**TEMPORAL, SOCIO-ECONOMIC AND GOVERNANCE DYNAMICS IN NIGERIA'S GDP (1950-2020)**

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**ABSTRACT**

Nigeria’s economic development has naturally drawn from its rich endowment of natural resources, especially petroleum products that grew astronomically in the 1970s and 1980s but in the process stifled growth of other sectors of the economy. In recent years, quite dramatic changes have been noticeable in expanding macro-level wealth that continues amidst widespread and deepening poverty and hopelessness. From the standpoint of efficient economic management, understanding the underlying causes of these confounding and often contradictory situations is crucial. To achieve this, it is necessary to undertake a wide-sweeping exploration of the broad socio-economic and political environment, particularly in respect to the governance systems, leadership, and economic management approaches most likely to have influenced the past and present trends in GDP growth. Innovative econometric procedures based on ARDL and ARIMA models were employed to analyze conventional macro-economic data from the Penn World Table (PWT) database in combination with dummies calibrated for Nigeria to respresent types of rule, governance systems, agricultural and overall economic policy management systems. Important insights were gained on the possible relationships among these factors and GDP growth on which future policy interventions can be designed.

**Keywords**

Nigeria, GDP, timeseries, Structural Change, Governance

## 1. Introduction and Problem Context

An important prerequisite for efficient economic management is the capacity to provide a good approximation of the dynamics of the economy. The rate at which the economy grows remains one universally accepted measure of such dynamics and this is reflected in the growth of the GDP. The critical development question for Nigeria is how to achieve economic growth at rates that are high enough to accommodate the demands of a growing population and can be sustained over time. In recent years, notions of sustainability and inclusivity have been identified as crucial for growth to be meaningful.

For growth to be sustained a broad range of outcomes must interplay and overtime Governments have utilized different strategies and policies with the primary goal of achieving economic growth, price stability, full employment among others (Egbulonu and Ajudua 2017). According to Alex (2013), GDP is mostly influenced by increase in oil prices, power shortages, corruption, political instability and wars among others in developing countries. While some countries, particularly in Eastern Asia have achieved very rapid rates of growth and catching up with already wealthy countries, others particularly Sub-Saharan Africa countries, have achieved little or no growth (Yeboah-Forson, Addor, Gyamfi and Twenefour, 2015). What factors account for these differences have been of more than passing interest to both academics and policymakers alike.

In Nigeria, although the GDP has grown significantly over the years, it has featured considerable instability with highly dramatic upwards and downwards swings. From the point of view of planning effectiveness, such instability has been a source of serious concern. For one thing, it makes anticipatory economic management quite difficult. While the phenomenal growth of the GDP of Nigeria is as a result of the contribution of several sectors of the country's economy, the relative proportions in which these sectors engage with the economy have not been updated in the most recent decades. The mindset that the oil sector is the main driver of Nigeria's growth remains, but the emergence of several non-traditional sectors is becoming more widely known and recognized than previously. However, more in-depth assessments are needed to establish the extent of the changes that are currently underway. Such an assessment will confront the challenge that it will involve more complexity than the hitherto simplistic notion that the Nigerian economy fits a binary classification into oil and non-oil sectors (National Bureau of Statistics, NBS 2016). While the oil sector is mainly driven by crude oil production and sales, the non-oil sector straddles numerous other sectors of the economy among which are agriculture, water supply, information and communication, arts entertainment, education etc. Identifying all these activities and sectors of the non-oil contributors of growth and establishing parameters for measurement are needed for long-term development planning in an era in which oil is not the mainstay of the economy. But the data, time and resource requirements for this exercise are high and detailed planning is necessary to implement a research process at that level of rigour.

For the immediate term, it is feasible to examine roles played by time, policy changes and alternative economic management regimes in the country, on the levels and rates of growth of the GDP. Results of such quantitative assessments can help to explain the trends in GDP growth that are directly traceable to the oil sector and maybe related to the developments in the emerging non-traditional sectors. Recent studies have actually shown interesting trends in the GDP that call for deeper scrutiny. According to Mustapha (2017), the highest annual growth rate of Nigerian's GDP per capital was observed between 1999 and 2007. The rate of GDP per capita growth in the post Structural Adjustment Programme (SAP) era was higher (2.91%) than the pre-SAP era (0.83%). This may be linked to macroeconomic inconsistency arising from divergent opinions about which policies are most beneficial for long-run economic growth. Some of these trends may elicit contradictory responses which may include capital flights or divestments, leading to negative output growth which may prevent or slow down economic development.

## 2. Literature Review and Conceptual Framework

### 2.1 Theoretical Literature

Among the key manifestations of economic growth of a country, expansion in its labour force, consumption, capital and volume of trade are considered the most important (Egbulonu and Ajudua 2017). It is conventionally measured as the percent rate of increase in real gross domestic product (real GDP). According to the Organization for Economic Co-operation and Development (OECD), GDP is the standard measure of the value of final goods and services produced by a country during a period (OECD, 2009).

The neo-classical growth theory explains the patterns of economic change across countries based on the aggregate production function. It relates the total output of an economy to the aggregate amounts of labor, human and physical capital and a measure of the level of technology in the economy. Some of the proponents (Solow 1956 and Swan 1956) opined that the main determinant of economic growth was technological progress and population growth. The theory estimates the separate effects on economic growth of technological change, capital, and labour. It postulates that at any given point in time the aggregate output of the economy is determined by the quality and quantity of physical capital employed, the quantity of labour employed and the level of technical progress.

On the other hand, the endogenous growth theory explains the long run growth rate of an economy on the basis of endogenous factors. The endogenous growth model has included other variables such as financial development, education, population, international trade, and public policy etc. The theory implies that long-run growth is determined within the model. It associates growth of output per capita to savings and efficiency, with efficiency being a function of education, diversification, privatization, liberalization, stabilization, strong capital market development (Egbulonu and Ajudua 2017). According to Barro (1990) and Lucas (1990), other factors such as distortionary taxation and productive expenditure also affect the output level and its steady growth in addition to physical and human capital.

## 2.2 Empirical reviews

Daniel *et al.* (2015) estimated the Solow growth model (Augmented Cobb-Douglas production function) to model the economic growth of Ghana during the period 1990 to 2010. Capital, labour force, total factor productivity and total production were computed and the results from the model were compared with real GDP growth figures. The result showed a correlation between the actual growth rates and the calculated, even though the relationship was weak. However, other economic variables were not included which is a characteristic of the neo-classical growth models. In trying to forecast the real GDP rate in Greece for 2015 to 2017, Dritsaki (2015) applied the Box – Jenkins technique with one ARIMA (1,1,1) model. The study found out that there was a steady improvement in the real GDP rate.

Uwakaeme (2015) studied the causal relationship between economic growth and some selected growth factors in Nigeria between 1980 and 2012. While trade openness had a positive effect on economic growth, inflation and government fiscal deficit had a negative impact. The study concluded that there was a need for government to channel its funds to productive sectors in order to achieve price stability and stronger capital markets. Keita (2016) opined that countries in Africa can experience high per capita GDPs if there is high investment in human capital. The study associated the growth in some African countries to the levels of their technological and industrial output in addition to the high educational level of their populace.

In the same vein, Mustapha (2017) investigated the determinants of economic growth of Nigeria for a sample period 1960-2015. The study was based on the estimation of Autoregressive Distributed Lag (ARDL) model. GDP per capita was regressed against a set of economic variables including real GDP per capita, share of investment in GDP, share of labour compensation in the total national income, trade openness, political freedom and political stability. The result indicated that economic growth was influenced positively by the level of investment in the long-run.

Ismaila and Imoughele (2015) examined the macroeconomics determinants of economic growth in Nigeria for a period of 26years (1986 to 2012). The unit root test was carried out through the use of Augmented Dickey-Fuller (ADF) while the short and long run relationships between economic growth and its macroeconomic determinants was established by the Johansen's co-integration test. In addition, Ordinary Least Square (OLS) was used to determine the influence of the variables on economic growth. The results showed that gross fixed capital formation, foreign direct investment and total government expenditure were the main factors that influenced economic output under a stable inflationary rate.

What stands out vividly is the diversity of estimation methodologies that have been used over the years. In the first instance, researchers treat extensive time series data differently from other types of data because of the fact that considerable changes occur over the sample period that affect the results of the analysis outside the inherent features of the data themselves (Erdogdu, 2007). For instance, the assumptions of fixed coefficients and constant elasticities of the structural form models and similar procedures have proved unrealistic and hardly helpful when data ranges are very long (Weber and Hawkins, 1971). From the foregoing literature review in this paper, it is clear that researchers try to overcome the pitfalls of the fixed coefficients and constant elasticities assumptions by employing two main techniques for these estimations; one that makes use of univariate econometric techniques and the other that involves more multivariate modelling (Hamid and Shabri, 2017). The univariate techniques employ the Autoregressive Integrated Moving Average (ARIMA) model which is considered a relatively simple approach in comparison to other models and explains the present value of a variable by its past value and error (Hamid and Shabri, 2017). Since ARIMA model does not require the inclusion of price variables in the forecasting process, it is often attractive to researchers who are concerned about avoiding the problem of low elasticities that are inherent in forecasting estimates that include price data (Erdogdu, 2007). In these models, only the dependent variable is lagged and they do not consider the effects of possible exogenous variables (Malik, 2018). But this fails to take into account the full dynamism of the real world. It has also been found that ARIMA models are ineffective in estimating extreme values (Grogan, 2020). To overcome this limitation, a more dynamic model which utilizes both the dependent and explanatory variables is often preferred and is referred to as the Autoregressive Distributed Lag (ARDL) model.

## 4. Materials and Methods

The tendency for time series data to diverge from their mean values, implying non-stationarity, introduces serious problems of interpretation due to what Granger and Newbold (1974) called "spurious regression phenomenon". This phenomenon results when variables exhibit apparent co-movement overtime (Obi, 2006). To deal with this problem, the application of specialized techniques of co-integration are necessary to first determine whether the underlying stochastic processes that generated the data are invariant with respect to time (Pindyck and Rubinfeld, 1991; Nkoro and Uko, 2016, among others). To illustrate this, in equation 1, we assume that for a random variable:

$$X_t = X_{t-1} + \varepsilon_t \text{, where } \varepsilon \sim \text{NID } (0, \sigma^2) \quad \text{.......(1)}$$

where, the error term ε is normally and independently distributed with a zero mean and a finite variance, $\sigma^2$. The variance of the dependent variable in this situation, $X_t$, will however tend towards infinity as presented in equation 2.

$$\text{Thus, } X_t = \sum_{j=0}^{t-1} e_{t-j} \text{, given } X_0 = 0 \quad \text{.......(2)}$$

As the foregoing situation is undesirable, the goal is to achieve stationarity which, notationally, is defined in the following terms:

| | |
|---|---|
| Mean: | $E(Y_t) = \mu$ |
| Variance: | $var(Y_t) = E(Y_t - \mu)^2 = \sigma^2$ |
| Covariance: | $\gamma_k = E\{(Y_t - \mu)(Y_{t+k} - \mu)\}$ |

Econometric literature has provided useful insights into how non-stationarity and the presence of structural breaks can be detected in a data series. A number of highly precise tests are available for this purpose, each depending on the nature of the data and model, and the amount of prior information existing on the dataset, especially with respect to the precise time of the structural break(s). Maddala and Kim (1998) distinguish among four types of tests as follows:

(i) tests specific to situations in which the break points are known versus those situations in which the break points are unknown.
(ii) tests for single break versus those for multiple breaks.
(iii) tests for univariate versus multivariate relationships.
(iv) Tests for stationary versus nonstationary variables.

In general, the E-Views software allows for the following test model to be fit, using Augmented Dickey-Fuller (ADF) test (or the Phillips-Perron test), which is presented in equation 3.

$$Y_t = \mu + \theta DU_t + \beta t + \gamma DT + dD(T_B)_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_t \ \Delta y_{t-i} + e_t \text{……………………………………….} (3)$$

where:
$\mu$ = the intercept term;
$T_B$ = time of break
$D(T_B)$ = value of 1 if t = $T_B$ + 1, and 0 otherwise;
$DU_t$ = value of 1 if t > $T_B$ , and otherwise
$DT$ = t if t > $T_{B,}$ and 0 otherwise.

The hypotheses on which the ADF test is based are presented in equations 4 and 5.

$(H_0) Y_t \ is \ not \ I(0) \ or \ Y_t \ is \ nonstationary$…………………………………………………(4)
$(H_1) Y_t \ is \ I(0) \ or \ Y_t \ is \ stationary$……………………………………………………..(5)

It is preferable to first regress the variable with its trend and intercept to ascertain if a significant relationship exists as basis for determining whether these two parameters would be included in the unit root test. Other preliminary tests carried out before the unit root tests include plotting histograms and reading off the Jacque-Bera, Kurtosis and Skewedness statistics as well as plotting correlograms to check for existence of autocorrelation in the series.

Comparing the calculated ADF statistics with the tabulated (critical) values, the null hypothesis $(H_0)$ is not rejected if the test ADF statistics is less than the tabulated (critical) values, leading to the conclusion that the time series is nonstationary. Alternatively, if the calculated ADF test statistics exceed the tabulated (critical) values, $(H_1)$ is accepted and it is concluded that the series is stationary. The E-Views estimation output displays both ADF test statistics and the critical values associated with the specific data series and its properties and these can be read out directly instead of consulting the Fuller tables separately. When non-stationarity is detected, differencing procedures are undertaken on the data series by adjusting the lag lengths using Schwartz Information Criteria until the dataset becomes stationary.

Having achieved stationarity in the series, it is important to determine the orders of integration of the variables. The preliminary tests run before the unit root tests already pointed up differences in the distributions of the individual variables and the unit root confirmed important differences in the orders of integration. These differences confirm the appropriateness of the ARDL approach for conducting the co-integration analysis of the series. A key step in fitting the ARDL model is choosing the appropriate lag length which is crucial to obtaining stationary series that have standard normal error terms and are not subject to non-normality, autocorrelation, and heteroscedasticity (Nkoro and Uko, 2016). Selecting the appropriate lag length is executed by the use of any of a range of Model Order Selection Criteria, namely the Akaike Information Criteria (AIC), Schwarz Bayesian Criterion (SBC), or Hannan-Quinn Criterion (HQC) which are listed below:

- **Akaike Information Criteria (AIC)**

The AIC is a measure of the appropriate lag structure of the model which provides a basis for concluding about the goodness or closeness of the statistical fit and reflects the number of parameters estimated (Maddala and Kim, 1998). If the task is to estimate a regression model, the AIC can be represented as shown in equation 6.

$$AIC_{\sigma} = \log(\sigma^2) + \frac{2p}{n} \quad \ldots\ldots(6)$$

where:

$\sigma^2$ is the maximum likelihood (ML) estimator of the variance of the regression residuals, $\mu_t$ .

- **The Schwarz Bayesian Criterion (SBC)**

The distinction of the SBC is that it provides a large sample approximation to the posterior odds ratio of the models being considered. The following definition is standard for this criterion when considering a maximum likelihood estimation, with the parameters defined as was the case in the corresponding measure for the Akaike Information Criterion, presented in equation 8.

$$SBC_{\ell} = \ell_n(\theta) - \frac{1}{2}\rho \log n \text{……………………………………………………….}(8)$$

In the case of regression models, the criterion is commonly re-written as presented in equation 9.

$$SBC_{\sigma} = \log(\sigma^2) - \left(\frac{\log n}{n}\right)\rho \text{……………………………………………………….}(9)$$

In the case of the SBC, the decision rule again differs depending on whether we are dealing with the maximum likelihood estimation procedure or a regression model. Where our task relates to ML, the $SBC_{\ell}$ across the models are examined and the highest value is selected. In the case of a regression procedure, the model with the lowest $SBC_{\sigma}$ is chosen.

- **Hannan-Quinn Criterion (HQC)**

The HQC is an important criterion for the selection of the order of autoregressive moving average (ARMA) or vector autoregressive (VAR) models (Hannan & Quinn, 1979), and is defined in either of these cases as shown in equation 10.:

$$HQC_{\ell} = \ell_n(\theta) - (\log \log n)\rho \text{………………………………………….}(10)$$

or, when a regression model is involved, as presented in equation 11.

$$HQC_{\sigma} = \log_{\sigma} + \left(\frac{2\log\log n}{n}\right)\rho \text{……………………………………..}(11)$$

Having established these conditions, a simple ARDL model as presented in equation 12 is fitted

$$Y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \varepsilon_t \text{…………………………………….}(12)$$

Where the error term $\varepsilon_t$ is assumed to be identically and independently distributed ($\varepsilon_t \sim iid(0, \sigma^2)$) and the absolute value of the intercept term is less than 1, $|\alpha_1| < 1$.

The ARDL model represented by equ. 6 is the long-run relationship when it is expected the current and lagged values of both dependent variables and explanatory variables are individually equalized, that is: $y_t = y_{t-1}$ and $x_t = x_{t-1}$,

which allows the model to be re-written as shown in equation 13.:

$$y_t = \alpha_0 + \alpha_1 y_t + \beta_0 x_t \beta_1 x \leftrightarrow (1 - \alpha_1) y_t = \alpha_0 + (\beta_0 + \beta_1) x \ldots\ldots (13)$$

which provides insight into the long-run response to $y$ elicited by a change in $x$ and can be depicted by equation 14.

$$k = \frac{\beta_0 + \beta_1}{1 - \alpha_1} \ldots\ldots (14)$$

However, the procedure of differencing that allowed for the fitting of the model with the stationary variables led to loss of critical information which can be recovered by a series of additional steps involving the specification of an Error Correction Model (ECM). The procedure will involve subtracting the term $y_{t-1}$ from both sides of equ. 6 and simultaneously adding and subtracting the term $\beta_0 x_{t-1}$ from the right-hand side, yielding equation 15:

$$y_t - y_{t-1} = \alpha_0 + (\alpha_1 - 1) y_{t-1} + \beta_0 (x_t - x_{t-1}) + (\beta_0 + \beta_1) x_{t-1} + \varepsilon_t \ldots\ldots (15)$$

Transposing equ.14 yields equation 16.

$$\beta_0 + \beta_1 = k(1 - \alpha_1) \ldots\ldots (16)$$

Which is inserted into equ.15 to substitute for $\beta_0 + \beta_1$. Then the terms for long-run equilibrium in equ.13, namely $\Delta y = y_t - y_{t-1}$ and $\Delta x = x_t - x_{t-1}$, are also inserted into equ. 15 to give the Error Correction Model as presented in equation 17.

$$\Delta y_t = \alpha_0 + (\alpha_1 - 1)(y_{t-1} - k x_{t-1}) + \beta_0 \Delta x_{t-1} + \varepsilon_t \ldots\ldots (17)$$

**5. Data**

The data used for this study were obtained from the real GDP database of the Penn World Table (PWT) under the group's International Comparisons Programme (ICP). The organization has been collecting and maintaining a wide range of historical macro-economic data for more than 40 years and is seen as a credible source of these vital pieces of information on "relative levels of income, output, input and productivity" which allow researchers and policy makers to pursue research interests in structural change, agricultural transformation and other global thematic issues

(Feenstra, Inklaar and Timmer, 2015). Thus, researchers and policy makers from all over the world use these data to analyse productivity, structural change, and economic growth in details. The database maintained under the programme facilitates research in globalisation, technology and institutional change, and its impact on long-run economic growth, structural change, productivity and inequality. Over the years, the data have been maintained for between 152 at inception to 189 countries at its peak in the mid-2000s (Feenstra, Inklaar and Timmer, 2015). However, only 167 countries maintained complete data for the period 1950-2020, that is 70 years, although data coverage is uneven, being linked to the length of the investment series (Feenstra, Inklaar and Timmer, 2015). Of the countries that had data for the full period, 70 countries maintain data for the full period, having been keeping investment time series prior to 1950, 69 countries date their investment time series since 1970, while the remaining 25 countries have data going back only 25 years. The latest version 9.1 launched in September 2019 and covered the period 1950-2017 for 182 countries. The relevant dataset for Nigeria was available for the full period of the version 9.1 dataset,1950-2017, and extended to 2020 by reprocessing data from the World Bank, Food and Agriculture Organisation (FAO), and the National Bureau of Statistics (NBS).

**Table 1: Key variables in the Penn World Table (PWT)**

| **Variable Name** | **Acronym** | **Units** |
|---|---|---|
| **Based on prices that are constant across countries in any given year** | | |
| Expenditure-side real GDP | $CGDP^{E}$ | Millions of US $ in 2005 |
| Output-side real GDP | $CGDP^{O}$ | Millions of US $ in 2005 |
| Real consumption of households and government | CCON | Millions of US $ in 2005 |
| Real domestic absorption | CDA | Millions of US $ in 2005 |
| Capital Stock | CK | Millions of US $ in 2005 |
| Total Factor Productivity | CTFP | 2005 value =1 |
| Welfare-relevant TFP level | CWTFP | 2005 value =1 |
| **Based on prices that are constant across countries over time** | | |
| Expenditure-side real GDP | $RGDP^{E}$ | Millions of US $ in 2005 |
| | RGDPO | |
| **Based on national prices that are constant over time** | | |
| Real GDP at constant national prices | $RGDP^{NA}$ | Millions of US $ in 2005 |
| Real household and government consumption | $RCON^{NA}$ | Millions of US $ in 2005 |
| Real domestic absorption | $RDA^{NA}$ | Millions of US $ in 2005 |
| Capital Stock | $RK^{NA}$ | Millions of US $ in 2005 |
| Total Factor Productivity Index | $RTFP^{NA}$ | 2005 value =1 |
| Welfare-relevant TFP index | $RWTFP^{NA}$ | 2005 value =1 |
| **Other Variables** | | |

| | | |
|---|---|---|
| Price level of CCON | PL_CON | USA value =1 in 2005 |
| Price level of CDA | PL_DA | USA value =1 in 2005 |
| Price level of CGDP | PL_GDP$^{O}$ | USA value =1 in 2005 |
| Share of Labour income of employees and self-employees | LABSH | Fraction of nominal GDP |

**Source:** Feenstra, Inklaar, and Timmer, 2015, "The Next Generation of the Penn World Table", *American Economic Review 2015, 105(10): 3150–3182 http://dx.doi.org/10.1257/aer.20130954*

Apart from the global PWT data, additional data were inserted in the model to account for known structural breaks. According to the theory, the results obtained by the regression will be different if the underlying data have been subject to structural change of one type or another. It is often necessary to perform the test to identify the existence of a structural break prior to carrying out the unit root test since the existence of a structural break may lead to an erroneous conclusion of a unit root when in fact there is none (Perron, 1989). But a combined plot of the entire series did not indicate the sort of generalized breaks that would justify prior testing for structural breaks. In such a situation, the approach adopted by Lloyd and Rayner (1990) would be appropriate. In that case, the authors performed a recursive estimation of an equation previously estimated by OLS to see if there are significant differences in the regression coefficients for different sub-samples of the series. This is because there was prior knowledge about the dates of the possible breaks and the authors examined the response of land prices to inflation before and after the break dates (Lloyd and Rayner, 1990).

In line with the foregoing, trials were conducted to obtain the optimal number of breaks. At the beginning, 10 breaks were proposed but after several trials, the analysis settled for seven breaks. The consideration of these breaks involved creating of dummies to represent the emergence/occurrence of key political and institutional events in the country over the period covered by the PWT dataset. To create dummies amidst the various identified scenarios, the following breaks were applied:

A. Trend (based on visual examination of the data, Fig. 1): Sub-period I <=1985; Sub-period II 1986 <=2001; Sub-period III > 2001.
B. Type of rule (Political System): colonial<= 1959; civilian 1960<= 1967, 1979 <= 1983, >1998; military 1968 <= 1979, 1984 <= 1998
C. Structural Adjustment (Economic Policy Management Scenarios): Pre-SAP <= 1986; SAP 1987 <= 1998; Commercialisation >1998
D. Agricultural policies: Pre-ADP<= 1974; ADP 1975<= 2010; ATA 2011 <= 2013; ATASP >2013

E. Leadership Personality (Presidents): British <= 1959; Balewa 1960<= 1967; Gowon 1968 <= 1975; Obasanjo 1976 <= 1978; Shagari 1979 <= 1983; Buhari 1984, 1985; Babangida 1986 <= 1992; Abacha 1993 <= 1997; Salami 1998; Obasanjo1 1999<=2006; Yar'Adua 2007 <= 2009; Goodluck 2010 <= 2014; Buhari1 >2014
F. Natural Disasters (Eze, 2018): Drought1<= 1954; Drought2 1955<= 1972; Drought3 1973<= 1984; Drought4 1985<= 2007; Flood >2007
G. ICT: Pre-Indolence <= 1959; P&T 1960 <=1983; NITEL 1984<= 2000; GSM >2000

The various breaks and technologies were estimated as follows:

Breakpoints estimate the entire trend and determine the breakpoints while Model0 is for the entire trend without any scenario. Model1 combines all the scenarios enumerated above while Model2 estimates the scenarios with constant intercept. Model2 estimates the scenarios with changing intercept and slopes. In addition to the joint estimation, that is full model run for all the factors, each factor was estimated separately as limited model. This is to determine the partial effect of each factor on the GDP. The other models ARDL, splines without Knots, splines with Knots, Smooth spline and ETS (error, trend and seasonality) (Hyndman et al., 2008) were also estimated. All the estimations were carried out with R packages and E-Views.

## 6. Results

The study takes off on the assumption that GDP growth over the study period is related to a range of factors that have been hypothesized as structural breaks in the previous section. A preliminary step is to conduct a series of time series plots of the real GDP under alternative assumptions of what matters most: time, changing policy and economic management environments, and political leadership.

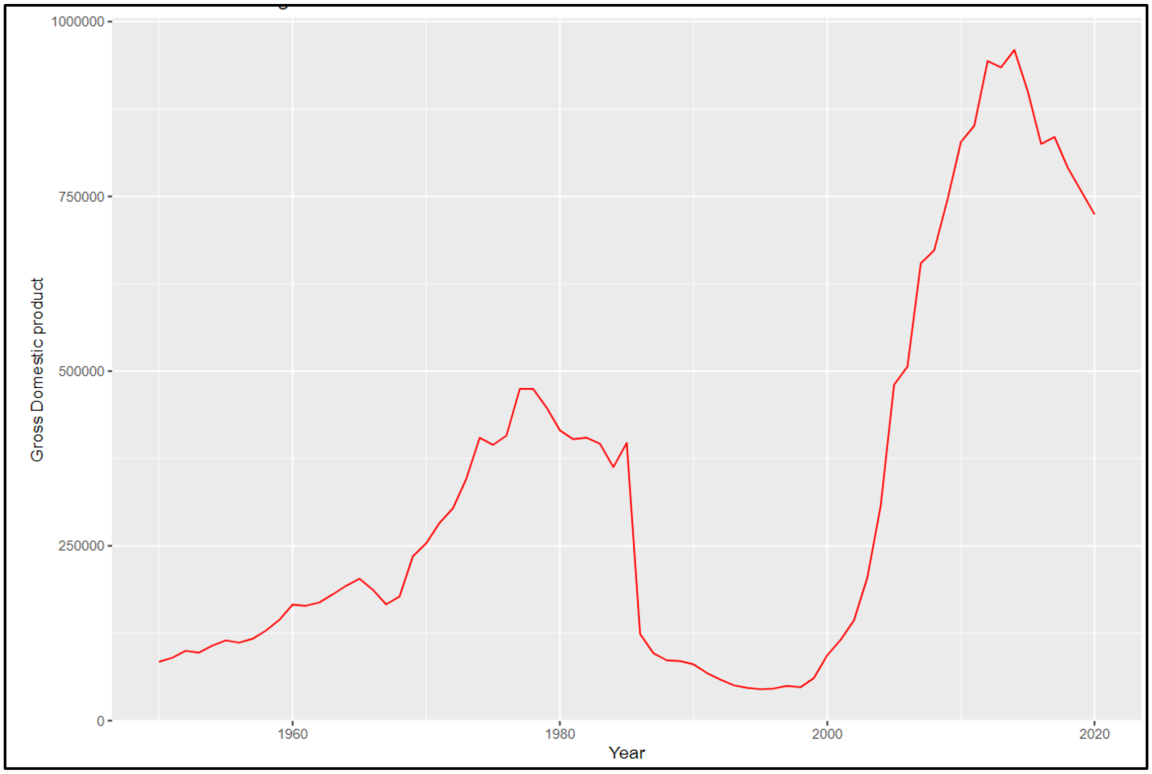


**Figure 1: Nigeria's GDP growth 1950-2020**

The results are shown in Figures 1-6 which reveal significant break-points that are probably linked to different scenarios of Government economic management programmes, policies, political regimes and leadership personalities, as well as how these factors relate with one another and the GDP growth. Alternative procedures were followed to inspect the trends of the different variables in order to determine at the outset how the different parameters have impacted on the fluctuations over the years. Figure 1 graphs the trend in GDP over time.

The indication is that Nigeria experienced a steady, virtually uninterrupted growth in the GDP for nearly 30 years, only slightly declining in the closing years of the 1970s and continued on this downward trend for nearly 20 years. As Figure 1 shows, the Nigeria's GDP growth resumed its upward climb from the year 2000. Over the next 15 years, the country was on a virtual roll as the GDP climbed steeply, reaching a peak in about 2012-2015 when the nominal value may have been more than two times the earlier peak attained 20 years earlier. Finding an explanation for these phenomenal swings within the context of identifiable policy effects is warranted and is the focus of Figure 2 which examines the existence of significant breaks in the data.

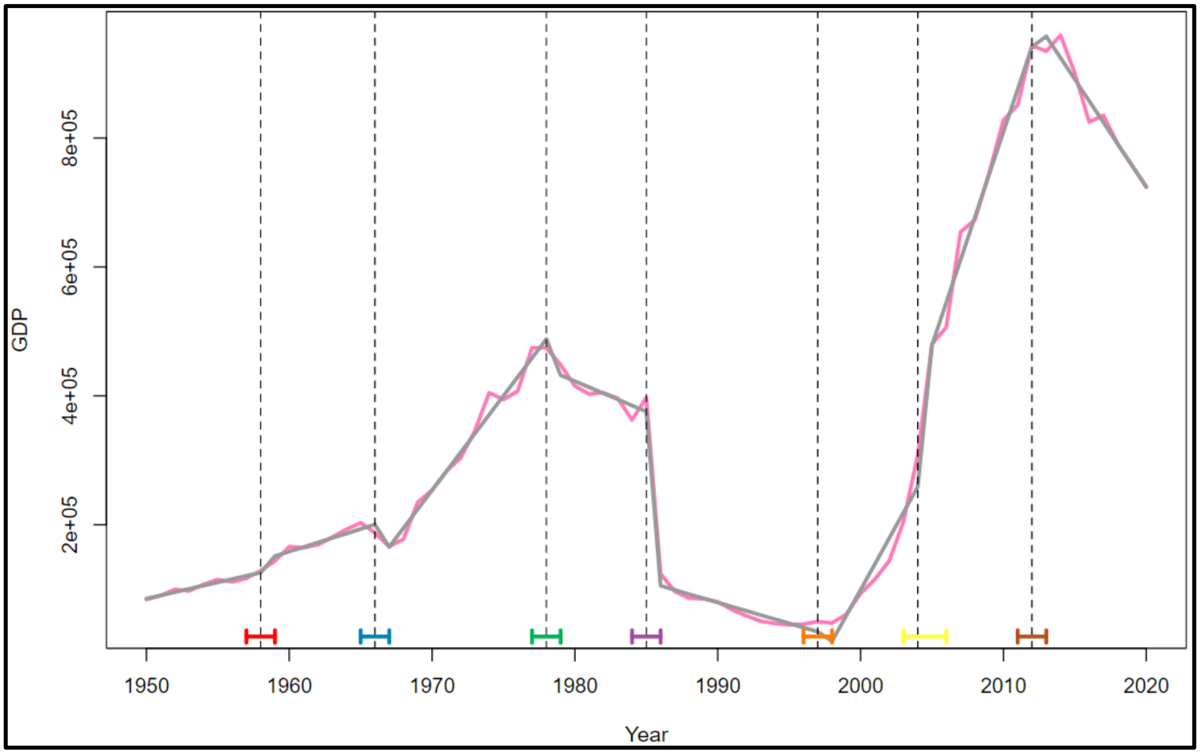


**Figure 2: Trends in Nigeria's GDP with break-points, 1950-2020.**

In line with the foregoing consideration, Figure 2 integrates the trends with break-points to reveal 7 important turning points in the GDP over the period under investigation. Whether those points that appear as sudden shifts in the flow of the time series data bear strong relationships with actual landmark events in the economy is established through tests that have been formalized over the years. In that regard, this study conducted the Chow breakpoint test on the data for all the years between 1950 and 2020 to detect any year or years for which turning points could be considered as arising from effects of policy. Table 1 presents the result of the test and reveals significant F-tests which compel the rejection of the null hypothesis of no structural change. It can therefore be concluded that the observed fluctuations in the plotted GDP are due to important policy, political and leadership effects during the sample period.

**Table 1: Results of the Chow tests on the models assuming multiple breakpoints**

| **Models** | **Res. Df** | **RSS** | **Df** | **Sum of Sq** | **F** | **Pr(>F)** |
|---|---|---|---|---|---|---|
| Model0 | 69 | 48.859790 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Model1 | 48 | 2.056132 | 21 | 46.80366 | 52.02963 | 0.0000 |
| Model2 | 62 | 20.705800 | -14 | -18.64967 | 31.09806 | 0.0000 |
| Model3 | 55 | 2.506808 | 7 | 18.19899 | 60.69313 | 0.0000 |
| Without knots | 67 | 1.735429e+12 | | | | |
| With knots | 63 | 2.358427e+11 | 4 | 1.499587e+12 | 100.1451 | 0.0000 |

Following the confirmation of the structural breaks in Table 1, the models were estimated under alternative assumptions of knot distributions. Based on these estimates, it was found that the model with knots yielded more robust results in terms of the coefficient of determination, $R^2$, as well as adjusted $R^2$. The estimates are presented in Table 2.

**Table 2: Model estimates under alternative assumptions of knots distributions**

| | ARIMA | Without knots | With knots | ETS |
|---|---|---|---|---|
| ar1 | 0.188 | | | |
| | (0.110) | | | |
| ar2 | 0.352 | | | |
| | (0.110) | | | |
| (Intercept) | | -18869.078 | 110563.776** | |
| | | (72536.590) | (42698.264) | |
| bs(gdp$t, knots = NULL)1 | | 854284.172**** | | |
| | | (210886.884) | | |
| bs(gdp$t, knots = NULL)2 | | -597544.913**** | | |
| | | (136893.721) | | |
| bs(gdp$t, knots = NULL)3 | | 1120467.549**** | | |
| | | (113498.959) | | |
| bs(gdp$t, knots = c(16, 36, 56, 65))1 | | | -68780.660 | |
| | | | (76878.058) | |
| bs(gdp$t, knots = c(16, 36, 56, 65))2 | | | 157167.876*** | |
| | | | (54813.907) | |
| bs(gdp$t, knots = c(16, 36, 56, 65))3 | | | 416525.593**** | |
| | | | (67867.891) | |
| bs(gdp$t, knots = c(16, 36, 56, 65))4 | | | -515921.519**** | |
| | | | (57736.103) | |
| bs(gdp$t, knots = c(16, 36, 56, 65))5 | | | 1276726.217**** | |
| | | | (65022.901) | |

| | ARIMA | Without knots | With knots | ETS |
|---|---|---|---|---|
| bs(gdp$t, knots = c(16, 36, 56, 65))6 | | | 495010.889**** | |
| | | | (72183.889) | |
| bs(gdp$t, knots = c(16, 36, 56, 65))7 | | | 654770.337**** | |
| | | | (69539.831) | |
| Nobs | 70 | 71 | 71 | |
| Sigma | 48677.994 | 160940.767 | 61184.433 | |
| Sigma2 | | | | 0.02955322 |
| logLik | -853.996 | -949.890 | -879.038 | -895.1893 |
| AIC | 1713.992 | 1909.781 | 1776.076 | 1802.379 |
| AICC | | | | 1803.691 |
| BIC | 1720.737 | 1921.094 | 1796.440 | 1815.955 |
| MSE | | | | 2430046623 |
| AMSE | | | | 6556297990 |
| Nobs.1 | 70.000 | 71.000 | 71.000 | |
| R.squared | | 0.680 | 0.957 | |
| Adj.r.squared | | 0.666 | 0.952 | |
| Statistic | | 47.464 | 197.973 | |
| p.value | | 0.000 | 0.000 | |
| Df | | 3.000 | 7.000 | |
| Deviance | | 1735429351741.190 | 235842692067.488 | |
| df.residual | | 67.000 | 63.000 | |

## alpha = 0.9999, beta = 0.1502684, phi = 0.8000002
**** p < 0.001; *** p < 0.01; ** p < 0.05; * p < 0.1.

The models incorporated the dummies for political systems (type of rule), structural adjustment (economic policy management), presidents (leadership personality), natural disaster, the infrastructural profile with respect to information and communications technologies (ICT), and implementation of various agricultural policies and programmes. The estimates reveal that the model with knots consistently showed an increase in GDP growth at different probability levels with respect to the political systems (type of rule), structural adjustment (economic policy management), presidents (leadership personality), natural disaster, and the infrastructural profile with respect to information and communications technologies (ICT). The types of rule were identified as era of Colonial Rule up to 1959 (Nigeria became Independent from British rule in 1960), the Civilian Regime that prevailed over the period 1960-1966, from 1979 to 1983 and since 1999. The final element of the type of rule considered were the series of Military Regimes that were in place from 1966 to 1979 and from 1984 to 1998. These political systems differed markedly in respect to the decision-making processes and the extent of representation of the popular will which affect the pattern of resource allocation and the distribution of investment priorities. The Colonial era was clearly a period when a previously backward society began to emerge from underdevelopment to embrace modernity consistent with Rostow's 5-Stage Model (Rostow, 1950), consisting of the following stages:

(a) traditional society,
(b) preconditions to take-off,
(c) take-off,
(d) drive to maturity and
(e) age of high mass consumption.

It can be said that the Nigerian society under Colonial combined the first three stages of Rostow's model and therefore involved significant amount of new investment in an environment that was virtually starting from nothing. The positive growth rate observed for that period can easily be explained in those terms. But the rather gentle slope of the curve may imply half-heartedness in the investment levels or excessive fiscal frugality that meant that important initial developments that would have laid a solid foundation for take-off and primed the young nation were not implemented. Figure 2 shows that the entry of the Military from the mid-1960s turned the slope of the GDP curve upwards. Some suggestion has been made that much of the colonial era economic activities rewarded the mother country (Britain) to a substantial extent. Referring to an earlier era of the Colonial period pre-dating the sample period, the historian Elizabeth Isichei (1983) drew attention to the substantial proportion of the national budget of Nigeria that was remitted to England as "home pay" for British officials working in the Civil Service of Nigeria. The fact that virtually all institutions and infrastructure for operating a modern state needed to be developed from scratch would have meant a much more rapid growth path. This was, unfortunately, not the case, with the result that the in-coming civilian administration inherited a large backlog of essential infrastructure and extremely weak institutions that may explain the high fragility of the society in the years that followed.

The Civilian Regime that succeeded the Colonial Regime has been widely criticized for fiscal irresponsibility that led to the interventions by the Military. A comparison of military and civilian regimes in relation to their public policy outputs and outcomes has been conducted by Iren Omo-bare (1990). Albeit with a number caveats, it is suggested that the Military Regimes performed better than the Civilian Regimes they succeeded in terms of fiscal responsibility and delivery of tangible development outcomes. Without question, the extent to which any regime could deliver development outcomes depend on the policies implemented by the regime and not necessarily on the type of regime *per se*. Figure 3 compares the three governance regimes.

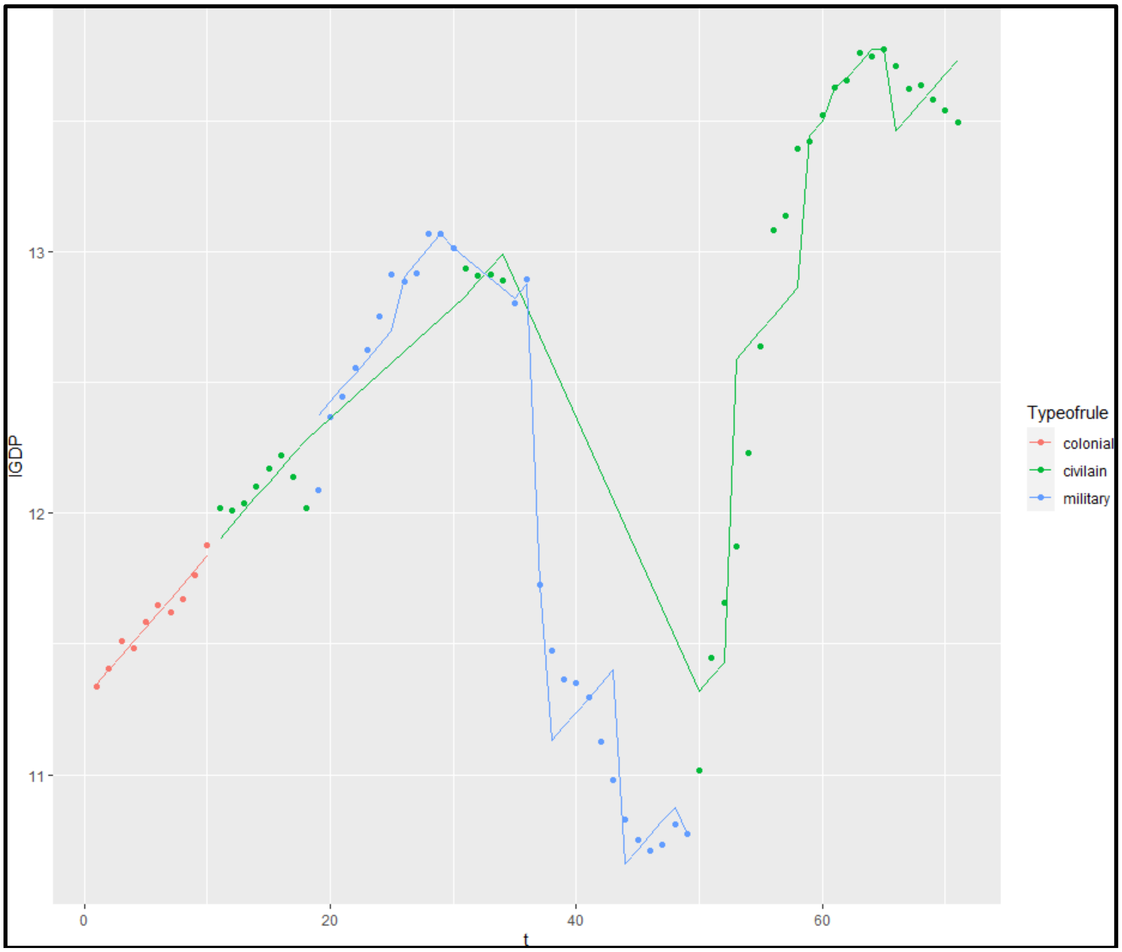


**Fig. 3: Trends in GDP under alternative governance regimes**

The indication from Figure 3 is that while Military rule may have predominated in terms of total time they have been in power, the Civilian regimes have moved the GDP further than all the governance systems under which Nigeria has been managed politically. This may reflect the fact that the civilian administrations guarantee broader participation of the population in the development process and ensure that group interests are better accommodated. But it is also possible that, as Omo-bare (1990) has observed, the environment, both national and international, in which the particular regime operated matters a lot. As it were, the different regimes, military and civilian, spanned over many years during which important international and local developments took place and cannot be ignored.

The model examined policy effects by inserting the agricultural policies dummies alongside the leadership personalities into the models. The model showed that agricultural policies were associated with significant decrease in GDP growth (Table 2). Over the years, the following agricultural policies have been implemented by various administrations in Nigeria: Agricultural Development Programme (ADP) which had two components namely, pre-ADP and ADP; the Agricultural Transformation Agenda (ATA); and Agricultural Transformation Agenda Support Programme (ATASP). From the results, it might seem that these agricultural policies were largely unsuccessful and failed to make positive contributions to GDP growth.

The dummies for Political leadership identified 13 individuals who have held the reins of power at the national level since Nigeria's accession to nationhood, which included the period of British Rule prior to Independence. These are calibrated as: British (up to 1959), Balewa (1960 – 1966), Gowon (1968-1975), Obasanjo (1976-1978), Shagari (1979-1983), Buhari (1984-1985), Babangida (1986-1992), Abacha (1993-1997), Salami (1998), Obasanjo1(1999-2006), Yar'Adua (2007-2009), Goodluck (2010-2015), Buhari1 (from 2015). The regime of Aguiyi-Ironsi that succeeded the Balewa regime lasted for about 5 months and was therefore not included since it could not have possibly made any impact on the GDP in such a short time. This variable was inserted in the model as dummy #5 in the estimation table (Table 2) and the results show that it positively significantly influenced the GDP growth. Without question, different leaders came to the office with different agenda which they pursued with differing degrees of commitment and dedication, helped on as might be expected by the overall political and economic environment in which they operated. To determine who among them made the most impact in terms of influencing the GDP growth, other levels of analysis are necessary. For this study, the leadership dummies calibrated as time series data were plotted as shown in Figure 4.

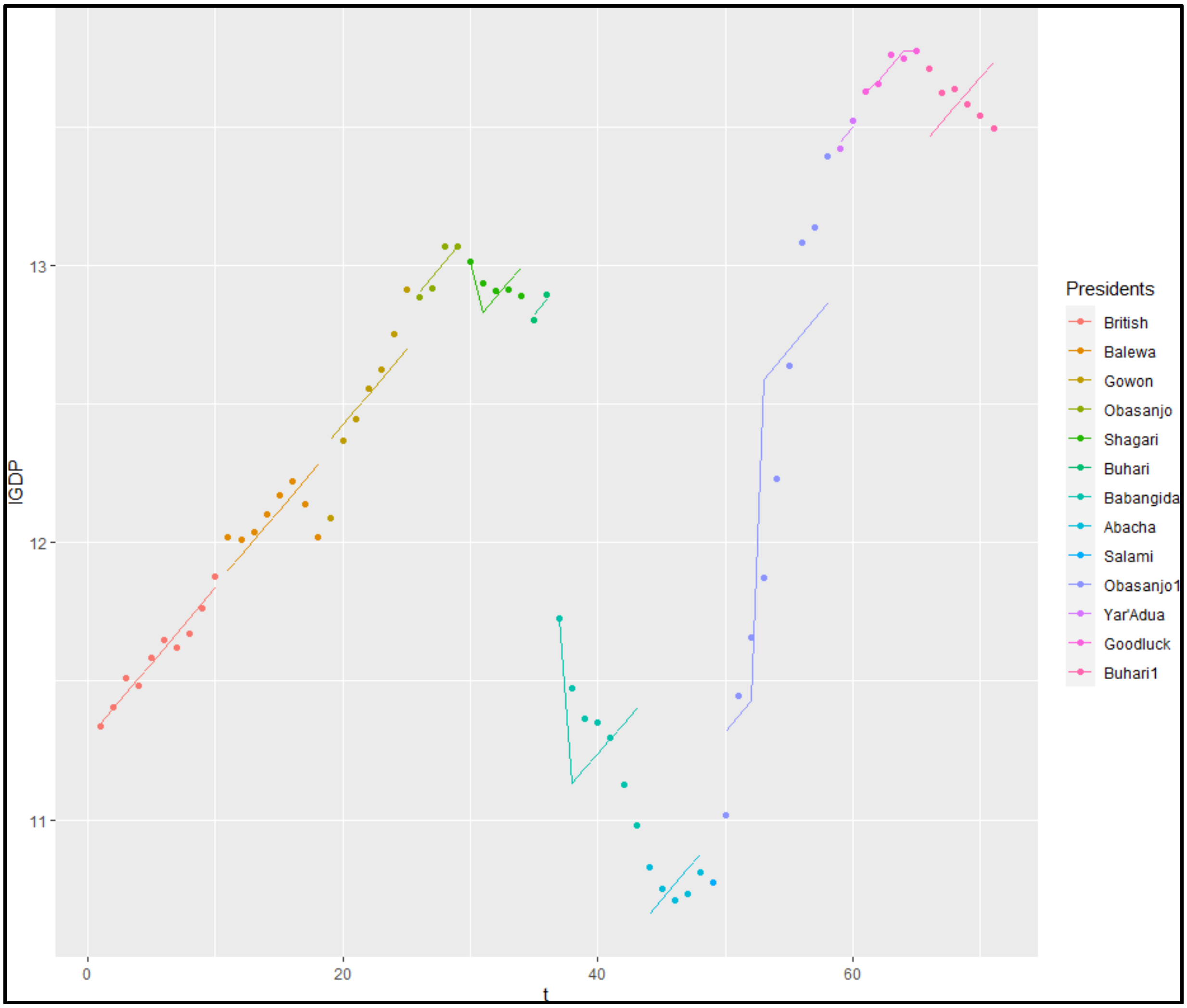


**Figure 4: Modelling time effects under different policies and political regimes at same intercept**

It would seem that the first-generation leaders, namely British, Balewa, Gowon, Obasanjo, Shagari and Buhari (in his first term), were associated with positive GDP growth. After the Babangida Era, things seemed to have taken a turn for the worse as the GDP growth became somewhat erratic, going up and down in successive years. But Table 3 shows that only the presidencies of Obasanjo (in his first term, perhaps) and Babangida revealed positive statistically significance in the regression. As is well known, the two presidencies identified to have shown statistical significance were both Military regimes and coincided with periods of very buoyant economy mostly driven by favourable oil production and pricing environments. The Babangida regime was shown to have positively significantly contributed to GDP growth at 1% probability level. The possible reason for this might be that the economic policies introduced by that regime were more proactive and coherent than those that preceded it. Initially, the SAP introduced by the Babangida regime achieved what it set out to do in the first two years, that is, a positive economic growth and prime growth in non-oil sectors. Exchange rate policy was a core strategy; the idea was to allow market forces to play a greater role in the economy and determining the exchange rate of the Naira. Other priorities were tariff/export policy reform, privatisation of state-owned enterprises and a general reduction in the running costs of government. Although Nigeria has been producing and marketing oil for many years before Independence, the management of this vital resource had been less than satisfactory and may have engendered the Dutch Disease in stifling growth in other sectors outside oil. The second term of Buhari seems to have shown some positive trend in its early years although by the end of the sample period the GDP growth is apparently on the decline

**Table 3: Estimates with dummies of time trend, type of rule, economic management, governance system**

| Factors | Variables | model0 | model1 | model2 | model3 |
|---|---|---|---|---|---|
| Entire trend | (Intercept) | 11.603*** | 11.292*** | 11.187*** | 11.310*** |
| | | -0.202 | -0.099 | -0.24 | -0.134 |
| | t | 0.020*** | 0.054*** | 0.117*** | 0.039* |
| | | -0.005 | -0.014 | -0.021 | -0.017 |
| Trend | Sub-period II | | -2.157*** | | |
| | | | -0.364 | | |
| | Sub-period III | | -1.049* | | |
| | | | -0.417 | | |
| Type of rule | civilian | | -0.19 | | |
| | | | -0.362 | | |
| | military | | 0.047 | | |
| | | | -0.247 | | |
| Structural Adjustment | SAP | | -0.651** | | |
| | | | -0.228 | | |
| | Commercialisation | | 0.314 | | |
| | | | -0.535 | | |
| Agricultural policies | ADP | | -0.421 | | |
| | | | -0.248 | | |
| | ATA | | -0.436 | | |
| | | | -0.359 | | |
| | ATASP | | -0.49 | | |
| | | | -0.412 | | |
| Presidents | Balewa | | 0.201 | | |

| Factors | Variables | model0 | model1 | model2 | model3 |
|---|---|---|---|---|---|
| | | | -0.289 | | |
| | Gowon | | | | |
| | Obasanjo | | 0.574** | | |
| | | | -0.21 | | |
| | Shagari | | 0.464 | | |
| | | | -0.264 | | |
| | Buhari | | | | |
| | Babangida | | 0.955*** | | |
| | | | -0.251 | | |
| | Abacha | | 0.159 | | |
| | | | -0.23 | | |
| | Salami | | | | |
| | Obasanjo1 | | -0.236 | | |
| | | | -0.339 | | |
| | Yar'Adua | | 0.293 | | |
| | | | -0.344 | | |
| | Goodluck | | 0.367 | | |
| | | | -0.228 | | |
| | Buhari1 | | | | |
| Parameter of the models | Nobs | 71 | 71 | 71 | 71 |
| | r.squared | 0.191 | 0.963 | 0.633 | 0.931 |
| | adj.r.squared | 0.18 | 0.951 | 0.599 | 0.918 |
| | Sigma | 0.841 | 0.207 | 0.588 | 0.266 |
| | Statistic | 16.32 | 75.699 | 18.434 | 72.128 |
| | p.value | 0 | 0 | 0 | 0 |
| | Df | 1 | 18 | 6 | 11 |
| | logLik | -87.477 | 22.254 | -59.386 | -0.21 |
| | AIC | 180.955 | -4.509 | 134.771 | 26.421 |
| | BIC | 187.743 | 40.745 | 152.873 | 55.836 |
| | Deviance | 48.86 | 2.221 | 22.146 | 4.182 |
| | df.residual | 69 | 52 | 64 | 59 |
| | nobs.1 | 71 | 71 | 71 | 71 |

***** p < 0.001; ** p < 0.01; * p < 0.05.**

Table 4 presents results for the estimates that combine the trend effects in model 2 and model 3. The results show that when trend effects are considered, type of rule (D2), and Economic Policy Management (D3) are statistically significant but negative, implying strong inverse policy effects. In model 3, type of rule (D2) modelled without trend effects showed a positive significant effect, probably in line with earlier indications that some elements of the Military Rule may have made positive contributions to GDP growth. Nevertheless, Agricultural Policies and Economic Policy

Management in general remained unhelpful to the GDP growth goals. Figures 5 and 6 show how the GDP growth relate to agricultural policies and a range of economic policy management arrangements.

**Table 4: Estimation of dummies with trend effects**

| Dummies with Trends | Model 2 | Model 3 |
|---|---|---|
| tD1 | 0.021** | |
| | -0.007 | |
| tD2 | -0.043*** | |
| | -0.006 | |
| tD3 | -0.037*** | |
| | -0.009 | |
| tD4 | 0.006 | |
| | -0.004 | |
| tD5 | -0.002 | |
| | -0.003 | |
| D1 | | -3.542** |
| | | -1.286 |
| D2 | | 0.825** |
| | | -0.293 |
| D3 | | -2.236 |
| | | -1.609 |
| D4 | | 1.948*** |
| | | -0.441 |
| D5 | | 0.065 |
| | | -0.295 |
| t:D1 | | 0.082** |
| | | -0.027 |
| t:D2 | | -0.031** |
| | | -0.01 |
| t:D3 | | 0.037 |
| | | -0.038 |
| t:D4 | | -0.034*** |
| | | -0.008 |
| t:D5 | | -0.004 |
| | | -0.006 |

| Parameter of the models | | |
|---|---|---|
| Nobs | 71 | 71 |
| r.squared | 0.633 | 0.931 |
| adj.r.squared | 0.599 | 0.918 |
| Sigma | 0.588 | 0.266 |
| Statistic | 18.434 | 72.128 |
| p.value | 0 | 0 |
| Df | 6 | 11 |
| logLik | -59.386 | -0.21 |
| AIC | 134.771 | 26.421 |
| BIC | 152.873 | 55.836 |
| Deviance | 22.146 | 4.182 |
| df.residual | 64 | 59 |
| nobs.1 | 71 | 71 |

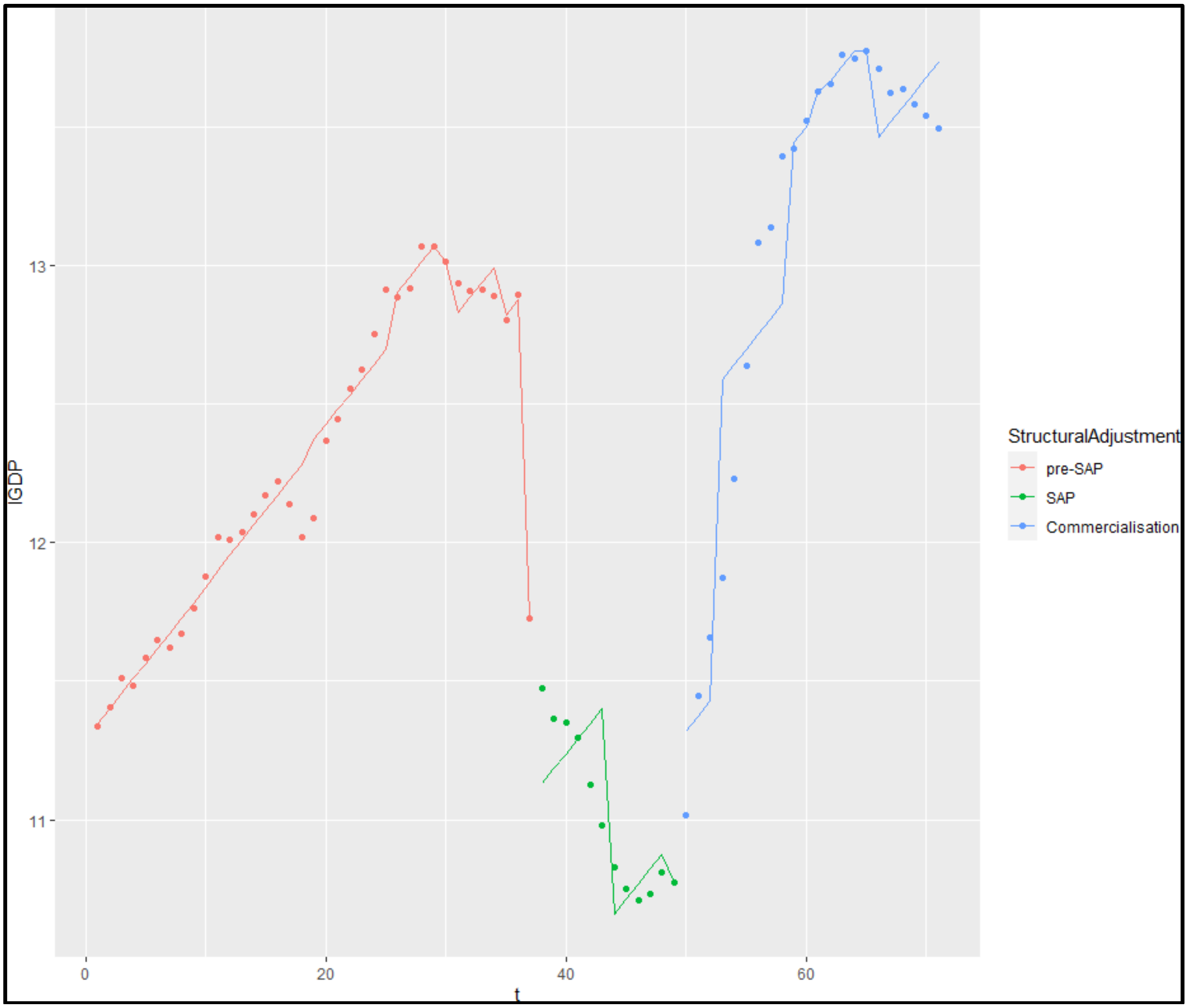


**Figure 5: GDP trends under different structural adjustment and economic management regimes**

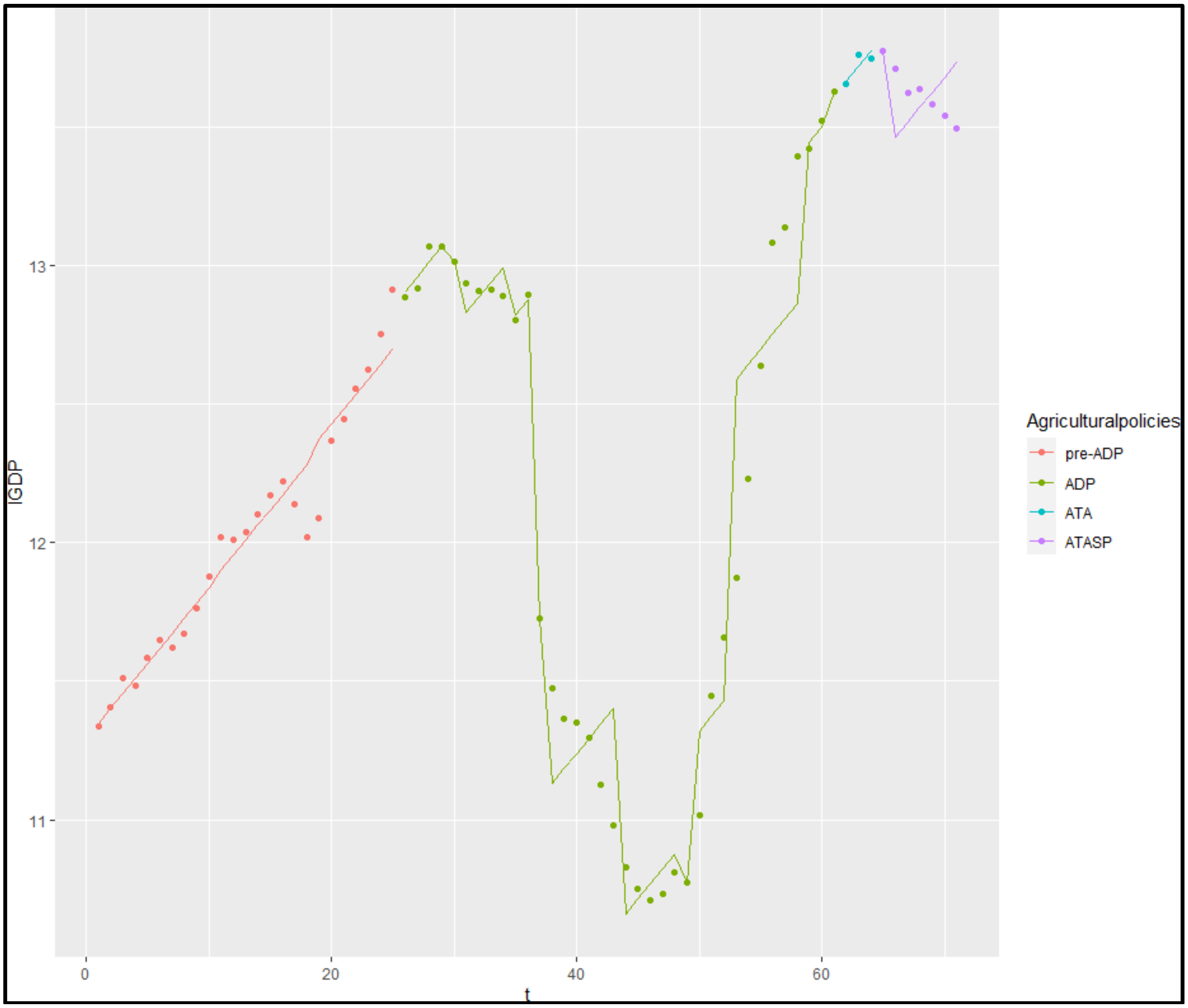


**Figure 6: Influence of alternative agricultural policy regimes on GDP growth rates**

Table 5 presents results of the model estimates for the dummies of type of rule, alternative governance arrangements, agricultural and economic policy management systems, under alternative knot distributions. The results are consistent with indications given by previous estimates and show that modelling that incorporated knots yielded more robust results and showed that the dummies for type of rule, political system, leadership, policy environment, natural disasters, and information and communications technologies (ICT) showed significant relationships with the GDP growth over the sample period, 1950-2020.

**Table 5: Model estimates of dummy variables with or without knots**

| | ARIMA | Without knots | With knots |
|---|---|---|---|
| ar1 | 0.188 | | |
| | (0.110) | | |
| ar2 | 0.352 | | |
| | (0.110) | | |
| (Intercept) | | -18869.078 | 110563.776* |
| | | (72536.590) | (42698.264) |
| bs(gdp$t, knots = NULL)1 | | 854284.172*** | |
| | | (210886.884) | |
| bs(gdp$t, knots = NULL)2 | | -597544.913*** | |
| | | (136893.721) | |
| bs(gdp$t, knots = NULL)3 | | 1120467.549*** | |
| | | (113498.959) | |
| bs(gdp$t, knots = c(16, 36, 56, 65))1 | | | -68780.660 |
| | | | (76878.058) |
| bs(gdp$t, knots = c(16, 36, 56, 65))2 | | | 157167.876** |
| | | | (54813.907) |
| bs(gdp$t, knots = c(16, 36, 56, 65))3 | | | 416525.593*** |
| | | | (67867.891) |
| bs(gdp$t, knots = c(16, 36, 56, 65))4 | | | -515921.519*** |
| | | | (57736.103) |
| bs(gdp$t, knots = c(16, 36, 56, 65))5 | | | 1276726.217*** |
| | | | (65022.901) |
| bs(gdp$t, knots = c(16, 36, 56, 65))6 | | | 495010.889*** |
| | | | (72183.889) |
| bs(gdp$t, knots = c(16, 36, 56, 65))7 | | | 654770.337*** |
| | | | (69539.831) |
| Nobs | 70 | 71 | 71 |
| Sigma | 48677.994 | 160940.767 | 61184.433 |
| logLik | -853.996 | -949.890 | -879.038 |
| AIC | 1713.992 | 1909.781 | 1776.076 |
| BIC | 1720.737 | 1921.094 | 1796.440 |
| nobs.1 | 70.000 | 71.000 | 71.000 |
| r.squared | | 0.680 | 0.957 |
| adj.r.squared | | 0.666 | 0.952 |
| Statistic | | 47.464 | 197.973 |
| p.value | | 0.000 | 0.000 |
| Df | | 3.000 | 7.000 |
| Deviance | | 1735429351741.190 | 235842692067.488 |
| df.residual | | 67.000 | 63.000 |

## 6. Conclusion

This study aimed to determine the factors that influence the GDP growth in Nigeria over the years by modelling global macroeconomic data obtained from the database of the Penn World Table's (PWT) International Comparison Programme (ICP), and a range of dummies calibrated for type of rule, economic management and governance systems. Based on the application of innovative econometric procedures, there are indications that historical GDP growth in Nigeria has been influenced by a wide range of factors and interactions, most of which have not been previously examined by conventional analysis. For instance, the role of type of rule emerged as important, and revealed that the different political systems under which Nigeria has passed over the years might have had some influence on the economic outcomes and the way they have influenced the population. The indication that Military rule may have been associated with significant positive improvements in GDP growth probably reflects the importance of some of the bold economic management policies and programmes that were introduced under at least two presidencies in the late 1980s to early 1990s. To say that a particular change occurred under a presidency may reflect what actions were undertaken under that presidency than the individual personalities involved but the role of the personal characteristics in bringing such changes about cannot be completely overlooked. That level of analysis may be of interest and can be further pursued to the extent that such information can contribute to formulation of policy to influence personality traits that are amenable to manipulation.

A rather curious finding that agricultural policies implemented over the years actually had a negative influence on GDP growth could be explained in terms of the half-heartedness of such policies. There is a strong possibility that the inordinate emphasis on the oil sector may have been accompanied by weaker than expected deployment of skills and know-how to develop and grow the other sectors of the economy in the face of the overwhelming influence of the oil sector developments. This phenomenon has been identified as the so-called Dutch Disease that manifests in a leading sector growth resulting in the decline of other sectors. If agricultural policies fail to move the agricultural sector of an economy with a large rural population and also fail to contribute positively to overall economic growth, it is difficult not to blame that on the appropriateness of such policies or the way they have been implemented. There are also indications that natural disasters and the introduction of improved information and communication technologies (ICT) have played an important role. That both dummies emerged as having positively influenced GDP growth might suggest that, in the case of natural disasters that there have been very few of these while, in the case of information and communications technologies, there have been a proliferation. Nigeria’s location on the equator means that extremes of climate are minimal in the past, without prejudice to recent changes that may be emerging as part of the climate change the world is now having to confront. Those effects are probably not yet manifesting and it will be important to investigate what lessons can be learnt from existing patterns to inform strategies to cope with climate change problems when they eventually begin to manifest. In the case of ICT, there has clearly been an explosion of this on the Nigerian society in recent years, possibly over the past decade or so. The evolution of this technology has been phenomenal. From a situation of almost complete absence of ICT in the 1970s and early 1980s expect for the largely non-functional public utilities such as P&T and NITEL with their fixed line rotary dial systems, the country experienced from the late 1990s a virtual explosion of the mobile telephone system which was followed by internet technology that has now permeated the entire society. There is no question that this has made a huge difference in the cost of doing business, among others.

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