

International Journal of Statistics and Applied Mathematics

ISSN: 2456-1452
Maths 2021; 6(4): 90-94
© 2021 Stats & Maths
www.mathsjournal.com
Received: 23-04-2021
Accepted: 08-06-2021

Nnadede Augustine Chinatu
Department of Macroeconomic
Analysis National Bureau of
Statistics, Abuja, Nigeria

Dr. Obini Nweze
Department of Statistics,
Nassarawa State University,
Keffi, Nigeria

Corresponding Author:
Nnadede Augustine Chinatu
Department of Macroeconomic
Analysis National Bureau of
Statistics, Abuja, Nigeria

Interregional multiple regression models of inflation rates in Nigeria

Nnadede Augustine Chinatu and Dr. Obini Nweze

DOI: <https://doi.org/10.22271/math.2021.v6.i4b.710>

Abstract

The differences in inflation rates in the regions of Nigeria occur with little or no attention paid to it but all effort is concentrated on the national inflation rates. Regions of Nigeria are as large as some countries of Africa and as a result it became imperative to look at the contribution of each of the region's inflation rates to the national rates. Original prices data collected by the National Bureau of Statistics of Nigeria was used to produce state price index series. This research made use of the state price index series to compute state inflation rates for all the states. The already existing regional structure of the country was utilized and average inflation rates of states under each region was computed and used to generate a multiple regression model of inflation rate for the regions. The study was able to discover that not all the regions contribute to the rise in inflation rates in Nigeria. From the research also, it was discovered that North West and South East regions have minimum contributions to the rising inflation rates in Nigeria during the period under study.

Keywords: Consumer price index, inflation rate, household expenditure, multiple regression models, classification of individual consumption by purpose (COICOP)

1. Introduction

The regional structure of Nigeria is mostly in the line of religion, culture and size of the population; this has made it possible for consumption patterns and production capabilities to differ across the regions. It is based on these assumptions that this study on variations or otherwise of interregional inflation rates is being embarked upon. The consumer price index which is used to compute inflation rates will lead the process for this study. The Consumer Price Index measures changes in the average level of retail prices of goods and services paid by consumers over time; this is an internationally accepted practice which Nigeria has adopted a long time ago. High inflation rates create high level of uncertainty, thereby reducing incentives for investment for the consuming public. It also reduces the competitiveness of domestic exports. Note also that high inflation is also a social problem because salary earners will directly feel its impact. The low income earners are the most vulnerable to inflation because their wages are relatively low. In this case, they will start to demand for increase in their wages.

In 2004, a comprehensive price index manual: Theory and practice was published by International Labour Office (ILO), with the cooperation of a number of other international Organization. IMF CPI hand book (2) page. Consequently, it is of great interest to government, labour unions, business organization, research institutions and the general public. In Nigeria, the consumer price index (CPI) is mainly used by Government as an important fiscal tool for the yearly budget. Some institutions such as the National Accounting Standard Board of Nigeria use it as a deflator. The Labour Unions, other agencies and individuals settling disputes on contract agreements over periods utilize the CPI as a reference. In view of the foregoing, various aspects of the methodology had been examined and re-examined from time to time.

The index relates to all households living in the urban and rural areas in Nigeria except those in institutional homes such as old people and motherless homes. According to consumer price index (CPI) report of National Bureau of Statistics (NBS), a comprehensive national statistical frame of market outlets was compiled and Price

collection outlets were selected from the frame. About 835 products specifications are to be priced in each centre for computation and this form the CPI basket.

Research works have been undertaken concerning inflation rates. Some have compared countries inflation rates, others doing trend analysis of inflation rate over a long period of time, but it seems that much work has not been done on interregional comparison of inflation rates. The study will rely mainly on official assignment and experience gathered while carrying out daily price statistics compilation work.

Michael McCracken (May 2018), in his work “Monetary Policy and Regional Inflation” said that the Federal Reserve has a dual mandate from congress loosely stated as “full employment” and “Price Stability”. There are many ways to define and evaluate these mandates, but most shares one thing in common: They consider the U.S. as a whole, ignoring any idiosyncrasies present among Regions, States and even cities.

As such, it is possible that monetary policy works on aggregate despite not having the intended effects in a particular geographic portion of the country’s Inflation across Regions.

In a 2015 post, Alejandro Badel and Joseph McGillicuddy investigated the differences in consumer Price Index (CPI) based Inflation rates across the four Regions: Western Region, Midwestern Region, North Eastern Region and Southern Region.

At the time, aggregate Inflation for the Nation was slightly above zero, but among the four Regions, only the Western Region exhibited positive levels of Inflation. The other three regions had essentially zero inflation or were even exhibiting a bit of inflation. These differences were largely the result of higher energy – and shelter – driven inflation in the western region. Obviously, national inflation reports need not accurately represent price movements in any specific part of the country.

National Policy versus Regional Needs: This comparison is just one example of how inflation levels differ across geographic areas within the U.S. even between cities in the same region of the country.

As such, it reminds us that monetary policy is a blunt tool. Policy makers at the federal are unable to address separately the heterogeneous economic conditions that exist among the different parts of this large diverse country.

In a study “An Econometric Model for Inflation Rates in the

Volta Region of Ghana” by Francois Mahama, Elikem Krampa and Solomon Yemidi all of Department of Mathematics and Statistics, HO Technical University, Ghana, the paper noted that Ghana has been challenged by high inflation rates for a long period of time. The phenomenon in many cases leaves in its trial adverse economic consequences. Therefore, forecasting inflation rates in Ghana becomes very important for government and central bank to design fiscal measures or effective monetary policies to combat any unexpected high inflation in the country. The paper added that for firms and households, knowledge about the rate of inflation in future enables them to factor it into their planning so as to guard against unpleasant ramifications. The paper employed Autoregressive integrated moving average (ARIMA) technique to model inflation rates in Volta region of Ghana.

The paper looked at one region in Ghana (Volta), but this research will attempt to study the six regions in Nigeria with a view to determining which regions have minimum inflation rates. It is also important to note that using yearly data takes care of seasonal effects instead of the monthly data used to come up with the conclusion by the Ghana researchers.

2. Materials And Methods

2.1 Materials

The materials used in this research work are sourced from the National Bureau of Statistics, Nigeria. The method of data collection for prices data for the meantime is twelve module structured paper questionnaire of the NBS. A list containing all goods and services in the consumer price index (CPI) basket is prepared and handed to price data collectors who carry out the data collection. The National Statistics office (NBS) has offices in the 36 federating states including Abuja (Federal Capital Territory). Well trained staff of the office collects prices data on monthly basis from each state from selected outlets. Since the country is partitioned along regional lines, six regions exist with average of six states per region. One central state in each region is made the head quarter of the region for ease of data gathering coordination. These headquarters are equipped with computer networks. Upon transmission of data from the states to their respective headquarters, data entry is carried out and the data transmitted online to the Federal capital (National headquarters) where analysis and publications are done.

Table 1: Average Regional Price Indices for the six regions

Year	South West Region	South South Region	South East Region	North West Region	North East Region	North Central Region
2011	135.1972	143.3382	147.3872	136.3484	141.1810	140.0358
2012	143.3834	156.6368	148.4587	137.8696	143.0895	145.8030
2013	145.2231	157.1655	149.2236	139.4690	148.2384	152.8232
2014	162.0397	161.8205	155.5469	154.9863	158.8123	169.6813
2015	175.9059	176.4826	169.8575	169.2353	173.9614	182.6749
2016	204.7159	202.3192	196.6776	195.2787	197.5003	213.1140
2017	238.8739	233.4433	229.4130	230.4976	231.7925	246.2204
2018	266.6513	260.5114	256.9957	259.9109	261.1482	274.1557
2019	297.7172	288.4839	286.5482	292.7443	293.8531	305.3362
2020	335.7582	326.5190	324.7845	333.9193	334.0632	345.4621

Source: National Bureau of Statistics, Nigeria

Table 2: Headline and Regional Inflation Rates calculated for the regions

Year	Headline Inflation	South West Region	South South Region	South East Region	North West Region	North East Region	North Central Region
2011	11.4084						
2012	11.8463	6.0550	9.2777	0.7270	1.1157	1.3518	4.1184
2013	9.5329	1.2831	0.3376	0.5152	1.1601	3.5983	4.8148

2014	8.0231	11.5798	2.9618	4.2375	11.1260	7.1330	11.0312
2015	8.6457	8.5573	9.0608	9.2002	9.1937	9.5390	7.6576
2016	13.3629	16.3780	14.6397	15.7898	15.3889	13.5311	16.6630
2017	17.2288	16.6855	15.3837	16.6442	18.0352	17.3631	15.5346
2018	13.2455	11.6285	11.5951	12.0231	12.7608	12.6646	11.3456
2019	11.2702	11.6504	10.7375	11.4992	12.6326	12.5235	11.3733
2020	12.4235	12.7776	13.1845	13.3438	14.0652	13.6838	13.1416

2.2 Methods

In this research, attempt will be made to determine how regional inflation rates R1, R2... R6 in Nigeria depend on activities of the years under study. The aim in multiple regressions is to examine the nature of the relationship between a given dependent variable and two or more independent variables. The research is intended to solve real live economic problem of the household by using economic model (multiple regression) to measure the values of the parameters (B values) in the model. The parameters relate to R variables which will be used to determine the contribution of each region's inflation rates to the overall national inflation rate. The variables R₁, R₂, R₃, R₄, R₅ and R₆ are the regional inflation rates for the six regions of the country; H represents the headline inflation (dependent variable) for the country for a period of ten years (2011 - 2020).

In multiple regression, as in simple regression, the model describing the relationship between the dependent variable (H) and a set of K independent variables, R1, R2, R3... R6 can be expressed as:

$$H_i = B_0 + B_1R_{i1} + B_2R_{i2} + \dots + B_6R_{i6} + E_i$$

for i = 1, 2, ..., n

where 'n' is the number of observations in both the dependent and independent variables

H_i is the ith observation on the dependent variable H, B₁, B₂, B₃, ..., B₆ are known constants representing respectively the ith observations on the independent variables R₁, R₂, R₃, ..., R₆ which also represents the six regions in Nigeria.

R₁ Represent South West region (Lagos, Ogun, Ondo, Osun, Oyo, Ekiti and Lagos states with Oyo as the head quarter).

R₂ Represent South South region (Edo, Delta, Akwa Ibom, Rivers, Cross River and Bayelsa states with Cross River as the head quarter).

R₃ Represent South East region (Abia, Imo, Anambra, Enugu and Ebonyi states with Enugu as the head quarter).

R₄ Represent North West region (Kaduna, Kano, Jigawa, Katsina, Kebbi, Zamfara and Sokoto states with Kaduna as the head quarter).

R₅ Represent North East region (Bauchi, Borno, Adamawa, Gombe, Taraba and Yobe states with Borno as the head quarter).

R₆ Represent North Central region (Abuja, Benue, Plateau, Kwara, Niger, Nasarawa and Kogi states with Plateau as the head quarter).

The error terms captured in E, are assumed to be independently and normally distributed with mean zero and variance δ² and parameters B₀, B₁, ..., B₆ are parameters referred to as regression coefficients.

2.3 Multiple Regression Model

Having explained above how inflation rates are computed, our task here is to employ the multiple regression technique to

model the regional inflation rates obtained in other to ascertain the contribution of each region to the national inflation rate.

Parameter Estimation in Multiple Regressions:

Unbiased estimates of the parameter B₀, B₁, B₂, B₃, ..., B₆ above can be obtained by several methods. The most widely used is the method of least squares. This means that the sum of the squared deviations of the observed values of Y from their expected values is minimized. In other words, by the method of least squares, sample estimates b₀, b₁, b₂, b₃, ..., b₆ of B₀, B₁, B₂, B₃, ..., B₆, respectively, are selected in such a way that

$\sum e_i^2 = \sum (Y_i - B_0 - B_1X_{i1} - B_2X_{i2} - \dots - B_6X_{i6})^2$ is minimized. As in simple regression, we obtain estimates, b₀, b₁, b₂, b₃, ..., b₆ of the regression coefficients by solving the following set of normal equations:

$$\sum Y_i = nb_0 + b_1 \sum X_{i1} + b_2 \sum X_{i2} + \dots + b_6 \sum X_{i6}$$

$$\sum X_{i1} Y_i = b_0 \sum X_{i1} + b_1 \sum X_{i1}^2 + b_2 \sum X_{i1} X_{i2} + \dots + b_6 \sum X_{i1} X_{i6}$$

$$\sum X_{i2} Y_i = b_0 \sum X_{i2} + b_1 \sum X_{i1} X_{i2} + b_2 \sum X_{i2}^2 + \dots + b_6 \sum X_{i2} X_{i6}$$

$$\dots$$

$$\sum X_{i6} Y_i = b_0 \sum X_{i6} + b_1 \sum X_{i1} X_{i6} + b_2 \sum X_{i2} X_{i6} + \dots + b_6 \sum X_{i6}^2$$

Although these normal equations are obtained mathematically by finding estimates b₀, b₁, ... b₆ that would minimize Q above, a simple procedure to remember in obtaining them is as follows:

The usual regression equation is written down with b₀, b₁, ... b₆ as coefficients. The first normal equation is then obtained by summing each term of this regression equation. The second normal equation is obtained by multiplying every term in the regression equation by X_{i1} and summing the result. The third normal equation is obtained by multiplying every term in the regression equation by X_{i2} and summing the result, and so on.

It will be too cumbersome to obtain separate expression for the estimates b₀, b₁, ... b₆. Instead these coefficients are obtained by calculating the required sums from the data for the various combinations of Y, X₁, X₂, ..., and X₆ and substituting these sums into the normal equations, which are solved simultaneously.

The cumbersomeness of manual calculation involved due to large number of variables has made it inevitable the use of statistical software such as statistical package for social sciences (SPSS) for this analysis.

3. Results and discussion

3.1 Results

Model Fitting

Model		Coefficients				
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.863	3.326		-.861	.480
	SWZ-REGION	1.856	1.487	3.196	1.248	.338
	SSZ-REGION	.166	.654	.299	.254	.823
	SEZ-REGION	-1.405	.725	-3.047	-1.937	.192
	NWZ-REGION	-3.038	1.586	-6.360	-1.916	.195
	NEZ-REGION	3.304	1.192	6.094	2.772	.109
	NCZ-REGION	.457	.670	.706	.682	.566

Dependent Variable: Headline inflation

3.2 Discussion

This research work is able to discover that there are differences in contribution of regional inflation rates to the national. This is revealed in the multiple regression model developed from the data set.

The standard error determines how much variability surrounds a coefficient estimate. A coefficient is significant if it is non-zero, therefore since all the regions are having non-zero standard error, it shows that the standard errors of the estimates of the regions are significant. Also inflation rates in the respective regions are significantly different from each other.

It was also discovered that South East and North West recorded the minimum inflation rates within the period under study.

The table above shows the result obtained when a multiple regression analysis is carried out using the data. From the result, South West, South South, North East and North Central Regions made positive contributions while South East and North West regions made negative contributions to the overall national inflation rate.

The interregional multiple regression models can therefore be stated thus:

$$H_i = -2.863 + 1.856R_1 + 0.166R_2 - 1.405R_3 - 3.038R_4 + 3.304R_5 + 0.457R_6 + E_i$$

To fit multiple regression models above is the aim of this research.

The Nigerian regional inflation exhibits similar pattern as the United States with South East and North West Regions exhibiting deflation. The reason for the differences in the regional inflation rates cannot be determined in this research since we are making use already computed indices from the National Bureau of Statistics. Although like the earlier researcher has observed, National inflation rates reports need not accurately represent price movements in any specific part of the country, this research has been able to observe a similar movement.

This comparison has observed how inflation levels differ across regions within the country. This reminds us that the monetary policy of government has not been able to address separately the heterogeneous economic conditions that exist among the different parts of this large and diverse country.

From the result also, it can be seen that the minimum inflation rates are recorded in two regions (South East and North West of Nigeria).

4. Conclusion

This research has been able to address the main question of fitting multiple regression models of interregional inflation rates in Nigeria.

Multiple regression models fitted discovered that while two of the regions (South East and North West) contributed minimally to the high rate of inflation, the other four are the main reason why inflation rates have being on the rise. Our candid suggestion is that the National Bureau of Statistics should as a matter of need start the compilation of regional CPI's leading the computation of the inflation rates. The current practice only gives a Macro picture of the economy ignoring the components where proper planning should start from that will metamorphose into clear view and better understanding of the entire economy. This practice will aid the National government to beam their search light on the regions that need any form of economic assistance.

5. References

1. Adenomon MO, Micheal VA. Introductory Econometric with Examples in EViews. Jube-Evans Books and Publications F.M.C Road, Bida, Niger State 2017.
2. Bruce EW, Clifford J. Drew Theory and Application of Statistics 1990.
3. Biyi Afonja. Introductory Statistics: A Learner's Motivated Approach 1975.
4. Consumer Price Index Manual, Theory and Practice with support of ILO 2004.
5. ECOWAS: Harmonized Consumer Price Index Guideline on how to compile CPI's in ECOWAS Price Index Manual Sub-Region 2013.
6. Jude IE, Micah EO, Edith NE. Statistics and Quantitative Methods for Construction and Business Managers. The Nigerian Institute of Building Moris Hamburg: Statistical analysis for decision making 2005.
7. Oyeka CA. Applied Statistical Methods Michael F. Bryan: Origin and evolution of the word inflation 1996.
8. Dr. Paul M. Johnson: Open market operations: A Glossary of political economy.
9. William F. Hummel: Operation market operations.
10. Federal Reserve Bank of New York: Open market operation.
11. Swiss Bank: Monetary policy instruments (situation in 2009).
12. Brown Peter Robert Lamont The world of late Antiquity 1971.
13. Potter David Stone. The Roman Empire at Bay, AD 180 – 395, Routledge history of the ancient world 2004.

14. Kenneth Harl W. Coinage in the Roman economy.
15. Francis O, Francois M, Solomon Y, Elikem K. An Econometric Model for Inflation Rates in the Volta Region of Ghana. IOSR Journal of Economics and Finance (IOSR-JEF) e-ISSN: 2321-5933, p-ISSN: 2321-5925 2015;6(6):48-55. Retrieved from <http://www.iosrjournals.org>
16. Michael McCracken. Monetary Policy and Regional Inflation Rates 2018.
17. Nwaboku OF. Methodology of CPI in Nigeria 2014.
18. Sani Bawa, Ismaila Abdullahi S, Adamu Ibrahim. Analysis of Inflation Dynamics in Nigeria, (1981- 2015) 2016.