretical link between the explanatory variables and unemployment rate previously discussed, the *a priori* expectations are: G_1, G_2, $G_3 < 0$, G_4, $G_5 > 0$, G_6</>0. RWAGE represent real employees'

compensation and it is included in the model as proxy for real wages. Other variables are as previously defined.

A simultaneous equation's model of unemployment, inflation and economic growth

The three equations specified under section 5.1 shall now be brought together to investigate the relationships among unemployment, inflation and economic growth in Nigeria. Thus we shall specify and estimate a 3-equation system of simultaneous equations for the investigation, using the logs of the variables. An advantage of using the logs of variables is that the estimated parameters can be interpreted as elasticities (Adamu et al, 2013). The system of simultaneous equations is formally expressed as:

$$LUN = h_o + h_1 Ldinv(-1) + h_2 Lgdi(-1) + h_3 LINF(-1) + h_4 LRWAGES + h_5 LPCY + u_3 \quad (4)$$

$$LINF = g_o + g_1 LBMG(-1) + g_2 Lgce + g_3 Lgce(-1) + g_3 LUN + g_4 LPCY + u_2 \quad (5)$$

$$LPCY = f_o + f_1 LPCY(-1) + f_2 LTOPEN + f_3 LTOPEN(-1) + f_4 Ldinv + f_5 Lfdi + f_6 LHCE + f_7 LUN + f_8 LINF(-1) + u_1 \quad (6)$$

"L" indicates natural logarithms of variables and u represents stochastic error term. The system of simultaneous equations has three endogenous variables namely per capita income (PCY, proxy for economic growth), inflation (INF) and unemployment (UN). There are 6 exogenous variables namely trade openness (TOPEN), domestic investment as percentage of GDP (dinv), foreign direct investment as percentage of GDP (FDI), government consumption expenditure as percentage of GDP (GCE), broad money supply (MS) and wages (WAGE). The equations are identified (See Appendix for proof of identification using the Order Condition and the Rank Condition of identification). Since the equations are identified, the entire system is therefore identified and can be estimated. We observe that the degree of over identification of the system is less than six. On the strength of this, the two-stage least squares (2SLS) estimation technique can be employed to estimate the structural parameters of the equations of the system. The estimates of the 2SLS estimator are consistent, asymptotically normal and asymptotically efficient (Iyoha, 2004).

A vector autoregression model for unemployment, inflation and real per capita income

In addition to the method of simultaneous equations modeling, we shall also employ a vector autoregressive model (VAR). The VAR developed by Sims (1980) is perceived to be an alternative to the simultaneous equation method. It is a set of linear dynamic equations in which each variable is specified as a function of equal number of its own lags and that of other variables of the model. As a matter of fact, in the absence of any restrictions, all variables of a VAR model are considered to be endogenous. The VAR enables us examine the dynamic interrelationships (including short- and long-run relationships) between variables as we are able to obtain estimates of Granger causality, forecast error variance decomposition of the variables as well as impulses response functions. An advantage of using the VAR method over univariate time series model and simultaneous equation model is that the problem of identification does not arise with the use of VAR.

For this study we specify a 3-equation (multivariate) VAR model as:

$$y_t = \Pi_1 y_{t-1} + \Pi_2 y_{t-2} + \ldots + \Pi_k y_{t-k} \quad (7)$$

Where y is a vector of endogenous variables containing log(UN), log(INF) and log(PCY). The optimal number of lag (k) of each variable is to be determined empirically using appropriate lag order selection criteria. The Πs represent estimates of the VAR parameters. The VAR model specification is not driven by any theory; it is therefore viewed as a-theoretical. This has been considered as one of its defects.

Data for the analyses covers the period from 1981 to 2013, and were sourced mainly from the World Bank's World Development Indicators, 2014. The estimations were performed with the aid of the Microfit 5.

Results and discussions

Descriptive statistic of key variables

Table 1 shows the descriptive statistics of the key variables under investigation.

Table 1: Descriptive statistics of key variables

	PCY	INF	UN
Mean	682.3858	20.39206	10.11212
Median	590.0519	12.87658	7.000000
Maximum	1055.837	72.83550	29.50000
Minimum	494.2390	5.382224	1.900000
Std. Dev.	177.8669	18.26210	7.486269
Skewness	0.928826	1.539861	0.905633
Kurtosis	2.347024	4.080227	2.875213
Jarque-Bera	5.331215	14.64593	4.532354
Probability	0.069557	0.000660	0.103708
Sum	22518.73	672.9378	333.7000
Sum Sq. Dev.	1012372.	10672.14	1793.415
Observations	33	33	33

The descriptive statistics of the key variables show that per capita income in the period under review (1981-2013) ranged from per capita income ranged from $494.24 to $1055.84, with a standard deviation of $177.86 and an average of $682.39. The probability of the Jarque-Berra statistic being greater than 0.05 ($p>0.05$) indicates that the null hypothesis of normality cannot be rejected at the 5% level. Inflation rate in the period ranged from 5.38% and 72.83%, with a standard deviation of 18.26% and an average (mean) of 20.39%. The p-value of the Jarque-Bera statistic ($p<0.05$) indicates that the null hypothesis of normal distribution cannot be accepted at the 5% level. Thus the variable does not follow a normal distribution. Unemployment rate ranged from 1.90% to 29.5%, with an average of 10.11% and standard deviation of 7.48%. The variable follows a normal distribution as indicated by the p-value of the Jarque Berra Statistic ($p>0.05$).

Evidence from two-stage least squares estimation

The 2SLS estimation results are presented in Tables 2, 3 and 4.

Table 2: 2SLS estimation of LUN two stage least squares estimation

Dependent variable is LUN 32 observations used for estimation from 1982 to 2013

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-15.4253	3.4456	-4.4768[.000]
LFDI(-1)	-.25392	.14732	-1.7236[.097]
LDINV(-1)	-.38065	.23711	-1.6054[.120]
LINF(-1)	-.34107	.11801	-2.8902[.008]
LRWAGES	-.35800	.16450	-2.1763[.039]
LPCY	3.2037	.57094	5.6113[.000]

R-Squared .76474 R-Bar-Squared .71950
S.E. of Regression .41088 F-Stat. F(5,26) 16.9031[.000]
Mean of Dependent Variable 2.0562 S.D. of Dependent Variable .77580
Residual Sum of Squares 4.3895 Equation Log-likelihood -13.6216
DW-statistic 1.6284 System Log-likelihood 7.6001
System AIC -13.3999 System SBC -28.7901

The overall fit of the model is quite impressive with an R^2 of 76.5%, indicating that 76.5% of the systematic variations in unemployment rate are explained by the regressors. The F-statistic of 16.9 (with p-value = 0.000) is highly significant, easily passing the significance test even at the 1% level. Thus the hypothesis of a log-linear relationship between unemployment rate and the regressors cannot be rejected at the 1% level of significance. The signs on one-period lagged values of domestic investment, foreign direct investment, inflation and per capita income conform to *a priori* expectations, while those on current values of real wages and per capita income do not. Domestic investment is inversely related to unemployment rate as presumed, though the relation is not statistically significant. However, foreign direct investment variable is significant at the 10% level, an indication that the inflow of foreign direct investment into Nigeria's economy in the period under review contributed to reduction in the rate of unemployment in the country. The coefficient of the variable suggests that a 10% increase in FDI inflows into the economy of Nigeria helps reduce unemployment rate by about 2.5% after a year lag.

The prediction of trade-off between inflation and unemployment by the Philips Curve is upheld by the observed negative coefficient of the inflation variable. This is further attenuated and magnified by the fact that

the variable is highly statistically significant even at the 1% level, suggesting that (acceptable) increase in the rate of inflation will engender reduction in the rate of unemployment in the country. This however occurs after a lag of one year. The coefficient of the lagged inflation variable suggests that increase in the rate of inflation by 10% engenders reduction in the rate of unemployment by 3.4% after a year lag.

The observed negative and statistically significant coefficient of the real value of employees compensation (the variables is significant at the 5% level) indicates that increase in the compensation of employees significantly depresses unemployment rate in the country. This suggests that unemployment in Nigeria is influenced by supply factors. Willingness to work (that is supply of labour) is significantly influenced by the level of compensation of employees). A further plausible explanation for this observation is that the increase in the compensation of employees enables or empowers the employees to create employment for or engage the unemployed in productive services thus leading to reduction in the rate of unemployment. A 10% increase in real compensation of employees is associated with about 3.6% reduction in the rate of unemployment in the country.

The coefficient of current real per capita income is positive and highly statistically significant even at the 1% level. This violates the Okun's law, and suggests that the country's economic growth has been a jobless growth.

Table 3: 2SLS Estimation of LINF

Two Stage Least Squares Estimation
Dependent variable is LINF
32 observations used for estimation from 1982 to 2013

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	.58625	5.240	.11187[.912]
LBMG(-1)	.39638	.17047	2.3252[.028]
LGCE	-.49861	.50583	-.98572[.333]
LGCE(-1)	.31302	.49025	.63848[.529]
LUN	-.62399	.29891	-2.0876[.047]
LPCY	.40265	.88294	.45604[.652]

R-Squared .37420 R-Bar-Squared .25386
S.E. of Regression .64757 F-Stat. F(5,26) 3.1094[.025]
Mean of Dependent Variable 2.7062 S.D. of Dependent Variable .74968
Residual Sum of Squares 10.9031 Equation Log-likelihood -28.1791
DW-statistic 1.1828 System Log-likelihood 7.6001
System AIC -13.3999 System SBC -28.7901

The 2SLS estimation output of the inflation equation indicates that broad money growth and unemployment rate significantly affect inflation rate in the country. The effects are statistically significant at the 5% level. While the effect of unemployment is contemporaneous and is in conformity with the original Philips Curve proposition, the effect of broad money growth on inflation is with a lag. In other words, broad money growth affects inflation with a lag. The positive sign on the coefficient of broad money indicates that growth of broad money has been inflationary. A 10% increase in broad money growth is associated with 4% increase in the rate of inflation. This occurs after a lag of one year. 10% increase in the rate of unemployment is associated with 6.2% decrease in inflation rate. The decrease in inflation rate could be attributed to reduction in effective aggregate demand occasioned by higher rate of unemployment, *ceteris paribus*.

The other exogenous variables of the inflation equation (government consumption expenditure and per capita income) are not statistically significant. This suggests that the variables did not have any significant influence on the rate of inflation in Nigeria in the period under review. Theoretically, government expenditure on subsidies for example, is presumed to help reduce inflation, but this has not transpired owing to unproductiveness of government expenditure. The growth of Nigeria's economy has also not had any significant influence on domestic inflation.

The explanatory ability of the model is quite low as indicated by the R^2, suggesting that there are more variables affecting inflation than are included in the model. However, the R^2 has no statistical importance in the context of two-stage least squares estimator. The F-statistic is significant, easily passing the test of statistical significance at the 2.5% significance level, confirming the existence of significant log-linear relationship between inflation and the regressors.

Table 4: 2SLS estimation of LPCY

Two stage least squares estimation
Dependent variable is LPCY
32 observations used for estimation from 1982 to 2013

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.12624	.86025	-.14674[.885]
LPCY(-1)	.93712	. 11414	8.2099[.000]
LTOPEN	-.0046700	.069003	-.067678[.947]
LTOPEN(-1)	.095877	.055013	1.7428[.095]
LDINV	-.027946	.049785	-.56134[.580]
LFDI	-.015407	.027626	-.55770[.582]
LHCE(-1)	-.0042749	.015553	-.27487[.786]
LUN	.071622	.044114	1.6236[.118]
LINF(-1)	.048716	.022886	2.1286[.044]

R-Squared .95383 R-Bar-Squared .93777
S.E. of Regression .060957 F-Stat. F(8,23) 59.3917[.000]
Mean of Dependent Variable 6.4937 S.D. of Dependent Variable .24435
Residual Sum of Squares .085462 Equation Log-likelihood 49.4007
DW-statistic 2.0032 System Log-likelihood 7.6001
System AIC -13.3999 System SBC -28.7901

The estimated economic growth equation reveals that the model's explanatory ability is quite high, as the R^2 indicates 95.3% of the systematic variation in per capita income is explained by the regressors. The F-statistic is also highly significant, easily passing the test of statistical significance at the 1% level. Current level of per capita income is significantly and positively affected by its lagged value as indicated by the t-ratio of lagged PCY. Trade openness positively affects per capita income with a lag of one year. The lag effect is significant at the 10% level. This conforms to theoretical predictions. The signs on the coefficients of foreign direct investment, domestic investment, human capital expenditure and unemployment variables do not conform to *a priori* expectations. The t-ratios of these variables indicate that they are not statistically significant in explaining per capita income in Nigeria.

Finally, one year lagged value of inflation rate is observed to be positively related to current real per capita income. The relationship is significant at the 5% level, suggesting that inflation may have contributed

to the growth of Nigeria's economy in the period covered by the study. The coefficient of the lagged inflation variable suggests that a 10% increase in inflation rate brings about 0.5% increase in per capita income after a lag of one year

Further evidence from vector autoregressive (VAR) model

Unit root and cointegration tests

We begin the VAR analysis with an examination of the time series properties of the variables by performing the unit root test for each of the variables and then the cointegration test to determine whether a long run equilibrium relationship exists among them. The Augmented Dickey Fuller (ADF) test and the Philips-Perron test were employed to test for unit root, while the Johansen Maximum likelihood approach to cointegration was employed to test for cointegration of the variables. The results are presented in Tables 5 and 6.

Table 5: Summary results of unit root tests for variables

Augmented Dickey Fuller Test			
Variables	ADF Test Statistics	Critical ADF Statistics (95%)	Order of Integration
LPCY	-4.8928	-3.5629	I(1)
LINF	-3.9726	-3.5629	I(0)
LUN	-6.2530	-3.5629	I(1)
Phillips-Perron Test			
Variables	ADF Test Statistics	Critical ADF Statistics (95%)	Order of Integration
LPCY	-4.8431	-3.5629	I(1)
LINF	-9.8033	-3.5629	I(1)
LUN	-6.2542	-3.5629	I(1)

The ADF unit root test result indicates that (log of) inflation is stationary at levels while log (PCY) and (log of) unemployment rate are stationary at their first differences. The result of the Phillips-Peron test for unit root however indicates that all the variables are stationary at their first differences. These, not withstanding, there exists the possibility for the variables to converge in the long run. In other words, though the variables are individually not stationary at levels as observed in the Phillips-Perron unit root test result, a linear combination of the variables may be stationary. That is they may be cointegrated – a long run (equilibrium) relationship may exist among them. The Johansen Maximum Likelihood test for cointegration result is presented in Table 6.

Table 6: Cointegration test results

Sample (adjusted): 1983 2013
Included observations: 31 after adjustments
Trend assumption: Linear deterministic trend
Series: LPCY LINF LUN
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.693153	44.18921	29.79707	0.0006
At most 1	0.210096	7.565591	15.49471	0.5130
At most 2	0.008174	0.254426	3.841466	0.6140

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.693153	36.62362	21.13162	0.0002
At most 1	0.210096	7.311164	14.26460	0.4530
At most 2	0.008174	0.254426	3.841466	0.6140

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Both the Trace and Maximum Eigenvalue test indicate 1 cointegrating equation among the variables. On the strength of these, it could be reasonably inferred that the variables (unemployment, inflation and per capita income) are indeed cointegrated. Cointegration of variables enhances their reliability for policy.

Lag length selection

An important initial step in VAR analysis is the determination of the optimal lag length of the variables of the VAR model that is, the order of the VAR. This can be obtained empirically. The result of the VAR lag order selection from different criteria is presented in Table 7.

Table 7: VAR lag order selection criteria

Endogenous variables: LPCY LINF LUN

Exogenous variables: C

Sample: 1981 2013

Included observations: 30

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-52.83478	NA	0.008302	3.722319	3.862439	3.767144
1	9.503333	108.0527	0.000238	0.166444	0.726923*	0.345746
2	21.15252	17.86209*	0.000204*	-0.010168*	0.970670	0.303610*
3	23.72858	3.434738	0.000330	0.418095	1.819292	0.866350

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Evident from the result of the VAR lag order selection is that the optimal lag order of the VAR is 2 as indicated by the choice of the majority of the selection criteria (LR, FPE, AIC and HQ). On the strength of this, we estimate a VAR model of order 2 to investigate the interrelationships among the variables (unemployment, inflation and economic Growth).

Estimated VAR model

The result of estimation of the VAR model is presented in Table 8.

Table 8: Vector autoregression estimates

Sample (adjusted): 1983 2013
Included observations: 31 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LPCY	**LINF**	**LUN**
LPCY(-1)	1.009309	-0.842849	0.962187
	(0.19981)	(2.07892)	(1.12640)
	[5.05129]	[-0.40543]	[0.85421]
LPCY(-2)	-0.132695	0.595996	-0.255530
	(0.19046)	(1.98159)	(1.07367)
	[-0.69672]	[0.30077]	[-0.23800]
LINF(-1)	0.033779	0.557617	-0.072721
	(0.01754)	(0.18245)	(0.09886)
	[1.92620]	[3.05620]	[-0.73562]
LINF(-2)	0.014171	-0.422953	-0.229512
	(0.02026)	(0.21077)	(0.11420)
	[0.69954]	[-2.00670]	[-2.00975]
LUN(-1)	0.087536	-0.527033	0.598296
	(0.03396)	(0.35337)	(0.19146)
	[2.57734]	[-1.49144]	[3.12485]
LUN(-2)	-0.006454	0.253169	0.013250
	(0.03599)	(0.37448)	(0.20290)
	[-0.17932]	[0.67605]	[0.06530]
C	0.517232	4.540576	-2.908092
	(0.42968)	(4.47051)	(2.42221)
	[1.20377]	[1.01567]	[-1.20060]
R-squared	0.954537	0.463475	0.853654
Adj. R-squared	0.943172	0.329344	0.817067
Sum sq. resides	0.084088	9.102594	2.672236
S.E. equation	0.059192	0.615853	0.333681
F-statistic	83.98443	3.455387	23.33241
Log likelihood	47.61602	-24.99296	-5.995483
Akaike AIC	-2.620389	2.064062	0.838418
Schwarz SC	-2.296585	2.387866	1.162222
Mean dependent	6.492591	2.727692	2.076202
S.D. dependent	0.248301	0.752016	0.780164
Determinant resid covariance (dof adj.)		0.000105	
Determinant resid covariance		4.88E-05	
Log likelihood		21.92408	
Akaike information criterion		-0.059618	
Schwarz criterion		0.911792	

Evident from the estimated VAR model is that per capita income is positively affected by its previous (one-year lag) value and one year lags of inflation and unemployment. While the relationship between lagged and

current values of per capita income is not unexpected, the observed relationships between inflation, unemployment and economic growth suggest the economy grew in spite of inflation and unemployment. This become worrisome when it is considered that the coefficients of one year lag inflation and one year lag unemployment rate are statistically significant (at 7% and 5% levels respectively) as indicated by the t-ratios. This suggests amongst others, that the growth of Nigeria's per capita income must have been driven by other variables.

It is also evident that current inflation is affected by its past values (one-year and two-year lags). The opposite signs on the variables – positive on one year lag and negative on two-year lag of the variable suggest that the effect of past levels of inflation on current inflation decreases with time.

The VAR model also shows that unemployment is significantly affected by its one year lag value and one year lag inflation. The sign on inflation coefficient conform to a priori expectation, and validate the Philips Curve phenomenon.

Granger causality test

Further investigation of the interrelationships among the variables is conducted with the aid of the Granger causality tests. The essence of the Granger causality test is to determine whether past (historical) values of a variable are significant predictors of current value of another variable. The result of the tests comprising the VAR Granger causality test and the Pairwise Granger causality test are presented in Tables 9 and 10.

Table 9: VAR granger causality/block exogeneity wald tests

Sample: 1981 2013
Included observations: 31

Dependent variable: LPCY			
Excluded	Chi-sq	Df	Prob.
LINF	5.933445	2	0.0515
LUN	11.43200	2	0.0033
All	13.83164	4	0.0079
Dependent variable: LINF			
Excluded	Chi-sq	Df	Prob.
LPCY	0.213084	2	0.8989
LUN	2.453911	2	0.2932
All	5.078742	4	0.2793
Dependent variable: LUN			
Excluded	Chi-sq	Df	Prob.
LPCY	3.227682	2	0.1991
LINF	6.478475	2	0.0392
All	9.093445	4	0.0588

Table 10: Pairwise granger causality test

Sample: 1981 2013
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LINF does not Granger Cause LPCY	31	0.88043	0.4266
LPCY does not Granger Cause LINF		1.28990	0.2923
LUN does not Granger Cause LPCY	31	3.43016	0.0476
LPCY does not Granger Cause LUN		1.11536	0.3430
LUN does not Granger Cause LINF	31	2.61237	0.0925
LINF does not Granger Cause LUN		2.80064	0.0792

The VAR Granger causality test shows that inflation and unemployment Granger-cause, that is, significantly predict per capita income in Nigeria. Also evident from the result is that per capita income and unemployment cannot significantly predict inflation in the country.

Furthermore, per capita income and inflation significantly predict unemployment albeit at the 6% level of significance.

The Pairwise Granger causality test result shows no evidence of causality between real per capita income and inflation. Unidirectional causality is observed between unemployment and per capita income with causality running from unemployment to per capita income, an indication that historical (past) values of unemployment rate significantly predict current per capita income. Per capita income does not Granger-cause unemployment. Bidirectional causality (significant at the 10% level) is observed between unemployment and inflation rate. This validates the Philips Curve hypothesis.

Forecast error variance decomposition

Further investigation of the interrelationships among unemployment, inflation and economic growth in Nigeria was conducted by exploiting the forecast error variance decomposition of the variables to deduce the inter-temporal response pattern of each of the variables to own exogenous shock, and to exogenous shock or innovations in other variables thus examining the proportion of the forecast error variance of each variable accounted for or explained by exogenous shocks to the other variables. The results of the forecast error variance decomposition of the variables are presented in Table 11.

Table 11: Forecast error variance decomposition

Variance decomposition of LPCY

Period	S.E.	LPCY	LINF	LUN
1	0.059192	100.0000	0.000000	0.000000
2	0.090387	92.17836	0.395949	7.425694
3	0.114867	84.75210	2.510633	12.73727
4	0.132945	81.79176	1.888375	16.31987
5	0.151926	76.86722	3.752793	19.37999
6	0.173256	70.94869	7.093281	21.95803
7	0.194181	66.64182	9.289412	24.06877
8	0.213975	63.70764	10.64388	25.64848
9	0.233203	61.44152	11.77430	26.78418
10	0.252284	59.55430	12.81420	27.63150

Variance decomposition of LINF

Period	S.E.	LPCY	LINF	LUN
1	0.615853	0.071922	99.92808	0.000000
2	0.772679	1.251198	95.06539	3.683416
3	0.787585	2.575176	91.52152	5.903304
4	0.796734	3.159198	90.70540	6.135398
5	0.799205	3.564556	90.18596	6.249488
6	0.807351	4.042275	89.44949	6.508234
7	0.815569	4.668711	88.36209	6.969203
8	0.821920	5.342345	87.23670	7.420960
9	0.827772	5.999360	86.19400	7.806639
10	0.834199	6.654322	85.16318	8.182500

Variance decomposition of LUN

Period	S.E.	LPCY	LINF	LUN
1	0.333681	2.141845	26.75160	71.10655
2	0.411375	5.920169	30.54914	63.53070
3	0.516785	8.185086	44.33061	47.48431
4	0.605900	10.87241	48.17234	40.95525
5	0.657942	14.22951	45.84660	39.92389
6	0.694296	17.37576	43.01614	39.60810
7	0.728071	20.04823	40.87260	39.07917
8	0.763574	22.33639	39.22498	38.43863
9	0.799836	24.40115	37.69940	37.89945
10	0.835691	26.30620	36.21026	37.48355

Cholesky Ordering: LPCY LINF LUN

The results indicate that each of the variables clearly responds more to own shocks than to shocks in other variables. The variance decomposition of LPCY shows that the effect of exogenous shocks to unemployment on per capita income dominates that of the effect of exogenous shocks to, or innovations in inflation on per capita income in all the periods shown. While unemployment accounts for 7.42%, 12.73% and 16.32% of the forecast error variance of PCY in the second, third and fourth year respectively, inflation accounts for only 0.40%, 2.51% and 1.89% respectively of the forecast error variance of PCY in the same period. Same is observed for effect of exogenous shock to unemployment (relative to per capita income) for the variance decomposition of (log of) inflation. This observation upholds the observation from the pairwise Granger-causality test and underscores the relevance of policies targeted at unemployment.

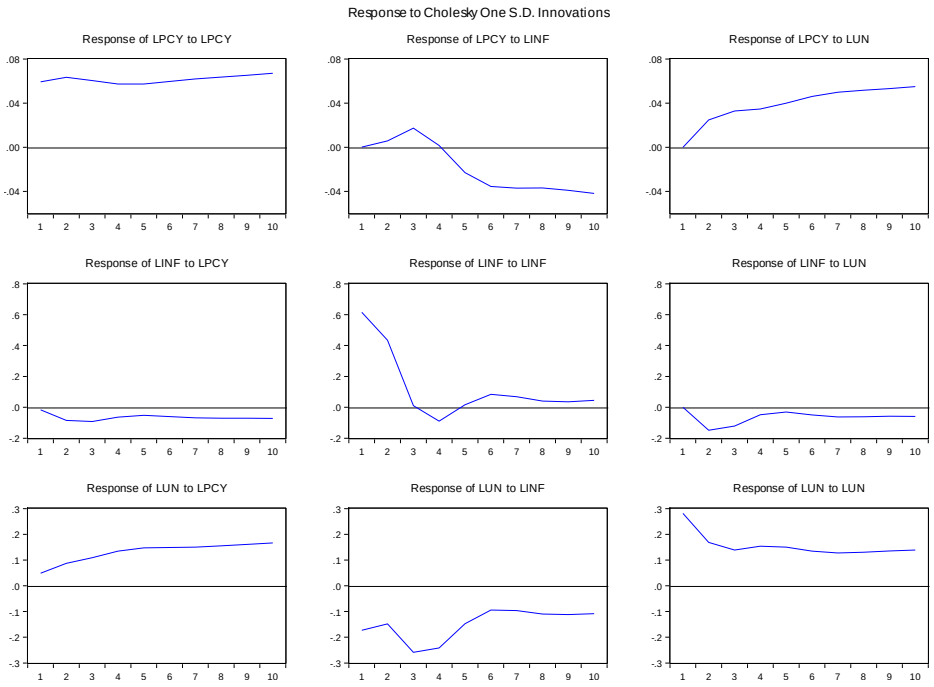
The result of the variance decomposition of (log of) unemployment indicates that the effect of exogenous shock to the inflation variable on the

forecast error variance of unemployment, consistently dominates the effect of exogenous shock to, or innovations in per capita income in all the periods displayed.

Impulse response analysis

Further investigation of the dynamic relationship between unemployment, inflation and per capita income is explored by exploiting the impulse response analysis. The graphical representation of the impulse response function is presented in Figure 3.

Figure 3: Graphs of impulse response function



Key observations from the impulse response graphs are that in the first three periods, per capita income responds to Cholesky one standard deviation innovation by rising. Thereafter, it begins to fall. Per capita income responds to one standard deviation innovation in unemployment rate by rising continuously. Similar pattern is also observed for the response of unemployment to per capita income. Evident from the graph of response of inflation to per capita income is that the response of inflation to

one standard deviation innovation in per capita income is not quite appreciable. We also observe that the response of inflation rate to one standard deviation innovation in unemployment rate is only appreciable in the first four periods. Inflation rate falls in the first two periods, then rises steadily in the next two periods and then almost stabilizes thereafter. The response of the unemployment rate to one standard deviation innovation in inflation rate is similar in patter to the response of inflation rate to one standard deviation innovation in unemployment. The graphs which lie below the zero line indicate the inverse relationship between the variables in the entire period.

Conclusion

The objectives of the paper were to examine the determinants of, and the interrelationships among unemployment, inflation and economic growth in Nigeria. Two appropriate methodologies, viz: simultaneous equations modeling and var autoregression (VAR) modeling were employed to analyse relevant data with a view to realizing the set objectives. The structural parameters of the system of simultaneous equations were estimated using the two-stage least squares technique to obtain consistent and asymptotically normal and efficient parameters. The long run relationship and causality of the variables were also tested with the Johansen maximum likelihood test for cointegration and Granger causality test respectively. The empirical analysis indicates that the variables – unemployment, inflation and economic growth are interrelated and cointegrated, and that unidirectional causality exists between unemployment and per capita income, with causality running from unemployment to per capita income. Bi-directional causality was also observed between inflation and unemployment. No causal relationship was observed between unemployment and per capita income. This observation tends to suggest that the observed positive sign on the coefficient of per capital income in the unemployment equation of the simultaneous equations system, and the positive relationship between per capita income and unemployment rate depicted by the impulse response function graphs could be interpreted, in addition to saying that economic growth resulting from the application of advanced technology may have led (in part) to structural unemployment, and that unemployment also grew irrespective of the growth of the nation's economy. The original Phillips curve proposition of inverse relationship between inflation and unemployment was upheld by the analysis.

Factors affecting unemployment in Nigeria identified include foreign direct investment, inflation rate, real compensation of employees (all of which are inversely related to unemployment), and per capita income which is positively related to it. Inflation was observed to be positively affected by growth of broad money, and negatively affected by unemployment rate. Per capita income was observed to be positively affected by the degree of trade openness and inflation.

Recommendations

Based on the empirical evidence, the following are recommended for policy consideration:

i. Considering that foreign direct investment negatively affects unemployment rate, there is need for the government to take measures to attract more foreign direct investment in country. These include infrastructural development, adequately addressing the problems in the power/energy sector, addressing the security challenges being faced by the country, favourable tax regimes, etc.
ii. The observed negative and signifcant relationship between in employees' compensation and unemployment suggests that increase in the compensation of employees will no doubt reduce unemployment in the country. There is therefore need for government and private sector employers to design attractive remuneration packages for their employees. It is believed that doing this will increase the willingness of people to work, and also lead to creation of jobs through increase in effective demand by the employees whose compensations have increased.
iii. Considering that expansion in broad money growth is observed to be positively related to inflation, there is need for the monetary authority to curtail the growth of broad money through the use of tight (contractionary) monetary policy.
iv. The observed positive relationship between per capita income and unemployment suggests the need for training and retraining of the nation's workforce to enhance their skill to avoid structural unemployment. There is also need for the government to design and implement skill acquisition programmes for the unemployed.
v. The positive effect of trade openness on Nigeria's economic growth (real per capita income) suggests the need for greater integration of Nigeria's economy with the global market, taking care to develop the productive non-oil sectors of the economy to expand their

capacity to boost the nation's non-oil export earnings. However, liberalization of the economy should not be full-scale, but selective. Those sectors that can face the challenges of globalization may be fully opened up, while those sectors which are not yet strong enough to face the challenges of which globalization should be protected, until they are strong enough to compete on a global scale.

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Appendix

The procedure for investigating the identification status of the specified system of simultaneous equations used in this paper is based on procedures outlined in Koutsoyianis, A. (1977). *Theory of Econometrics,* Second Edition, Palgrave, New York.

The order condition for identification

For convenience, we recall the system of simultaneous equations in its functional form:

UN = g (DINV(-1), FDI(-1), INF(-1), RWAGES, PCY)

INF = g (BMG(-1), gce, gce(-1) UN, PCY)

PCY = f (PCY(-1), TOPEN, TOPEN(-1), dinv, fdi, HCE, UN, INF(-1))

An equation belonging to a system of simultaneous equations is identified if

$(K-M) \geq (G - 1)$

Where K = total number of variables (endogenous and exogenous) in the system or entire model

M = number of variables (endogenous and exogenous) in any particular equation

G = number of structural equation = number of all endogenous variables in the model

(K-M) measures the total number of variables excluded from a particular equation

If $K - M = G - 1$, then the equation is exactly identified; if $K - M > G - 1$, then it is overidentified; if $K - M < G - 1$, then it is not identified or underidentified. For a system to be identified, all the equations of the system must be identified.

For the unemployment (UN), equation, K = 16, M = 6 and G = 3. Substituting into the identification relation, we have $16 - 6 > 3 - 1$, i.e. $10 > 2$. Thus, our unemployment equation is overidentified.

For the inflation equation, K = 16, M = 6 and G = 3. Substituting into the identification relation, we have $16 - 6 > 3 - 1$, i.e. $10 > 2$. Thus, our inflation equation is overidentified.

For real per capita income equation, K = 16, M = 9 and G = 3. Substituting into identification relation, we have 16 – 9 > 3 – 1, i.e. 7 > 2. Thus, the real per capita income equation is overidentified. Since all the equations of the system are overidentified, the entire system can be said to be overidentified and can therefore be estimated.

However, the *order condition* is a necessary condition for identification, but it is not sufficient. We therefore proceed to testing the identification status of the model using the rank condition.

The rank condition for identification

"The rank condition states that: in a system of G equations, any particular equation is identified if and only if it is possible to construct at least one non-zero determinant of order (G-1) from the coefficients of the variables excluded from that particular equation but contained in other equations of the model." (Koutsoyianis, 1977, p.353). The model may be re-expressed in the form:

$$-LUN + h_o + h_1 Ldinv(-1) + h_2 Lfdi(-1) + h_3 LINF(-1) + h_4 LRWAGES + h_5 LPCY + u_3 = 0$$

$$-LINF + g_o + g_1 LBMG(-1) + g_2 Lgce + g_3 Lgce(-1) + g_4 LUN + g_5 LPCY + u_2 = 0$$

$$-LPCY + f_o + f_1 LPCY(-1) + f_2 LTOPEN + f_3 LTOPEN(-1) + f_4 Ldinv + f_5 Lfdi + f_6 LHCE + f_7 LUN + f_8 LINF(-1) + u_1 = 0 \quad (6)$$

Ignoring the intercepts and the random disturbances, the table of parameters/coefficients of the model is as follows.

Equations	Coefficents of logs of Variables															
	UN	INF	PCY	PCY(-1)	TOPEN	OPEN(-1)	fdi(-1)	dinv	BMG(-1)	gce	gce(-1)	INF(-1)	dinv(-1)	Fdi	HCE(-1)	RWAGES
UN	1	0	h_5	0	0	0	h_2	0	0	0	0	h_3	h_1	0	0	h_4
INF	G_3	-1	g_4	0	0	0	0	0	g_1	g_2	g_3	0	0	0	0	0
PCY	f_7	0	-1	f_1	f_2	f_3	0	f_4	0	0	0	f_8	0	f_5	f_6	0

To examine the identifiability of the first equation, we strike out the row of coefficients of this equation and then strike out the columns in which non-zero coefficient of the equation appears.

This procedure yields

-1	0	0	0	0	g_1	g_2	g_3	0	0
0	f_1	f_2	f_3	f_4	0	0	0	f_5	f_6

Evidently, several non-zero determinants of order 2 (i.e 3-1, where G represents the number of equations) can be obtained from variables excluded from this equation but included in other equations. Thus the equation is identified.

We repeat the procedure for the other two equations. For the second equation, we have

0	0	0	0	h_2	0	h_3	h_1	0	0	h_4
f_1	f_2	f_3	f_3	0	f_4	f_8	0	f_5	f_6	0

From this, we can also obtain several non-zero determinants of order 2 from variables excluded from the inflation equation but included in other equations. Thus the equation is identified.

Lastly, repeating the procedure for the third equation, we have

0	h_2	0	0	h_2	0	0	h_1	h_4
-1	0	g_1	f_3	0	g_2	g_3	0	0

Again we observe that several non-zero determinants of order 2 can be obtained from variables excluded from this equation but included in other equations. Thus the equation is identified. Since all the equations are identified, then it can be reasonably inferred that the entire model is identified and can therefore be estimated.