

## INFLATION AND GROWTH NEXUS IN NIGERIA: AN INVESTIGATION INTO THE SIMULTANEOUS RELATIONSHIP

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**ABSTRACT:** *The relationship between inflation and economic growth remains an unresolved debate in empirical research. Its relevance in understanding growth behavior however remains pertinent. It is in this light that this study seeks to understand inflation and growth nexus in Nigeria. The study employs a two stage least square estimation to examine a simultaneous equation model with data from the Central Bank of Nigeria Statistical Bulletin and World Bank Indicators. The study shows that inflation is beneficial to growth though not significantly while growth is significantly beneficial to inflation; given the positive relationship between inflation and growth and the negative relationship between growth and inflation. The results further show that Money supply and trade openness are significant determinants of real GDP for all three estimation techniques under consideration. While, real GDP, money supply and interest rate are significant determinants of inflation. The study therefore recommends that inflation be controlled to have its optimal effect on output while production be diversified to optimize its effect on inflation.*

**KEYWORDS:** Inflation, Economic Growth, Simultaneous Relationship, Nigeria

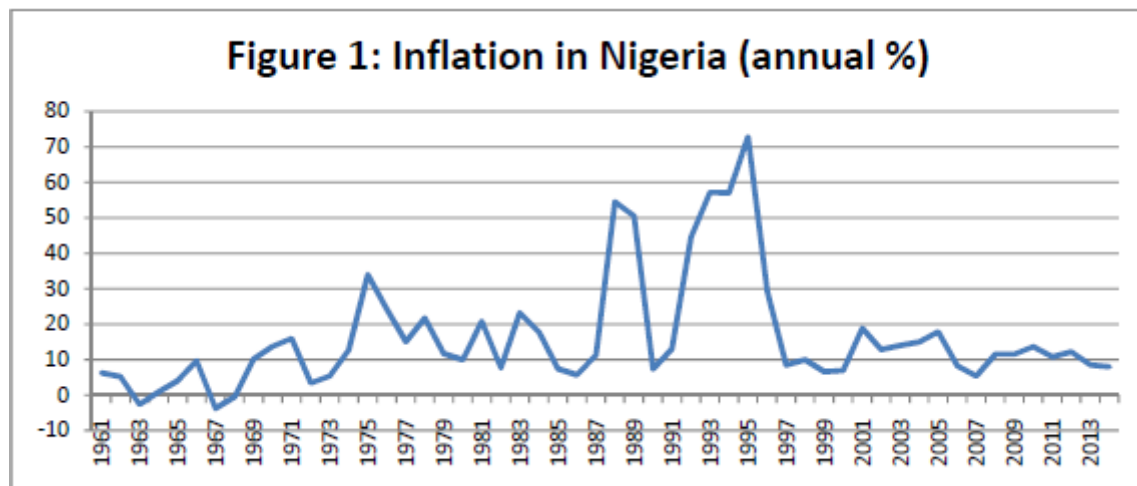
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### INTRODUCTION

Low inflation and economic growth are important macroeconomic objectives while achieving low inflation remains a core mandate of central banks. The principal benefit of low inflation is improved certainty and hence the ability to plan. Meanwhile, the fact that increasing price level leads to; a fall in the standard of living, unpredictability of government policy actions and of macroeconomic relationships is no more an issue of dispute (Maku and Adelowokan, 2013).

There exist several views and several schools of thoughts with backing empirical evidence emanating from cross country and country specific studies on the relationship between inflation and economic growth. Nevertheless, most of them seem to agree that inflation on its own –is not healthy for every economy and must therefore be diligently fought against. The link between inflation and economic growth usually measured by output growth over time cannot equally be disputed; inflation leads to a depreciation in the value of the currency such that the same bundle of goods and services consumed today cannot therefore be consumed tomorrow, hence a decrease in consumption capacity and consequently output. Yet, empirical evidence vary on whether it affects economic growth positively/negatively and significantly or not, as it differs with countries studied, periods considered and methodologies used. Inflation however remains a very sensitive issue in Nigeria.

Inflation in Nigeria is exposed to internal and external shocks and is highly volatile. Figure 1 below shows that inflation has been oscillatory for the past five decades with its peak point at 72.83% in 1995 and then dropped to about 29.2% in the preceding year.



*Authors Computation from World Bank Indicators*

The fact that Nigeria is largely an importing country especially the processed crude whose price is equally highly volatile, further makes inflation very unstable. This therefore translates to the economy and consequently affects economic growth. Several studies have estimated this relationship in Nigeria but there seldom exist studies that have explored the simultaneity that exists in the inflation and Economic growth nexus. This therefore constitutes the motivation of the study.

## LITERATURE REVIEW

### Theoretical relationship

Economic theory varies greatly in terms of the responsiveness of output growth to inflation and vice versa. According to Tobin (1965), inflation is beneficial to the output level because it lowers the interest rate and therefore the opportunity cost to invest, which in turn increases the capital-labour ratio and therefore output. On the other hand, Stockman (1981) pointed to the possible existence of an inverse Tobin effect, whereby an increase in the inflation rate causes the capital stock to decrease, once supposing a cash-in-advance constraint for capital accumulation and given that inflation raises the cost of money holding. Some decades later, Wang and Yip (1992) posit that inflation is inversely related to growth, because a decline in real balances arising from an increase in the rate of monetary growth raises transaction time and therefore transaction costs.

Meanwhile, Mino and Shibata (1995), in an overlapping generation framework, show that inflation may have a redistributive impact from one generation to the other and foster capital accumulation. Furthermore, Bonatti (2002) argue that, when multiple balanced growth paths exist in a non-monetary economy, inflation targeting cannot resolve the resulting indeterminacy, whereas a fixed monetary growth rule can do it and it also determines the growth path of the economy. Furthermore, a restrictive monetary policy may select a lower growth path than a more expansive one. There obviously exist therefore theoretical arguments for a positive inflation-growth relationship and a negative. Consequently, an inflation-growth relationship is circumstantial and therefore country/economy specific, hence should be accounted for as such.

## Empirical Evidence

On the global scene, works that have examined the relationship between inflation and economic growth simultaneously include; Chaturvedi, Kumar and Dholakia (2009) who examined the inter- relationship between economic growth, saving rate and inflation for south-east and south Asia in a simultaneous equation framework using two stage least squares with panel data. The results show that the relationship between saving rate and growth has been found to be bi-directional and positive. Inflation has a highly significant negative effect on growth but positive effect on saving rate. Inflation is not affected by growth but is largely determined by its past values, and saving rate is not affected by interest rate. Meanwhile Gillman and Harris (2009) examined the effect of inflation on growth in a panel of 13 transition countries over the 1990-2003 period. The panel regression estimation results drawn from a simultaneous equation model find a strong, robust, negative effect of inflation on growth or its standard deviation.

Mamo (2012) employed fixed effect panel model and Panel Granger causality to test the effect and causal relationship between inflation and economic growth. The study used strongly balanced panel data which contained 13 SSA countries and covering from 1969-2009. The estimation result has shown that inflation was negatively and significantly related to economic growth. It means that inflation has an adverse effect on economic growth. The Panel Granger causality test showed that inflation Granger causes economic growth for all countries in the sample, while economic growth Granger causes inflation for two countries. Yeh (2009) equally used a simultaneous equation model for a panel of 140 countries over the 1970-2005 period to show that there exists a bilateral causal relationship between the growth and inflation as predicted by recent theories. Most importantly, the results indicate that inflation is harmful to growth whereas the effect from growth to inflation is beneficial.

In Nigeria however, several works have equally investigated the relationship between inflation and economic growth though seldom considering the endogeneity effect that exists between them. Most of the studies that investigated the impact of inflation on economic growth using multiple regression are Aminu and Anono(2012), Osuala, Osuala and Onyeike (2013), Bakaere et al, Oluh and Idih (2015) who suggest inflation possessed a positive impact on economic growth, while Inyama (2013) suggest a significant negative relationship between inflation and economic growth. On the other hand, Chude and Chude (2015) shows that GDP significantly and negatively impact on Inflation in Nigeria. In terms of empirical evidence on the causal relationship between inflation and economic growth, Aminu and Anono (2012), Bakare, Kareem and Oyelekan (2015) suggest that GDP causes inflation and not inflation causing GDP, while Omoke (2010) shows that there exist unidirectional causality running from Inflation to economic growth. But also, Inyama (2013) and Shuaib, Ekeria and Ogedengbe (2015) show that there is no causality between inflationary rate and real gross domestic product. It is therefore on this note that this study seeks to contribute to existing stock of knowledge by investigating the evolution between inflation and economic growth with the aid of a simultaneous equation model.

## METHODOLOGY AND DATA

The study employs a simultaneous equation model to correct for endogeneity bias. The simultaneous model is made up of two equations where economic growth and inflation are both endogenous. The model is presented below;

$$Rgdp_t = \beta_0 + \beta_1\Pi_t + \beta_2gex_t + \beta_3inv_t + \beta_4MS_t + \beta_5TO_t + \varepsilon_1 \dots \dots \dots (1)$$

$$\Pi_t = \alpha_0 + \alpha_1Rgdp_t + \alpha_2vrex_t + \alpha_3int_t + \alpha_4MS_t + \varepsilon_2 \dots \dots \dots ..(2)$$

where t represents time and the structural parameters are  $\beta_i$  and  $\alpha_j$  ( $i=0,1,2,3,4,5$  and  $j=0,1,2,3,4$ )

The study is informed by empirical and theoretical literature to stipulate economic growth which is conventionally proxied with real Gross Domestic Product (rgdp) as a function of inflation ( $\Pi$ ), government expenditure (gex), gross fixed capital formation (inv), money supply (MS) and trade openness (TO). While Inflation is a function of real GDP, real exchange rate (rex), interest rate (int) and money supply.

It is clear therefore that, the system of equations allows inflation to affect growth and, in turn, growth to influence inflation. Also, growth and inflation depend on a vector of other control variables as stated above. This system of equation therefore caters for the endogeneity in the model.

Econometrically, the next step in the simultaneous process is to identify the reduced form parameters. The reduced form equation will therefore be given as

$$Rgdp_t = Z_{10} + Z_{11}MS_t + Z_{12}rex_t + Z_{13}int_t + Z_{14}gex_t + Z_{15}inv_t + Z_{16}TO_t + \mu_1 \dots \dots \dots ..(3)$$

$$\Pi_t = Z_{20} + Z_{21}MS_t + Z_{22}rex_t + Z_{23}int_t + Z_{24}gex_t + Z_{25}inv_t + Z_{26}TO_t + \mu_2 \dots \dots \dots (4)$$

Where the representatives for  $Z_{ij}$  ( $i=1,2$  and  $j=0,1,2..6$ ) is presented at the Appendix.

The reduced form model shows that there exist 12 reduced form parameters as against 11 structural parameters which implies that the model is over identified. This means that the appropriate estimation techniques to be used should be the instrumental variable method, two stage least square (2SLS), generalized method of moments (GMM) or the maximum likelihood estimation technique. The study therefore employs the 2SLS, GMM and the limited information maximum likelihood estimation technique (LIML) to estimate the simultaneous equations simultaneously.

The data for all the variables shall be gotten from the Central Bank of Nigeria Statistical Bulletin and the World Bank indicators. Given that it is a country specific study all currency variables shall be converted to Naira if it were in Dollars. The data time series in nature and spans between 1981 and 2014.

## RESULTS AND INTERPRETATION

The study used the three appropriate means of estimating over-identified simultaneous equations (2SLS, GMM and LIML) to estimate the effect of inflation on GDP. Pre-estimation test as well as the vital statistics of  $R^2$  and F statistic all show that the results are robust and therefore reliable. Meanwhile, inflation is an instrumented variable. The results are shown on

Table 1 below:

**Table 1: Regression result for the effect of inflation on Economic growth**

RGDP	2SLS	GMM	LIML
Inflation	1680.242 (0.169)	1689.01 (0.170)	1681.342 (0.169)
Government expenditure	13427.55 (0.177)	13705.3 (0.183)	13428 (0.178)
Investment	33553.44 (0.288)	33319.59 (0.146)	33566.05 (0.288)
Money supply	102784.7* (0.000)	102020.1* (0.000)	102785* (0.000)
Trade openness	-1766.607* (0.020)	-1802.202* (0.016)	-1766.559* (0.020)

*Probability values in brackets & \* if significant at 5% significant level*

Table 1 shows that only Money supply and trade openness are significant determinants of real GDP for all three estimation techniques under consideration. The key variable in this estimation

– inflation is not a significant determinant of economic growth and has a positive relationship. This is in line with Tobin (1965) and Mino and Shibata (1995) who opine that inflation is positively related to growth and therefore beneficial to growth but disagrees with Stockman (1981). The results however is in conformity with Aminu and Anono (2012), Osuala, Osuala and Onyeike (2013), Bakare et al. (2015) and Olu and Idih (2015).

The result implies that the higher the inflation the higher the output growth which is not expected a priori. Noteworthy is the fact that this relationship is not significant and therefore does not necessitate that the Nigerian economy should promote inflation so as to enhance output growth. The negative consequences of inflation still exists, hence inflation should still be in check; probably within the ‘one digit’ range as has been the objective of the monetary authorities.

Government expenditure and investment are strangely not significant in determining economic growth though positively related as expected a priori. Therefore more efforts are needed to reorient government expenditure towards capital-intensive productive areas while reducing corruption so as to improve management of these funds. On the other hand, investment needs to be encouraged to make it significant; primarily by lowering lending interest rates and improving the investment climate which is currently in a poor state. While money supply is positively and significantly related to economic growth at 5% and 1% significant levels given its probability value of 0.000. Trade openness on the other hand shows a significant negative relationship with economic growth which is not expected a priori. This could however be explained by the fact that Nigeria is largely an importing country and so trade is seldom in her favour. This means diversification must be greatly encouraged.

On the other hand, in estimating the simultaneous equation where economic growth is instrumented, the results are shown below;

**Table 2: Regression result for the effect of Economic growth on inflation**

Inflation	2SLS	GMM	LIML
RGDP	-0.0000467* (0.025)	-0.0000466* (0.006)	-0.0000467* (0.025)
Money supply	0.4948361* (0.023)	0.4949874* (0.010)	0.4948364* (0.023)
Real exchange rate	-0.0106202 (0.752)	-0.0105597 (0.706)	-0.0106202 (0.752)
Interest rate	1.986464* (0.015)	1.987709* (0.008)	1.986463* (0.015)

*Probability values in brackets & \* if significant at 5% significant level*

The findings show that for all three estimation techniques, real GDP, money supply and interest rate are significant determinants of inflation while real effective exchange rate is not. The results show that real GDP is beneficial to inflation as there exist an inverse and significant relationship between them. In fact, as real GDP increases by successive units, inflation reduces significantly by 0.0000467. This is equally evident in several empirical works. This could be explained by the fact that an increase in output is a reflection of many goods and services in the market thereby increasing the price elasticity of demand hence prices are inclined to remain stable. Diversification needs to be improved greatly in order to expand output not only in particular goods but across all sectors and goods if this relationship should be maintained.

Money supply on the other hand, has a positive and significant relationship with inflation as expected. The higher the money in supply, the greater the purchasing power, hence increasing the potential for prices to go up. Money supply must be controlled judiciously by the monetary authorities if the 'single-digit' inflation objective must be attained. Meanwhile, real exchange rate is not a significant determinant of inflation though record a negative relationship with inflation. The Nigerian economy must therefore make conscious efforts to improve exports so as to have a favourable exchange rate against the key currencies and hence a favourable inflation rate. Interest rate is significant and positively related to inflation as expected. It is expected that as interest rate rises, investors borrow at higher rates and therefore transfer the extra cost of doing business to the prices since they must make profits. In light with all the reasons for reducing interest rates, this is yet another reason if inflation must be curtailed.

## CONCLUSION

The unresolved debate between inflation and economic growth both on theoretical and empirical levels only point to the fact that its effects are country specific. Therefore the historical trend of inflation in Nigeria motivates the study to examine the evolution between



inflation and growth. The study shows that inflation is beneficial to growth though not significantly while growth is significantly beneficial to inflation; given the positive relationship between inflation and growth and the negative relationship between growth and inflation. The results further show that Money supply and trade openness are significant determinants of real GDP for all three estimation techniques under consideration. While, real GDP, money supply and interest rate are significant determinants of inflation. The study therefore recommends that inflation be controlled to have its optimal effect on output while production be diversified to optimize its effect on inflation.

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**APPENDICES****Appendix 1: Reduced form Model**

$$Z_{10} = \frac{\beta_0 + \beta_1 \alpha_0}{1 - \beta_1 \alpha_1}$$

$$Z_{12} = \frac{\beta_1 \alpha_2}{1 - \beta_1 \alpha_1}$$

$$Z_{14} = \frac{\beta_2}{1 - \beta_1 \alpha_1}$$

$$Z_{11} = \frac{\beta_1 \alpha_4 + \beta_4}{1 - \beta_1 \alpha_1}$$

$$Z_{13} = \frac{\beta_1 \alpha_3}{1 - \beta_1 \alpha_1}$$

$$Z_{15} = \frac{\beta_3}{1 - \beta_1 \alpha_1}$$

$$Z_{16} = \frac{\beta_5}{1 - \beta_1 \alpha_1}$$

$$Z_{22} = \frac{\alpha_2}{1 - \beta_1 \alpha_1}$$

$$Z_{26} = \frac{\beta_5 \alpha_1}{1 - \beta_1 \alpha_1}$$

$$\mu_1 = \frac{\varepsilon_1 + \beta_1 \varepsilon_2}{1 - \beta_1 \alpha_1}$$

$$Z_{23} = \frac{\alpha_3}{1 - \beta_1 \alpha_1}$$

$$\mu_2 = \frac{\alpha_1 \varepsilon_1 + \varepsilon_2}{1 - \beta_1 \alpha_1}$$

$$Z_{20} = \frac{\alpha_0 + \beta_0 \alpha_1}{1 - \beta_1 \alpha_1}$$

$$Z_{24} = \frac{\beta_2 \alpha_1}{1 - \beta_1 \alpha_1}$$

$$Z_{21} = \frac{\alpha_4 + \beta_4 \alpha_1}{1 - \beta_1 \alpha_1}$$

$$Z_{25} = \frac{\beta_3 \alpha_1}{1 - \beta_1 \alpha_1}$$

Where  $Z_{ij}$  ( $i=1,2$  and  $j=1,2..6$ ) are the reduced form parameters, while,  $\alpha_i$  ( $i=1,2..6$ ) and  $\beta_j$  ( $j=1,2..6$ ) are the structural parameters.  $\varepsilon_1, \varepsilon_2$  are the error term of the structural model and  $\mu_1, \mu_2$  are the error term of the reduced form model.