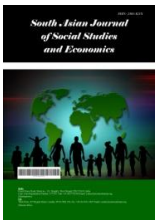

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# Poisson Regression Analysis on Economic Determinants of Commercial Banks Branches Expansion in Nigeria

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***Author's contribution***

*The sole author designed, analysed, interpreted and prepared the manuscript.*

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## ABSTRACT

This research work focused on economic determinants that contribute to Commercial Banks Branches Expansion in Nigeria from 1988–2016 covering 29 years. This study used secondary data extracted from the Central Bank of Nigeria Statistical Bulletin, 2016 and the Poisson Regression Analysis was used in the analysis. Based on the analysis from this work, it was discovered that there was a strong relationship existing between commercial banks branches expansion, population growth rate, bank assets, savings deposit and gross domestic product growth rate. Therefore, this study concludes that population growth rate, bank assets, savings deposit and gross domestic product growth rate influence commercial banks branches expansion in Nigeria. Finally, a recommendation was made that commercial banks management should consider these factors- population size of the area of interest, the bank asset, savings deposit and economic activity of the area of interest before the location of a branch.

*Keywords: Bank; expansion; poisson; regression.*

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## 1. INTRODUCTION

The banking sector is regarded as the heart of any country's economic growth and development by channelling funds from the surplus sector to the deficit sector of the economy. To deliver their services to customers, banks make use of different services outlet which comes in the form of branches (physical and e-branch) and other electronic services point.

Nevertheless, the commercial banking industry in Nigeria has become the fastest-growing sector of the economy, with a total branch network of 752 in 1980 to 5512 branch network in 2016. Despite the number of branches in Nigeria, the country is still underbanked judging from access of the population to banking facilities. Equally, the banking penetration level in Nigeria is low due to lack of access to financial services and the cost of banking services. This low trend could be attributed to banking charges and the difficulties experienced in the opening account by the underbanked public.

However, several factors have contributed to the expansion of commercial banks branches in Nigeria ranging from political factors, comparative strategies and economic factors. Therefore, the focus of this research work, we will be to determine how economic factors such as population growth rate, bank assets, savings deposit and gross domestic product growth rate, influence commercial banks branches expansion in Nigeria within the period of interest, from 1988-2016 covering 29 years. This research work is based on the data extracted from the Central Bank of Nigeria Annual Statistical Bulletin, 2017.

## 2. LITERATURE REVIEW

The expansion of commercial banks branches in Nigeria can be hinged on theories of firm growth and expansion. The Resource-based theory emphasizes that there are unlimited opportunities for firms in the marketplace; therefore firms' focus on sources of resources such as financial resources and expansion of business activities [1]. However, the classical economists believe that growth of a firm is as a result of change between on equilibrium situation and another, as firm searches for an optimum and most efficient size a negative relationship exist between a firm's size and growth. The behaviour economists' highlights that conflicts in the business objectives between the owners and managers of a firm can result in the oversize of the firm dues to managers' interests to maximize their value instead of firm's objectives. Also, stochastic economists' theory is of the view that the size and growth of a firm are determined by pure chance. That size is a reflection of cumulative random shocks over a period of time.

Nevertheless, [2] in their work, "Determinants of Branch Network of Commercial Banks in Kenya: A Survey of Commercial Banks in Kisii County, Kenya". They applied a method of descriptive statistics to establish that numbers of businesses in an area, the culture of the people, preferences and population size are the key variables to be considered when establishing commercial banks branches in Kenya.

Also, [3] applied both descriptive and discriminant analysis in their study, "The Analysis of Thai Commercial Banks Branches Expansion Factors including Leadership, Location, Cost and Economics". They identified factors that determine commercial banks branches expansion to be organizational leaders, external economic factors to include consumer behaviour, demographics of selected communities, population density and national income.

Furthermore, [4] investigated "Branch Expansion of Commercial Banks in Rural America" by applying the nested logit model to understand factors that drive expansion. They established that location of head office, loan to deposit, agricultural loan rate and profitability had a positive impact on the decision for commercial banks to expand their branch network.

Likewise, [5] in his work "Determinants of Financial Inclusion in Sub-Saharan Africa Countries: Does Institutional Infrastructure Matter?" He used the general method of moments to analyze his work and discovered that institutions, GDP per capita, bank concentration and inflation rate determine the extent of financial inclusion.

Equally, [6] in their study "Determinants of Bank Branch Expansion in Italy" a method of probit regression was applied and they found that market structures, past branch expansion and other hidden factors have a strong effect on branching in the de novo branch model.

Additionally, [7] studied "Spatial Analysis of the Distribution and Determinants of Bank Branch Presence in Ghana". They adopted a spatial analysis tool of weighted Poisson regression to critically assess Ghana's banking sector. The

concluded that population size, percentage urban residents, workforce size and literacy level determine a bank allocation of branches in Ghana.

## 3. RESEARCH DESIGN AND METHOD

The method of non-linear multiple regression was adopted since the dependent variable (bank branches expansion) is discrete. Therefore, the Poisson regression was used to determine the effect of population growth rate; commercial bank assets, savings deposit and gross domestic product growth on commercial banks branches expansion in Nigeria. Secondary data from the 2017 Statistical Bulletin of Central Bank of Nigeria was used for this study. Nonetheless, all variables for this study were subjected to both statistical and econometric tests (unit root test, normality test, cointegration test and Granger causality test) to avoid spurious relationships between the dependent and independent variables used in this research work. Also, descriptive statistics of the variables were computed to understand their behaviours.

### 3.1 The Poisson Distribution

The Poisson distribution is a discrete probability distribution that models the probability of y events that are countable (discrete) out of n trials with the formula;

$$\Pr(Y = y/\mu) = \frac{e^{-\mu}\mu^{y}}{y!} \quad (1)$$

($y_i$ = 0,1,2,…)

In Poisson distribution, the mean and variance are equal and it has a single parameter μ [8].

### 3.2 Multiple Regression

This is an extension of the simple linear regression. It studies the relationship between several independent variables [9].

The model for multiple regression is given as;

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + ... + \beta_k X_{ki} + \varepsilon_i \quad (2)$$

Where

$Y_i$ = the dependent or response variable
$X_i$ = the independent variable
$B_i$ = the parameters of the independent variables
$B_0$ = the intercept parameter
$\varepsilon_i$ = the error term associated with the model

### 3.3 The Poisson Regression

The Poisson regression is a non-linear multiple regression model where the dependent variable (*Y*) is an observed count that follows the Poisson distribution. Thus, the possible values of Y are the non-negative integers. The Poisson Regression reports on the regression equation as well as the goodness of fit, confidence limits, likelihood and deviance [10]. It is used to model count. In Poisson Regression, suppose that the Poisson incidence rate *μ* is determined by a set of *k* regression variables (the X's). The expression is;

$$\mu_i = E(Y_i) = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + ... + \beta_k X_{ki} \quad (3)$$

$\beta_1$ is the intercept while the regression coefficient $\beta_2, \beta_3, ..., \beta_k$ are unknown parameters that are estimated from the data.

Hence the Poisson Regression model for an observation 'i' is written as;

$$Y_i = \frac{\mu^{Y} e^{-\mu}}{Y!} + \varepsilon_i \quad (4)$$

That is, for a given set of values of the independent variables the outcome follows the Poisson distribution.

### 3.4 Model Estimation

The model for estimation in this study is:

$$\mu_i = Ln(CBE_i) = \beta_1 + \beta_2 PGR_i + \beta_3 BAS_i + \beta_4 SDP_i + \beta_5 GGR_i \quad (5)$$

Where CBE = Annual Total Commercial Banks Branches Expansion. This is defined as the number of additional commercial banks branches added to the existing number of branches per annum $CBE = Y_t - Y_{t-1}$. Y = Total number of existing commercial banks branches per annum.

PGR = Annual Population Growth Rate of Nigeria (%)

BAS = Annual Total Commercial Banks Assets (Naira)

SDP = Annual Total Savings Deposits in Commercial Banks (Naira)

GGR = Annual Gross Domestic Product Growth Rate of Nigeria (%)

The expected behaviours of these parameters are: $\beta_1 \succ 0, \beta_2 \succ 0, \beta_3 \succ 0, \beta_4 \succ 0, \beta_5 \succ 0$

Decision Rule: Reject $H_o$ if P-value < α, otherwise do not reject.

## 4. RESULTS AND DISCUSSION

### 4.1 Descriptive Analysis of the Variables

The descriptive statistics of the variables within the period of interest in Table 1 shows that annual commercial banks branches expansion within the period is average of 139 branches per annum with a variance of 139 branches also. Therefore, CBE satisfied the condition of Poisson distribution, this means the mean is equal to the variance. The mean population growth rate is 2.58%. Commercial banks assets is 7.33 Trillion Naira on the average while mean savings deposits in commercial banks are 798 Billion Naira. The gross domestic product grew at an average of 5.63% within the period. Except for commercial branches expansion with negative skew, all other variables are positively skewed.

Table 2 shows that samples of the dependent variable, Commercial Banks Branches Expansion (CBE) follow a Poisson distribution since the p-value of 0.14 is greater than the critical value 0.05. Therefore the null hypothesis cannot be rejected.

### 4.2 Normality Test

The Jarque-Bera test of normality shows that both commercial banks branches expansion and annual savings deposits are not from a normally distributed population, while annual population growth rate, commercial banks assets and annual gross domestic product growth rate are normally distributed with their p-values less than the significance level of 0.05.

### 4.3 Unit Root Test

The result of the common unit root test in Table 4 shows that the p-values are greater than the hypothesized significance level of α (0.05) this implies that the variables are not stationary at level while in Table 5, the p-values are less than the selected significance level of α (0.05), which indicates that the variables are stationary after first differencing and they are integrated to order 1.

### 4.4 Cointegration Test

The Trace and Eigenvalue tests result in Tables 6 and 7 respectively indicate two co-integrating equations. This also shows that in the long run, there is a strong relationship existing among the variables.

### 4.5 Granger Causality Test

The pairwise Granger causality test result in Table 8 shows significant relationships. From the commercial bank's branches expansion (CBE) granger causes population growth rate (PGR). Also, commercial banks branches expansion (CBE) granger causes savings deposit. Also,

**Table 1. Descriptive statistics**

| Variable | Mean | Median | Maximum value | Minimum value | Standard deviation | Skewness |
|---|---|---|---|---|---|---|
| CBE | 139.00 | 83.00 | 2125.00 | -2384.00 | 11.79 | -0.87 |
| PGR | 2.58 | 2.60 | 2.70 | 2.50 | 0.08 | 0.32 |
| BAS | 7334348 | 2766880 | 31682824 | 58027.20 | 8858485 | 1.03 |
| SDP | 798980.1 | 244064.1 | 3674544 | 7122.70 | 1056879 | 1.34 |
| GGR | 5.63 | 6.220 | 14.60 | -0.55 | 3.56 | 0.35 |

*Source: Authors computation*

**Table 2. Test of CBE Samples following a poisson distribution**

| **Chi-square test:** | |
|---|---|
| P-value) | 0.1387 |
| alpha | 0.05 |
| **Test interpretation:** | |
| H0: The CBE sample follows a Poisson's distribution | |
| Ha: The CBE sample does not follow a Poisson's distribution | |

*Source: Authors computation*

**Table 3. Normality test results of the variables**

| Variable | Jarque Bera | P-value |
|---|---|---|
| CBE | 68.08683 | 0.0000 |
| PGR | 2.642621 | 0.2668 |
| BAS | 5.159126 | 0.0758 |
| SDP | 9.086542 | 0.0106 |
| GGR | 0.604612 | 0.7391 |

*Source: Authors Computation*

**Table 4. Group unit root test (At Level)**

| Method | Statistic | Prob.** | sections | Obs |
|---|---|---|---|---|
| **Null: unit root (assumes common unit root process)** | | | | |
| Levin, Lin & Chu t* | 10.1533 | 1.0000 | 5 | 135 |
| **Null: unit root (assumes individual unit root process)** | | | | |
| Im, Pesaran and Shin W-stat | 5.72663 | 1.0000 | 5 | 135 |
| ADF - Fisher Chi-square | 15.3185 | 0.1209 | 5 | 135 |
| PP - Fisher Chi-square | 15.0655 | 0.1297 | 5 | 140 |

*Source: Authors Computation*

**Table 5. Group unit root test (After first difference)**

| Method | Statistic | Prob.** | sections | Obs |
|---|---|---|---|---|
| **Null: unit root (assumes common unit root process)** | | | | |
| Levin, Lin & Chu t* | -1.83504 | 0.0333 | 4 | 101 |
| **Null: unit root (assumes individual unit root process)** | | | | |
| Im, Pesaran and Shin W-stat | -4.89518 | 0.0000 | 4 | 101 |
| ADF - Fisher Chi-square | 57.7112 | 0.0000 | 4 | 101 |
| PP - Fisher Chi-square | 66.4468 | 0.0000 | 4 | 108 |

*Source: Authors Computation*

**Table 6. Trace test**

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.855230 | 114.2919 | 69.81889 | 0.0000 |
| At most 1 * | 0.738082 | 62.11139 | 47.85613 | 0.0013 |
| At most 2 | 0.414179 | 25.93890 | 29.79707 | 0.1305 |
| At most 3 | 0.302390 | 11.50089 | 15.49471 | 0.1825 |
| At most 4 | 0.063741 | 1.778313 | 3.841466 | 0.1824 |

*Source: Authors Computation*

savings deposit (SDP) granger causes bank Asset (BAS). This infers that there is a unilateral direction relationship existing among these variables in the table.

## 4.6 Model Estimation

$$\hat{\mu}_i = Ln(CBE) = 6.29 - 0.76PGR + 0.00BAS - 0.00SDP + 0.15GGR$$

Taking the anti-log of the coefficients:

The model is

$$CBE = 539.15 + 0.47PGR + 1.00BAS + 1.00SDP + 1.16GGR$$

**Population Growth Rate (PGR):** Since the p-value (0.0076) < α (0.05), it means that population growth rate has a positive significant relationship with commercial banks branches expansion. The anti-log result shows if population growth rate changes by one per cent (1%), expansion of commercial banks branches will increase by 0.47%.

**Bank Asset (BAS):** The estimated result shows that the p-value (0.0000) < α (0.05) which implies a positive significant relationship with commercial banks branches expansion and for 1 billion naira increase in bank assets, the expansion of commercial banks branches will increase by one.

**Savings Deposit (SDP):** From the result of the analysis, the p-value (0.0000) < α (0.05) this also indicates a positive significant relationship with commercial banks branches expansion and for 1 billion naira change in savings deposit, the expansion of commercial banks branches will increase by one.

**Gross Domestic Product Growth Rate (GGR):** The p-value (0.0000) < α (0.05) this also indicates a positive significant relationship with commercial banks branches expansion and for 1% change in gross domestic product growth rate, the expansion of commercial banks branches will increase by 1.16%.

## 4.7 Discussion of Result

This study, Poisson regression analysis on economic determinants of commercial banks branches expansion in Nigeria focused mainly to determine economic factors the drive commercial banks branches expansion in the country. The annual data for the period of 1988 to 2016 were obtained from the Central Bank of Nigeria Statistical Bulletin. Therefore, the descriptive analysis in Table 1 shows that the average annual expansion of commercial banks branches was 139 branches and satisfies the condition for the application Poisson regression.

Also, the test of normality in Table 3 shows that both commercial banks branches expansion and annual savings deposits are not from a normally distributed population, while annual population growth rate, commercial banks assets and annual gross domestic product growth rate are normally distributed with their p-values less than the significance level of 0.05.

Additionally, the common unit root test in Table 5 shows that the variables are stationary after first differencing and they are integrated to order 1 since the p-values are less than the selected significance level of α (0.05).

Equally, the cointegration tests results in Tables 6 and 7 show that a strong long-run relationship exists among all the variables in the model. More so, the pairwise Granger causality test results in Table 8 shows that the commercial bank's branches expansion (CBE) granger causes population growth rate (PGR), this means that establishment of commercial banks branches in a location will attract more people to the location area. Also, commercial banks branches expansion (CBE) granger causes savings deposit; this shows that locating branches of commercial banks will drive savings deposits upwards. Also, savings deposit (SDP) granger causes bank Asset (BAS), this indicates that as savings deposits increase, assets of commercial banks increase too in Nigeria.

Ansong et al. [11] worked using the same method and they pointed out that the banks need to re-envision branch banking technology to make branch banking more interactive. Banks need to find ways to fuse transferable elements of mobile phone banking into branch-based banking, not just to attract younger technology-savvy customers but also to help make operations more attractive, efficient, and cost effective. According to Kodongo [12] the empirical strategy using Poisson regression with Kenya as the source country revealed that the follow-the-client hypothesis is relatively muted in the East African banking arena.

**Table 7. Eigen value test**

| Hypothesized No. of CE(s) | Eigenvalue | Max-eigen statistic | 0.05 Critical value | Prob.** |
|---|---|---|---|---|
| None * | 0.855230 | 52.18053 | 33.87687 | 0.0001 |
| At most 1 * | 0.738082 | 36.17249 | 27.58434 | 0.0031 |
| At most 2 | 0.414179 | 14.43801 | 21.13162 | 0.3302 |
| At most 3 | 0.302390 | 9.722577 | 14.26460 | 0.2308 |
| At most 4 | 0.063741 | 1.778313 | 3.841466 | 0.1824 |

*Source: Authors Computation*

**Table 8. Pairwise granger causality test**

| Null hypothesis | Obs | F-statistic | Prob. |
|---|---|---|---|
| CBE does not granger cause PGR | 27 | 11.5565 | 0.0004 |
| CBE does not Granger cause SDP | 27 | 7.70293 | 0.0029 |
| SDP does not Granger cause BAS | 27 | 10.1187 | 0.0008 |

*Source: Authors Computation*

**Table 9. Model estimation result**

| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
|---|---|---|---|---|
| C | 6.294512 | 0.722505 | 8.712063 | 0.0000 |
| PGR | -0.761175 | 0.285174 | -2.669161 | 0.0076 |
| BAS | 2.56E-07 | 6.64E-09 | 38.60234 | 0.0000 |
| SDP | -2.54E-06 | 6.40E-08 | -39.72536 | 0.0000 |
| GGR | 0.145257 | 0.003487 | 41.65213 | 0.0000 |

*Source: Author's Computation*

**Table 10. Anti-log result of coefficients**

| Variable | Anti-log |
|---|---|
| C | 539.15 |
| PGR | 0.47 |
| BAS | 1.00 |
| SDP | 1.00 |
| GDP | 1.16 |

*Source: Authors Computation*

Consequently, from the estimated model**,** the population growth rate has a positive significant relationship with commercial banks branches expansion. This is confirmed by the works of Ariambe and Muturi [2], Meesrichan and Fungsuwan [3] and Ansong, Chowa and Adjabeng [7] that population growth and size influence branch expansion by commercial banks in the country. Therefore, as the population of an area grows considerably, commercial banks are most likely to locate their branches there. Equally, commercial banks assets show a positive significant relationship with commercial banks branches expansion and this is supported by the work of Nam and Ellinger [4] that increase in commercial banks assets help to drive branches expansion. This means that as assets increase, commercial banks will be willing to establish new branches. More so, savings deposits in commercial banks have a positive significant relationship with commercial banks branches expansion and this shows that growth in savings deposits will influence commercial banks to create more branch networks. Additionally, the gross domestic product growth rate has a positive significant relationship with commercial banks branches expansion and this is in line with the work of Meesrichan and Fungsuwan [3]. This depicts that as the economy grows leading to a high rate of economic activities, commercial banks in Nigeria will be willing to add more branches to their networks.

## 5. CONCLUSION

Commercial banks play a key role in the economic development of any nation by promoting savings, mobilization of savings, allocation of funds, promotion of trade, production and investment, and credit creation. Therefore, bringing banking facilities closer to people becomes important to mobilize surplus funds from the unbanked and extend these surplus funds to those that need them for production and investments.

Therefore, this work discovered that some economic factors such as savings deposits, population growth, bank assets, GDP growth rate are good determinants of commercial banks branches expansion in Nigeria. This implies that owners and managers these commercial banks should consider these factors while taking decisions on increasing the branch network of their commercial banks in the nearest future.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

## REFERENCES

1. Gupta PD, Cuha Sampti, Shiva Subramanian Krishnaswani. Firm growth and determinants. Journal of Innovation and Entrepreneurship. 2013;2:15. DOI:10.1186/2192-5372-15
2. Ariambe Joseph Kipkemboi, Muturi Willy. Determinants of branch network of commercial banks in Kenya: A survey of commercial banks in Kisii County, Kenya. International Journal of Economics, Commerce and Management. 2015; 111(6).
3. Meesrichan Sittichai, Fungsuwan Wanno. The analysis of thai commercial banks branch expansion factors including leadership, location, cost and economics. Research Journal of Business Management. 2014;8(4):552-565.
4. Nam Sangjeong, Ellinger Paul N. Branch expansion of commercial banks in rural America. A Selected Paper Presented at

the American Agricultural Economics Association Annual Meeting. Orlando, FL. 2008;27-30.
5. Ajide Kazeem B. Determinants of financial inclusion in Sub-Saharan Africa Countries: Does Institutional Infrastructure Matter? CBN Journal of Applied Statistics. 2017; 8:2.
6. Calcagrani Giorgio, De Bois Ricardo, Hester Donald D. Determinants of bank branch expansion in Italy. A Paper Presented at 40th Societa Italiana Degli Economisti Meeting held at the University of Amcona. 1999;29-30.
7. Ansong David, Chowa Gina, Adjabeng Bernard. Spatial analysis of the distribution and determinants of bank branch presence in Ghana. International Journal of Bank Marketing; 2015.
8. Hogg RV, McKean JW, Craig AT. Introduction to mathematical statistics. 6th Edition, Pearson Educational International, USA; 2005.
9. Nwachukwu VO. Principles of Statistical Inference. 3rd Edition, Zelon Enterprises, Port-Harcourt, Nigeria; 2008.
10. Hogg RV, Tanis EA. Probability and statistical inference. 8th Edition, Pearson Education International, USA; 2010.
11. Ansong D, Chowa G, Adjabeng BK. Spatial analysis of the distribution and determinants of bank branch presence in Ghana. International Journal of Bank Marketing. 2015;33(3):201-222.
12. Kodongo O. What drives cross-border bank expansion? Answers from Kenya. Economic Research South Africa (ERSA) Working Paper. 2016;584.



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