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DOES CHANGE IN PRICE LEVEL AID INDUSTRIAL SECTOR PRODUCTIVITY IN NIGERIA?

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Abstract:
This goal of this study is to assess the effect of inflation on industrial output in Nigeria using annual data from 1982 to 2015. The error correction model (ECM) was employed to estimate the short-run and long-run dynamics, while the Engel and Granger residual-based technique for cointegration was employed to test for long-run relationship. The Findings revealed that inflation, official exchange rate and real interest rate had negative effects on Nigeria's industrial output. A unit change in inflation rate and real interest rates brought about 9.2% and 3.3% decline in industrial output respectively. When however the broad money supply increased by 1%, industrial sector value added increased by 23.7%. Growth in broad money supply was however found to have significant positive effect on industrial production over the period. Based on the ECM, the study found that the last period's deviation from long-run equilibrium is corrected at the speed of 62.7% annually. We recommend that policymakers should take steps towards attaining price level stability while encouraging lower cost of borrowing for the industrial sector.

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1. Introduction

The industrial sector remains a major driver of economic growth (Aiyegbusi, 2016), and inflations is a key determinant of industrial sector performance (Otalu and Anderu, 2015) alongside such other factors as exchange rate, technological intensity, personal consumption, investment level etc (Tkalec and Vizek (2009). (Saritha, et al., (2015) maintains that inflation affects index of industrial production, and reduces manufacturing output (Siyakiya, 2013; Bans-Akutey, *et al*., 2016; Modebe and Ezeaku, 2016). For most jurisdictions, attaining sustainable economic growth and stability in general price level remain the core objective of macroeconomic policies.

In recent time, the debate on whether inflation is detrimental or necessary to growth continues to draw opinions from policymakers and the academia. A good number of studies establish that inflation is inversely related with economic growth, thereby inferring that inflation is harmful to economic growth Madurapperuma (2016). It is based on this theoretical position in literature that monetary policies of most countries are targeted at achieving price stability and promoting economic growth Mwakanemela (2013). Some other school of thought argues that inflation is necessary for the attainment of economic growth, which implies that inflation have positive or direct relationship with economic growth (Ahmad &Joyia, 2012; Majumder, 2016; Lu., et al., 2016).

Literally, there is no consensus as to what nature of relationship exists between inflation and growth. Empirical and theoretical studies that examined the linkages between the two variables have always come up with differing positions. The structuralists are of the opinion that inflation has a positive effect on economic growth while the monetarists contend that inflation is inimical to economic growth. From the neo classical view point, inflation stimulates economic growth by favouring the capitalists with shift in income distribution, and the resulting increases in savings boost investment which translates into economic growth. The age long stand point of the Keynesians is that inflation could increase economic growth by raising the profit level, thereby increasing rate of private investment. However, other theories argue that high inflation reduces investment level which consequently stifles economic growth (Mamo, 2012).

There has also been even more controversies surrounding the predicting power of inflation for economic growth, and the forecasting power of the latter for the former. This sort of relation is called causal relationship. The causal relationship between inflation and economic growth has been contentious. Methodically, the granger

causality examines whether one indicator is granger causal for the other. For instance, if inflation is granger caused economic growth, it means inflation contains information that helps to predict future economic growth and vice versa. Such predictability power of one variable for the other may take different directions. Previous empirical studies reveal a bi-directional causality, a uni-directional causality and no causality between economic growth and inflation (Jayathileke, *et al*., 2013). Denbel and Ayen (2016) found uni-directional causality in Ethiopia running from economic growth to inflation. Same was the indication in Pakistan (Ahmad & Joyia, 2012).

Singh and Singh (2016) contend that there exist bi-directional causality between economic growth and inflation in the case of Japan. While there is unidirectional causality between economic growth and inflation in the context of India, a bi-directional causality is the case in China (Behera and Kumar, 2016). Evidently, there is no clear cut decision about the growth-inflation relation. We attempt in this study to explore the underlying relation between economic growth and inflation in Nigeria between the period 1960 and 2014. Most studies on this subject often adopt a relatively short period. We therefore try to increase the coverage period while employing varied econometric techniques to evaluate economic growth and inflation nexus.

2. Review of Related Literature

A review of previous studies on the connection between economic growth and inflation has produced mixed findings and the unending debate lingers on. There appear to be a consensus among economists that a high rate of inflation is detrimental to aggregate economic growth. However, there is not as much consensus about the precise relationship that exists between inflation and economic growth. Denbel and Ayen (2016) examined the existing causal relationship between inflation and economic growth in Ethiopia for the period 1970-2011.The Johansen co integration test showed the presence of one co integrating vector and the VECM revealed the existence of long run and uni-directional causality from economic growth to inflation. In the short run one way causality was found from economic growth to inflation. In a related study, Ahmad and Joyia (2012) examined the relationship between inflation and economic growth in Pakistan using a time series data for the period of 1971 to 2011. Granger causality test and Ordinary Least Squares methods were employed in analyzing the data. The results of granger causality test suggest that GDP was causal for inflation while, contrary to theory, the results of OLS revealed that inflation has positive effect on economic growth in Pakistan.

Singh & Sigh (2016) evaluated the relationship between economic growth and consumer price index (CPI) in Japan for the period of 1980-2014. The study employed

the Johansen Co-integration and the Granger Causality model. The results reveal that economic growth and CPI are co-integrated and therefore indicated a long-run relationship between the variables. The Granger causality test supports bi-directional causality between economic growth and CPI in Japan.

Osuala, et al., (2013) used time series data spanning forty- one years (1970-2011) to evaluate the impact of inflation on economic growth from the perspective of an emerging market using empirical evidence from Nigeria. The results show that there exists a statistically significant positive relationship between inflation and economic growth in Nigeria. However, there is no leading variable in the relation between inflation and economic growth in Nigeria. Shuaib et al., (2015) assessed the impact of inflation rate on the economic growth in Nigeria using time-series data for the period of 1960 to 2012. The empirical results indicated that there was no co-integrating relationship between inflation and economic growth for Nigeria.

Majumder (2016) used Granger causality and then error correction model to investigate the relationship between economic growth and inflation in Bangladesh during the period of 1975 –2013. The VECM results demonstrated that there exists a statistically significant long run positive relationship between inflation rate and economic growth in Bangladesh.

Madurapperuma (2016) examined the impact of inflation on economic growth in Sri Lanka for the period of 1988 – 2015. The study adopted the framework of Johansen cointegration test and Error Correction Model. The results revealed that there is a long run negative and significant relationship between economic growth and inflation in Sri Lanka.

Behera and Kumar (2016) investigated the inflation growth linkages in the context of BRICS countries using time series data covering the period 1980 to 2012. The empirical findings of the study showed that a long run positive relationship between inflation and economic growth only for China and South Africa, while there was a uni-directional causality between economic growth and inflation in the context of India; bi-directional causality was the case for China. The VAR analysis however could not find a consistent short run association between inflation and economic growth over ten years ahead for BRICS countries

Mwakanemela (2013) examined the link between inflation and economic growth in Tanzania using time-series data for the period 1990 -2011. The OLS and the cointegration techniques were applied in analyzing the annualized data. In line with the findings in [15], the results showed that inflation has a negative impact on economic growth. No long-run association was found to exist between inflation and economic growth, and there was long-run relationship between the two variables.

Jayathileke, et al., (2013) examined the link between inflation and economic growth in three Asian countries over the period 1980-2010 using and causality test. The results revealed that there is a long run negative relationship between the economic growth and inflation in Sri Lanka. The findings also indicated that no statistically significant association was found between the variables in China and in India. The causality results revealed that there is a uni-directional causality running from the economic growth to the inflation in China. In the case of Nigeria, Sergii (2009) adopted the Ordinary Least Squares (OLS) logged multiple regression in examining the relationship between one inflation rate and economic growth in Nigeria between the period 1980 and 2013. The results showed that inflation rate in line with theoretical expectations had a positive but non-significant relationship with the economic growth.

3. Data and Methodology

This study used annualized data from 1982-2015 collated from the World Bank Economic Development Indicators. The industrial value added relative to GDP is our dependent variable and proxy for industrial sector output. Inflation rate is our independent variable while the exchange rate, broad money supply (annual growth, %) and real interest rate and the official exchange rate are our variables of control. The error correction model is employed in estimating the effect of changes in price level on the Nigerian industrial sector. The long-run association between the two variables was estimated using the Engel and Granger residual-based technique for cointegration.

The general model for this study is patterned is expressed as follows:

$$IND\_GDP_t + \beta_0 + \beta_1 INF_t + \beta_2 EXR_t + \beta_3 BMSgr_t + \beta_4 RIR_t + \varepsilon_t \text{---------- (1)}$$

t denotes period *IND_GDP* is the index for industrial output and is expressed as the ratio of industrial value added to GDP in a given year, which represents our dependent variable, *INF* is the inflation level, the independent variable and a measure for changes in price level. *EXR* is official exchange rate, *BMSgr* is the annual growth rate in broad money supply *RIR* is real interest rate which are our variables of control. β_0 is intercept, β_1- β_4 are coefficients, ε is error term, and t denotes period. When we adjust Equation (1) to accommodate for adjustment speed towards long-run equilibrium, our short-run and long-run dynamic error correction model is presented thus:

$$D(IND_{GDP})_t + \beta_0 + \beta_1 D(INF)_t + \beta_2 D(EXR)_t + \beta_3 D(BMSgr)_t + \beta_4 D(RIR)_t + ECT(-1) + \varepsilon_t \text{---- (2)}$$

Where ECT(-1) is the error correction term and speed of adjustment.

4. Results and Discussions

Inflation rate averaged 19.68 % while the mean value of industrial value added relative to GDP was 36.72% (see *Table 1*). The results of the unit root tests in *Table 2* are carried out order to determine whether the series are stationary or not. We have two different unit root tests for each series: The Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests. The columns shown as ADFΔ and PPΔ are the test results which are obtained when the first differences of the series are taken while the rest are obtained at level. The results in *Table 2* indicate that all the variables attained stationarity after first differencing.

Having ascertained that our series are stationary, and integrated of the same order, I(1), we conducted the Engel and Granger approach to cointegration in *Table 3* with the aim of finding out if our variables have long-run association. The residual or error term of the baseline regression was subjected to ADF and PP unit root tests at levels and was found to be stationary as can be observed in *Table 3*. Hence, it is established that our series have long-run relationship.

The results of the Error Correction Model (ECM) are presented in *Table 4.* The estimations reveal that inflation rate, exchange rate and real interest rate exert negative influence on the industrial sector output while growth in broad money supply have significant positive effect on the industrial sector output. The regressors jointly have significant influence on the explained variable. The error term (ECT) has the right sign – a negative coefficient value of 62.7 percent, with p value < 0.05. This shows that the model identified substantial speed of adjustment hence last-periods deviation from long-run equilibrium is corrected at the speed of 62.7% annually until a steady state is maintained.

Table 5 presents the diagnostics tests. The result in the first panel confirms the DW stat result in *Table 4* which reveals that our series do not have serial correlation problems. The second panel indicates that our variables are in fact homoscedastic while the third panel confirms that our model is well specified.

Table 1: Descriptive Statistics

	IND_GDP	INF	EXR	BMSGR	RIR
Mean	36.72268	19.68236	73.49089	24.30853	-0.072367
Median	36.10121	11.89750	57.20175	19.11641	3.227297
Maximum	52.99716	72.83550	192.4405	64.92465	25.28227
Minimum	20.38195	5.382224	0.673461	1.953095	-43.57266

Table 2: Result of ADF and Philips-Perron Unit Root Tests

Series	ADF	ADFΔ	PP	PPΔ
IND_GDP	-0.962121[-2.960411]	-6.548888[-3.661661]	-1.962029[-2.954021]	-7.294619[-3.653730]
INF	-2.722921[-2.954021]	-5.156373[-2.957110]	-2.590598[-2.954021]	-9.714280[-2.957110]
EXR	0.255130[-2.954021]	-5.163854[-2.957110]	0.264512[-2.954021]	-5.161448[-2.957110]
BMSGR	-3.423022[-2.957110]	-	-2.168243[-2.954021]	-6.297860[-2.957110]
RIR	-2.694184[-2.954021]	-5.746528[-2.954021]	-2.694117[-2.954021]	-5.995254[-2.954021]

Note: The values outside the bracket is the test statistic whereas the values inside the brackets are test critical values with 5% significance level.

Table 3: Engle - Granger Co-integration Test

μ →ADF(Critical value at 1%)	μ →PP(Critical value at 1%)
-6.734525	-8.262452
(-2.954021)	(-2.954021)

Table 4: Results of Error Correction Model Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.229943	1.099146	-0.209201	0.8359
D(INF)	-0.092053	0.068481	-1.344225	0.1901
D(EXR)	-0.009280	0.073229	-0.126727	0.9001
D(BMSGR)	0.236851	0.074424	3.182472	0.0037
D(RIR)	-0.033493	0.043786	-0.764940	0.4509
ECT(-1)	-0.627372	0.188237	-3.332894	0.0025
R-squared	0.874983			
F-statistic	23.594854			
DW-stat.	1.813479			

Table 5: Diagnostic Tests

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.976764	Prob. F(2,25)	0.3904
Obs*R-squared	2.391762	Prob. Chi-Square(2)	0.3024
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.640881	Prob. F(5,27)	0.1832
Obs*R-squared	7.690668	Prob. Chi-Square(5)	0.1741
Scaled explained SS	3.483174	Prob. Chi-Square(5)	0.6259
Ramsey RESET Test			
	Value	df	Probability
t-statistic	0.459088	26	0.6500
F-statistic	0.210762	(1, 26)	0.6500
Likelihood ratio	0.266427	1	0.6057

5. Conclusion

This study examined the effect of inflation on Nigeria's industrial output between 1982 and 2015. The findings showed that inflation rate has negative and insignificant effect on industrial sector output. Similarly, exchange rate and real interest rate were found to exert negative influence on the industrial value added. In contrast, growth in broad money supply had positive and significant effect of the dependent variable. The ECM estimation further revealed that disequilibrium on the long-run path is corrected at the sizable speed of 62.7% on annual basis. We recommend that policymakers should take steps towards attaining price level stability while encouraging lower cost of borrowing for the industrial sector.

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