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ESTIMATING AVERAGE VALUE OF NIGERIA GDP USING DUMMY VARIABLES REGRESSION MODEL

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ABSTRACT: *Dummy variables assign the numbers '0' and '1' to indicate membership in any mutually exclusive andexhaustive category. The number of dummy variables necessary to represent a single attribute variable is equal to the number of categories in that variable minus one. In this study, dummy variables regression analysis was applied to estimate the average GDP at various quarters; the GDP data was described and graphically presented. A regression model was estimated to determine the average value for each quarter, the seasonal component, and average GDP confidence interval. The study provides the seasonal prediction and revealed that the average GDP in the second, third and fourth quarters are not statistically difference except the first quarter. The result of the studies showed that Nigeria realised the highest income generated by productions and services in the country in the fourth quarter of every year.*

KEYWORDS: Dummy Variables, Average GDP, Seasonal Component and Time Series

INTRODUCTION

Time Series

A time series is defined as a set of data collected sequentially in time. Many economic time series based on monthly or quarterly data exhibit seasonal pattern. Often it is desirable to remove the seasonal component, from a time series so that one can concentrate on the other components, such as the trend. The process of removing the seasonal component from a time series is known as seasonal adjustment, and the time series thus obtained is called the seasonally adjusted, time series. Important economic time series, such as GDP, are usually published in seasonally adjusted form. There are several methods of deseasonalizing a time series, but in this study, based on the time series data of Nigeria GDP from 2010 to 2015, we consider the dummy variable regression model to first estimate the average value of Nigeria GDP of various quarters (from first quarter of 2010 to fourth quarter of 2015). On the other hand, this average values are used to estimate the seasonally adjusted value of the GDP.
The dummy variables techniques is only appropriate for a time series presented in additive model of the form

$$Y_t = s_t + c_t + t_t + u_t \qquad (1)$$

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where Y_t is the observed values, s_t represents the seasonal, t_t the trend, c_t the cyclical, and u_t the random component. However, if the model is multiplicative of the form

$$Y_t = (s_t)(c_t)(t_t)(u_t) \quad (2)$$

the technique of dummy variables is inappropriate (Gujarati, 2004 p. 315).

Gross Domestic Product

The Gross Domestic Product is one way to measure the well being of a state's citizen. Economic growth refers to GDP; which measure the total final output of goods and services produced by an economy, that is, within a country's territory by residents and non-residents, regardless of its allocation to domestic and foreign claims. It's calculated without making deduction for depreciation.

The World Bank reported that the GDP in Nigeria was worth 481.07 billion US dollars in 2015, represents 0.78% of the world economy. The Nigeria GDP averaged 87.05 billion US dollar from the period gained independent to 2015. In the first three months of 2016, the Nigeria GDP contracted by 0.36% year on year compared to 2. 11% expansion in previous period and below forecast of 1.7% growth. It is the first contraction since the second quarter of 2004 as the non-oil sector contracted, mainly as a result of slowdown in the service sectors due to weakening naira and lower oil prices keep dragging the oil sector down and Government revenue.

Dummy Variables

In statistics and econometrics, particularly in regression analysis, a dummy variable is an artificial variable created to represent an attribute with two or more distinct categories. It takes the value 0 or 1 to indicate the absence or presence of some categorical effect that may be expected to shift the outcome. Dummy variables are used as devices to sort data into mutually exclusive categories. In a regression model, a dummy variable with a value of 0 will cause its coefficient to disappear from the equation. Conversely, the value of 1 causes the coefficient to function as a supplemental intercept, because of the identity property of multiplication by 1. This type of specification in a linear regression model is useful to define subsets of observations that have different intercepts and/or slopes without the creation of separate models.

Charles (1970) considered five separate models to demonstrate, using numerical examples, the implications and interrelationships among various models which incorporate dummy variables. The outcome of his study reveals that

The independent estimation of each qualitative or cross sectional group will give the best possible estimates of the parameters. The R^2 will probably be lower than with other proper methods and degree of freedom may be a problem.

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The (0,1) dummy variable to allow for intercept changes is proper only if some a priori knowledge exists to justify the assertion that function are parallel.
When data are time series as well as either qualitative or cross sectional in nature, the statistical procedure should take account of both aspects

Gujarati (2004 p.305) discussed ANOVA models of the type related to dummy, although common in fields such as sociology, psychology, education, and market research, are not that common in economics. Typically, in most economic research a regression model contains some explanatory variables that are quantitative and some that are qualitative. Regression models containing an admixture of quantitative and qualitative variables are called analysis of covariance (ANCOVA) models. ANCOVA models are an extension of the ANOVA models in that they provide a method of statistically controlling the effects of quantitative regressors, called covariates or control variables, in a model that includes both quantitative and qualitative, or dummy, regressors.

Strategy researchers often make use of dummy variables to study strategic responses or orientations. McGahan and Mitchell (2003) discuss how firms change in the face of constraints to change. They argue that instead of examining the different ways in which firms respond to constraints, it is worthwhile investigating whether responses are path-independent or path-dependent. Each of these two types of responses can be represented by a dummy variable. The Makino et al. (2004) study of foreign affiliates of Japanese firms indicates that country effects are as strong as industry effects as predictors of business unit performance. Similarly, cultural influences have been found to affect performance (Barkema et al., 1996). These results suggest that country dummies or cultural block dummies may have to be included in empirical studies.

Paul and Eric (2007) discuss two approaches of entering dummy variables into a regression and their associated interpretations and some common mistakes of interpretation and hypothesis testing found in two recently published strategy papers, and highlight the advantages of their recommended approach over the approach usually adopted by management researchers. Their argument show that the partition approach will become the preferred way of entering dummy variables into a regression

Alabi (2014) incorporating dummy variables in regression model to study the average internally generated revenue and wage bill of the six geopolitical zones in Nigeria, categorized them into six using five dummy variables. From their result, it was found that only southwest and southsouth are fairly strong to revenue base while that of other four geopolitical zones are relative low to the wage bill of their workers.

MATERIALS AND METHODS

Quarterly values of Nigeria GDP in billion naira, was obtained from the Bureau of statistics of Nigeria's 2016 Statistical bulletin. In addition, dummy variables were created to categorize

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the GDP to quarterly seasonal variables (i.e Q_1, Q_2, Q_3, Q_4). The sample period was from the first quarter 2010 to fourth quarter 2015.

Dummy Variable Regression Model

The basic methodological approach was to determine the seasonal pattern in the Nigeria GDP data associated with various quarters and develop dummy variable regression model of the form.

$$GDP_t = \lambda_1 + \lambda_2 D_{t2} + \lambda_3 D_{t3} + \lambda_4 D_{t4} + u_t \quad (3)$$

where GDP_t is the observed value Nigeria GDP, and the $D_{ti}'s$ are the dummies, taking a value of 1 in the relevant quarter and 0 otherwise. The first quarter Q_1 is treated as reference quarter and assigns dummies to second Q_2, third Q_3 and fourth Q_3 quarters in order not to suppress the intercept λ_1. From the model (4), the average value of variable GDP at various quarter can be determine as follows

$$\begin{aligned} GDP_{Q1} &= \lambda_1 \\ GDP_{Q2} &= \lambda_1 + \lambda_2 \\ GDP_{Q3} &= \lambda_1 + \lambda_3 \\ GDP_{Q4} &= \lambda_1 + \lambda_4 \end{aligned} \quad (4)$$

where GDP_{Qi} is the average of GDP from each quarter, λ_1 is the intercept from the dummy variable regression model, $\lambda_2, \lambda_3, \lambda_4$ are the "slope" coefficients of the dummy variables which tell how mush average GDP in each quarter differ from the reference quarter (i.e first quarter). The 95% confidence interval of the average GDP also can be estimated using

$$CI = \mu_i \pm z_{(1-\alpha)}\sigma$$

where μ_i is the average GDP value at various quarters, $z_{(1-\alpha)}$ probability value at 95% confidence interval and σ_{se} is the standard error of the coefficients and the statistical significance of the models coefficients can be determine base on below hypothesis statement

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2.2 Hypothesis statement

$H_0 : \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$ i.e no significant difference

$H_1 : \lambda_i \neq 0$ i.e at least one coefficient is difference

Decision Rule: Reject H_0 if P-value < 0.05

Jarque–Bera (JB) Test of Normality

The JB test of normality based on the OLS residuals. This test first computes the skewness and kurtosis measures of the OLS residuals and uses the following test statistic (20)

$$JB = n\left[\frac{S^2}{6} + \frac{(k-3)^2}{24}\right]$$

where n = sample size, S = skewness coefficient, and K = kurtosis coefficient. For a normally distributed variable, S = 0 and K = 3. Therefore, the JB test of normality is a test of the joint hypothesis that S and K are 0 and 3, respectively. In that case the value of the JB statistic is expected to be 0. Under the null hypothesis that the residuals are normally distributed. If the computed p value of the JB statistic in an application is sufficiently low, which will happen if the value of the statistic is very different from 0, one can reject the hypothesis that the residuals are normally distributed. But if the p value is reasonably high, which will happen if the value of the statistic is close to zero, we do not reject the normality assumption.

RESULT AND DISCUSSION

The analysis is carried out using R statistical package and the results are summarized as follows:

Descriptive Statistics

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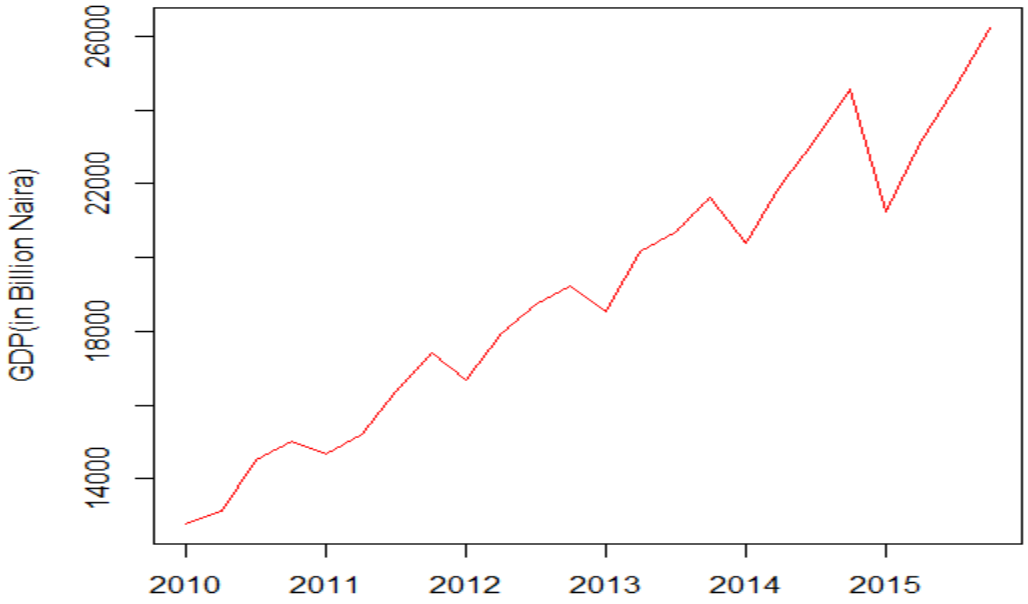

Figure 2:GDP 2010 - 2015 (quarterly)

Description of the Data

N	Mean	Median	SD	Skewness	Kurtosis
24	19088	18978	3810.4	0.06	-1.15

Figure 1 contains graphical presentations of Nigeria GDP. The variable exhibits strong upward movement with seasonal spikes. Also the descriptive statistics look symmetric, as indicated by the skewness which is closer to zero (0.06), the kurtosis is -1.15, while the Jarque-Bera statistics suggests that the null hypothesis of normality has no sufficient reason to be rejected with p-value of 0.6094. The GDP series is centred on a mean, median and standard deviation of 19088, 18978, and 3810.4 respectively.

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Regression model

$$\hat{GDP}_t = 17383 + 1205D_{t2} + 2314D_{t3} + 3300D_{t4} \quad (5)$$

$$t-valu = (11.04)\ \ (0.54)\ \ \ (1.04)\ \ \ (1.48)$$

$$p-value = (0.00)\ \ (0.59)\ \ \ (0.31)\ \ \ (0.15)$$

Table 1: Average value of GDP in Nigeria at various quarters

Quarters	Year 2015 GDP (in billion naira)	Average GDP (in billion naira)	Average GDP Confidence Interval (in billion naira)
Q_1	21243	17,383	14099, 20668
Q_2	23081	18588	10658, 26517
Q_3	24628	19697	11768, 27627
Q_4	26227	20683	12753, 28612

Table 2: GDP, Seasonal Component and Remainder

Year	Qtr	GDP	Seasonal variation	Remainder	Year	Qtr	GDP	Seasonal variation	Remainder
2010	I	12790	17383	-4592.66	2013	I	18522	17383	1139.15
	II	13142	18588	-5446.44		II	20150	18588	1561.73
	III	14517	19698	-5180.94		III	20704	19698	1006.29
	IV	15021	20683	-5661.78		IV	21634	20683	951.62
2011	I	14686	17383	-2696.93	2014	I	20382	17383	2998.86
	II	15230	18588	-3358.14		II	21957	18588	3369.51
	III	16369	19698	-3328.62		III	23233	19698	3535.29
	IV	17429	20683	-3254.13		IV	24565	20683	3882.16
2012	I	16675	17383	-707.94	2015	I	21243	17383	3859.5
	II	17968	18588	-619.64		II	23081	18588	4492.97
	III	18735	19698	-962.23		III	24628	19698	4930.22
	IV	19221	20683	-1461.74		IV	26227	20683	5543.87

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DISCUSSION

From the above results, the estimated constant value of the regression model is the average GDP value (17383) for the first quarter, since the first quarter is the reference or benchmark quarter, the coefficients of the dummies i.e 1205, 2314 and 3300 are the differences between the first quarter and second, third, fourth quarter respectively. The probability value from the analysis show that the coefficients of the dummies are statistically significant at 5% significant level, as their p-values are 59%, 31% and 15% respectively. Therefore, the values of GDP at various quarters are not statistically difference except the first quarter that is significant but numerically, it can be seen that the GDP from fourth seasonal quarter has the highest value follow by third, second and first quarters respectively. Therefore, the Nigeria GDP normally increases toward the end of every seasons (years) i.e October, November and December. Comparing the estimated average GDP confidence interval value to the observed 2015 GDP at various quarters, it can be found that the observed GDP value which is published by the National Bureau of Statistics of Nigeria were fall in the 95% GDP confidence interval except the first quarter value that is higher than the maximum GDP value in the first quarter confidence interval, so it is a successful average value.

Table 2 presents the seasonal variation of the GDP which estimated from model (5) and seasonally adjusted GDP which are simply residuals (remainder) from the regression model (5). This residual is the one refer to the remaining components of the Nigeria GDP time series, known as, trend, cycle and random component. While figure 2 display their movement patterns.

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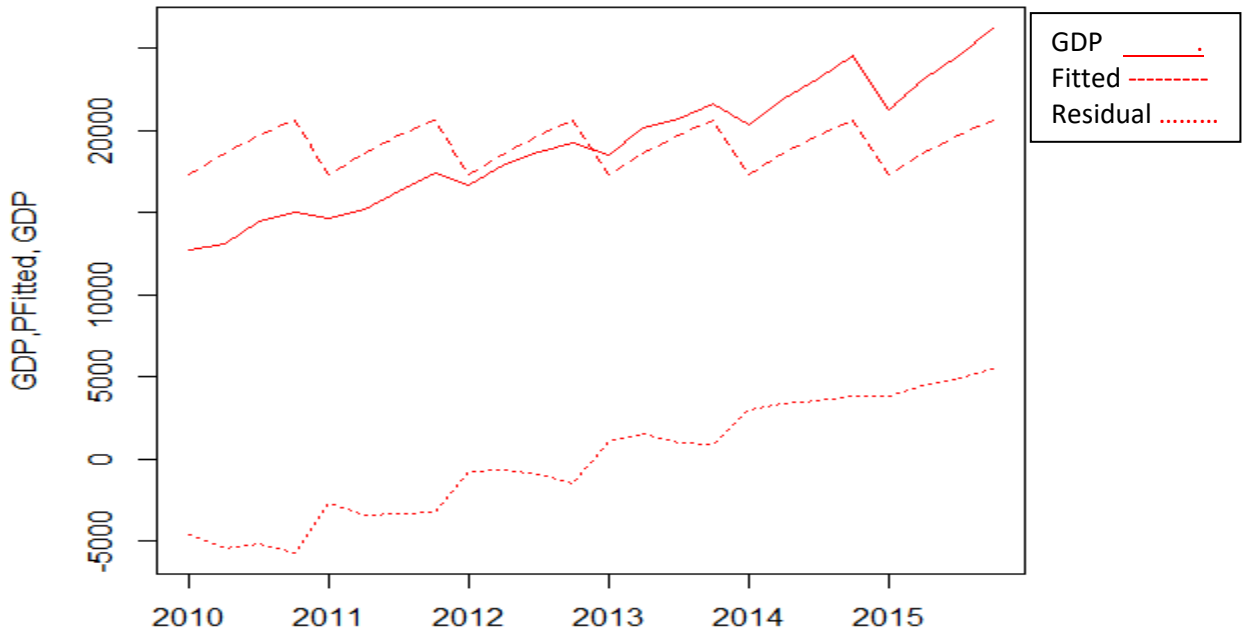

Figure 2:GDP, Fitted and Residual 2010 - 2015 (quarterly)

CONCLUSION

This study estimating the average Nigeria GDP at various seasonal quarters. The GDP data from 2010 to 2015 were categorized into four quarters (Q_1, Q_2, Q_3 and Q_4) using dummy variables. The regression analysis carried out with the dummy variables show that the average GDP in the second, third and fourth quarters are not statistically difference. Assessing the average GDP value numerically, the fourth quarter provides the highest average GDP. Therefore, Nigeria government use to realise highest income generated by production in the country in the fourth quarter of every year.

CONTRIBUTION TO KNOWLEDGE

This study provides information on average Nigeria GDP at various quarters. It is extremely useful in formulation of policies regarding to Nigeria economy.

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REFERENCE

[1] Alabi Oluwapelumi "Incorporating Dummy Variables in Regression model to Determine Average Internally Generated Revenue and Wage Bills of the Six Geopolitical Zones in Nigeria

[2] Barkema, H. G., Bell, J. H. and Pennings, J. M. 'Foreign Entry, Cultural Barriers, and Learning', Strategic Management Journal, 1996 17: 151 66.

[3] Charles Sappington "A Numerical Example of the Practical Use of Dummy Variables". Southern Journal of Agricultural Economics, 1970.

[4] Makino, S., Isobe, T. and Chan, C. M. 'Does Country Matter' Strategic Management Journal , 2004 25: 1027–43

[5] McGahan, A. M. and Mitchell, W " How Do Firms Change in the Face of Constraints to Change Toward an Agenda for Research on Strategic Organization", Strategic Organization , 2003 1: 231–9

[6] Paul S. L. Yip and Eric W. K. Tsang "Interpreting Dummy Variables and their Interaction effects in Strategy Research", Strategic Organization, 2007 Vol 5(l)

Print ISSN: ISSN 2055-0154(Print), Online ISSN: ISSN 2055-0162(Online)