What is the effect of Inflation on Manufacturing Sector Productivity in Ghana?

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Abstract

Using annual time series data for Ghana, the current study investigates the effect of inflation on manufacturing sector productivity for the period 1968-2013. The empirical verification is done by using the Johansen test (JT), the Vector Error Correction Model (VECM), and the Ordinary Least Squares (OLS) regression test. The results indicate significant stable long run relationship between inflation and manufacturing sector productivity. However, there is insignificant short run link between inflation and manufacturing sector productivity in the VECM. The results of the OLS test indicate negative significant link between inflation and manufacturing sector productivity. The findings suggest that inflation has led to a decrease in manufacturing sector productivity. Policy makers should manage inflation very well in order to improve manufacturing sector productivity. Future study should examine the current topic accounting for causality and structural breaks issues since the present study did not consider these issues.

Jel Codes: L60, E31, P24
Keywords: Manufacturing sector productivity, Inflation, Long run, Short run

1.1 Introduction

The effect of inflation on manufacturing sector has attracted attention in the literature over the years as a result of the important role of the manufacturing sector in the economic development of a country (Verdoorn Law, 1949; Thirlwall, 1983; Siyakiya, 2014). Improvement in the manufacturing sector leads to provision of income and poverty reduction (Sachikonye, 1999; Doran, 2009).

Theoretically, many reasons account for the effect of inflation on the manufacturing sector output (Williamson, 1981; Walker & Weber, 1984; Swanson, 1989; Corno, 1994; Grossman & Horrath, 2000; Guerrero & Parker, 2006; Wines, 2006; Karim, 2009; Manalastas, 2009; Damiyano et al., 2012; Nyanga et al., 2013).

The findings of empirical works indicate that inflation negatively influence manufacturing sector output. For example, Loto (2012) study revealed that variables such as capacity utilization (CU), Inflation rate (INF), Lending rate (LR) both shows a positive but insignificant shock on the manufacturing performance of Nigeria for the period of 2005Q1 – 2006Q4 and 2007Q1 to 2008Q4.

Chaudhry, and Ayyoub and Imran (2013) study established significant negative effect of inflation on the manufacturing sector of Pakistan for the period 1972 to 2010. The findings

are in support of that of Siyakiya (2014) study that reported that hyperinflation negatively reduces manufacturing sector output in Zimbabwe for the period 2000-2009 since the economy is highly monetised and has depreciating assets. These findings are not in support of that of Adaora (2013) study for Nigeria. Adaora (2013) reported of significant positive effect of inflation on the manufacturing sector for the period 1981 to 2011. Adaora (2013) study is in line with that of Loto (2012). Osinowo (2015) reported that the manufacturing sector has a positive relationship with all the determinant variables, while inflation rate has negatively influenced output growth of the various sectors with an exception of manufacturing sector.

Controlling inflation over the years have engaged the attention of policy makers in Ghana. Inflation targeting is now one of the main policy focus of policy makers since the issue of inflation control is intractable. Given the important role the manufacturing sector plays, effort are made to examine the influence of inflation on the output of the sector to aid policy making. The few empirical works that have examined the link between inflation and the manufacturing sector output have produced mixed findings and that motivated the current study. The objective of the study is to contribute empirically to the body of knowledge in the area of manufacturing sector productivity by examining the relationship between inflation and manufacturing sector productivity. Specifically, the long run and short run effects of inflation and manufacturing sector productivity are investigated.

The research questions underlying the paper are as follows: (1) what is the nature of short run relationship between inflation and manufacturing sector productivity? (2) What is the nature of long run link between inflation and manufacturing sector productivity? The paper is based on the assumption that inflation have significant effect on manufacturing sector productivity in the short run and the long run. The rest of the paper focuses on the research methodology, results and analysis, conclusions, and policy implications.

2. Research Methodology

The study is based on a quantitative research design, which is appropriate to observe, measure, and explain the relationship between inflation, and manufacturing sector productivity. The link between inflation and manufacturing sector productivity is quantified and explained in the current study. The paper is based on a time series model as specified in equation (1). The dependent variable is manufacturing sector productivity (MSP), whereas the independent variable is inflation (IF). The estimation methods for the study are Johansen model, the Error Correction model, and the OLS regression. The Johansen test is used to examine the stable long run link between inflation and manufacturing sector productivity. The error correction model (ECM) is used for the examination of the short run adjustment to the long run equilibrium. The Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test and the augmented Dickey-Fuller (ADF) test are used to examine the stationarity properties of the series. The paper is based on annual time series data covering the periods 1968 to 2013 for Ghana. Data was obtained from World Development Indicators (WDI).

$$MSP_t = \alpha_t + \beta_t IF_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

3. Empirical Results

3.1 Summary Statistics

Table 1 provides a summary statistics of the test variables in the estimated model. The mean measures the central tendencies, and the values indicate a good fit. The coefficients of variation measure the volatility of the data. The results show that manufacturing sector productivity (0.2622) is less volatile than inflation (0.7407). Inflation falls as low as 2.8892 and as high as 123.0610, whereas manufacturing sector productivity falls as low as 3.7323, and

as high as 15.5420. The standard deviation measures the dispersion of a set of data from its mean. The more spread apart the data, the higher the deviation. The results indicate that manufacturing sector productivity (2.5793) is less spread from the mean than inflation (22.5620). The coefficient of Skewness measures the nature of distribution of the series. The results shows manufacturing sector productivity is negatively skewed (-0.1457) whereas inflation is positively skewed (2.0647). The coefficient of kurtosis measures the nature of peakness. The values (0.1446) and (5.0238) are more than zero and does not indicate more flat-topped distribution.

Table 1 Descriptive Statistics

Summary Statistics, using the observations 1968 – 2013				
Variable	Mean	Median	Minimum	Maximum
MSP	9.8359	9.9714	3.7323	15.5420
IF	30.4606	25.8994	2.8892	123.0610
Variable	Std. Dev.	C.V.	Skewness	Ex. kurtosis
MSP	2.5793	0.2622	-0.1457	0.1446
IF	22.5620	0.7407	2.0647	5.0238

Source: Author's calculation from data collected from WDI, 2016

3.2 Time Series Plots of Inflation (IF) and Manufacturing Sector Productivity (MSP)

Figures 1 to 4 show the time series plots for IF and MSP. Figure 1 indicates inflation is non-stationary in levels. However, figure 2 indicates the series attained stationarity on first difference. Figure 3 shows manufacturing sector productivity (MSP) is non-stationary in levels. However, manufacturing sector productivity attained stationarity on first difference as shown in figure 4. Further, formal investigation of the nature of stationarity properties of the series using the ADF, and KPSS tests are performed and reported in Table 2.

Fig 1. Time series Plot of MSP in level

Fig 2. Time series Plot of MSP in first difference

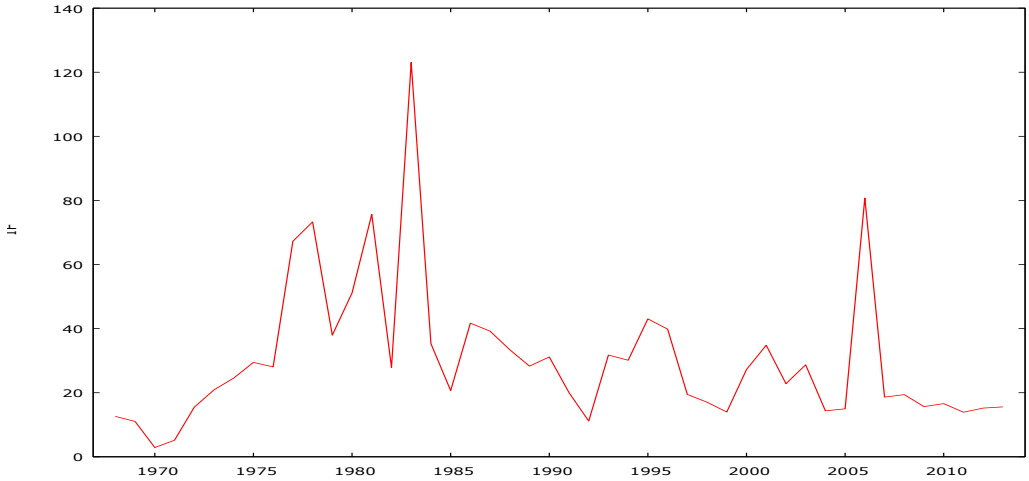

Fig 3. Time series Plot of IF in level

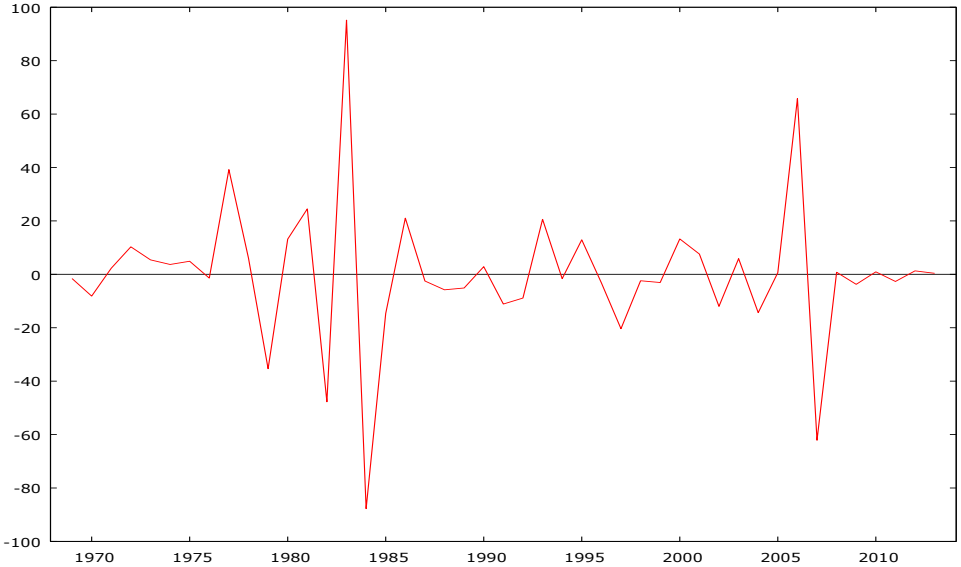

Fig 4. Time series Plot of IF in first difference

3.3 Stationarity Test

The results of the ADF test and KPSS test for stationarity are reported in Table 2 and Table 3. The results show MSP is non-stationary in levels using the ADF test. However, the variable (MSP) attained stationarity on first differencing. The variable IF is stationary in levels and on first differenced.

Table 2 ADF Stationarity Test Results with a Constant and a Time Trend

Variables	ADF-value	T-statistics	P-value	Results	Max Lag
MSP	-0.3469	-2.5906	0.2847	Not Stationary	9
MSP-1st dif.	-1.6388	-3.8484	0.0142	Stationary	9
IF	-1.6863	-4.4344	0.0019	Stationary	9
IF-1st dif.	-2.134	-8.3459	1.321e-013	Stationary	9

Source: Author's calculation from data collected from WDI, 2016

The results based on the KPSS test indicate that the KPSS statistic for MSP (0.1123), and IF (0.1407) in levels is less than 1% value (0.213), and 5% value (0.149). Therefore, the null that MSP is stationary is not rejected. The results based on the KPSS test indicate that the KPSS statistic for MSP (0.0693), and IF (0.0478) in first difference is less than 1% value (0.213), and 5% value (0.149). Therefore, the null that the variables are stationary is not rejected at the 1% and 5% levels.

Table 3 KPSS Stationarity Test Results with a Constant and a Time Trend

Variables	KPSS-value	Results	Max Lag
MSP	0.1123	Stationary	3
MSP-1st dif.	0.0693	Stationary	3
IF	0.1407	Stationary	3
IF-1st dif.	0.0478	Stationary	3
	10% 5% 1%		
Critical values:	0.121 0.149 0.213		

Source: Author's calculation from data collected from WDI, 2016

3.4 Regression Results

3.4.1 Johansen Test Results

The results on the investigation of the stable long run relationship between inflation and manufacturing sector productivity are reported in Table 4. The results show that there is significant long run link between inflation and manufacturing sector productivity using the Johansen method, since both the trace test and the maximum Eigen value test passed the test of stability. The error correction test (ECM) used to examine the short run relationship between inflation and manufacturing sector productivity indicate that there is still disequilibrium in the short run since the error correction term (ECM-1= -0.0141; p=0.5952) is not significant. However, the value is correctly signed. The value indicate that only about 1.4% of errors generated in the previous period is corrected in the current period for the manufacturing sector productivity equation.

Table 4 Johansen Cointegration Test Results and the Vector Error Correction Results

Johansen test:					
Number of equations = 2					
Lag order = 1					
Estimation period: 1969 - 2013 (T = 45)					
Rank	**Eigenvalue**	**Trace test**	**p-value**	**Lmax test**	**p-value**
r=0	0.4023	27.286	[0.0004***]	23.162	[0.0011***]
r=1	0.0876	4.1240	[0.0423**]	4.1240	[0.0423**]
Variable	**Coefficient**	**Std. Error**	**T-Ratio**	**P-value**	
EC-1	-0.0141	0.0264	-0.5353	0.5952	
Mean dependent var	-0.1937		S.D. dependent var	1.4497	
Sum squared resid	91.8656		S.E. of regression	1.4616	
R-squared	0.0067		Adjusted R-squared	-0.016	
rho	0.2325		Durbin-Watson	1.5336	

Source: Author's Calculation from Data Collected from WDI, 2016. Note *** and ** denote significance at 1% and 5% levels of significance.

3.4.2 OLS Regression Results

Since there is stable long run relationship between inflation and manufacturing sector productivity, the OLS regression was used to investigate the nature of the coefficients (magnitude and direction of signs). The results are shown in Table 5. The result shows that inflation is negatively related to manufacturing sector productivity. The results indicate that 1% increase in inflation leads to about 3% decrease in manufacturing sector productivity. The values of the R^2 and adjusted R^2 in Table 5 are not indication of a well-behaved model. The results indicate that the estimated model accounts for about 9% of the changes in manufacturing sector productivity equation.

Table 5 OLS Regression Results

Model : OLS, using observations 1969-2013 (T = 45) Dependent variable: MSP					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	10.8932	0.8301	13.1223	<0.0000	***
IF_{-1}	-0.0375	0.0165	-2.2713	0.0282	**
Mean dependent var	9.7388	S.D. dependent var		2.5218	
Sum squared resid	247.9316	S.E. of regression		2.4012	
R-squared	0.1139	Adjusted R-squared		0.0933	
F(1, 43)	5.1588	P-value(F)		0.0282	
Log-likelihood	-102.2483	Akaike criterion		208.4965	
Schwarz criterion	212.1099	Hannan-Quinn		209.8435	
Rho	0.7773	Durbin-Watson		0.4428	

Source: Author's Calculation from data Collected from WDI, 2016. Note ** denotes significance at 5% level.

3.4.3 Results of Diagnostic and Stability Tests

Table 6 reports the shows the diagnostic tests results of the OLS regression to examine the reliability of the estimated parameter coefficients. The estimated model passed the specification test, the heteroskedasticity test, and the normality test. However, the model failed the autocorrelation test.

Table 6 Diagnostic Test Results of OLS Regression

A. Reset Test for Specification
Null hypothesis: specification is adequate Test statistic: F(2, 41) = 0.0175086 with p-value = P(F(2, 41) > 0.0175086) = 0.982651
B. Breusch-Pagan Test for Heteroskedasticity
Null hypothesis: heteroskedasticity not present Test statistic: LM = 0.490457 with p-value = P(Chi-square(2) > 0.490457) = 0.782526
C. Test for Normality of Residual
Null hypothesis: error is normally distributed Test statistic: Chi-square(2) = 2.06008 with p-value = 0.356993
D. LM Test for Autocorrelation up to order 7
Null hypothesis: No Autocorrelation Test statistic: LMF = 9.395 P-value = P(F(7,44) > 9.395) = 4.5551e-007

Source: Author's Calculation from data Collected from WDI, 2016.

The stability tests results (CUSUM and CUSUMSQ) as reported in figures 5 and 6 show that, the estimates and the variance as well as the residuals are not stable whereas the square residual are stable, since they fall outside the 5% critical boundaries in the CUSUM and in the case of the CUSUMSQ, they fall within the 5% critical boundaries. The null assumptions of parameter stability are rejected in the CUSUM test; however, they are accepted in the CUSUMSQ test.

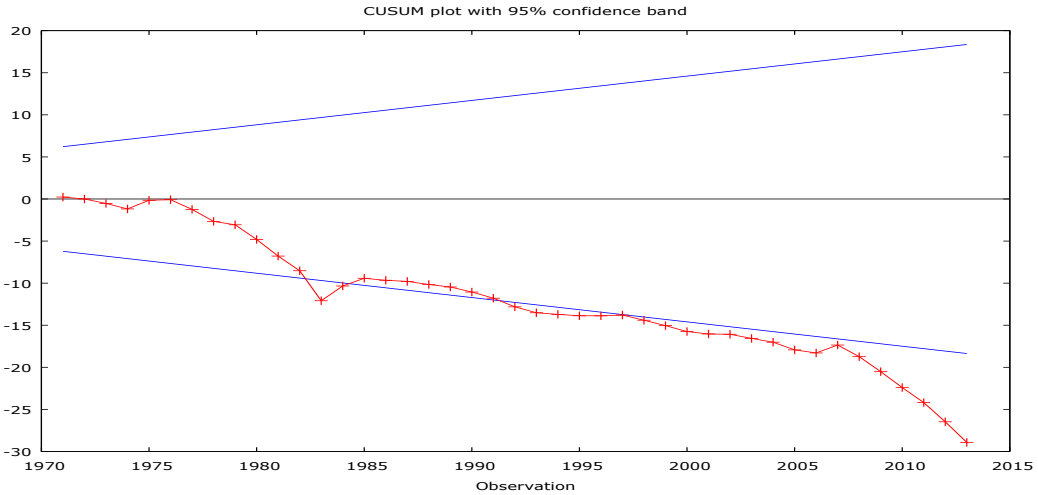

Figure 5 Plot of CUSUM

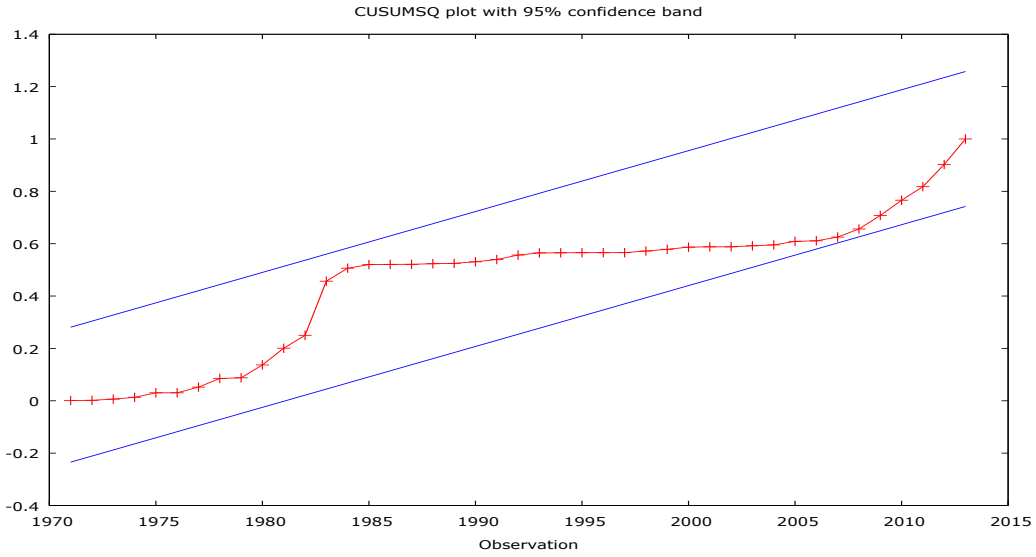

Figure 6 Plot of CUSUMSQ

4. Conclusions and Policy Implications

The study shows that inflation and the manufacturing sector output are linked in the long run. Changes in the manufacturing sector productivity are explained by changes in inflation in the long run. The findings from the OLS results indicate that there is negative effect of inflation on the manufacturing sector productivity. The findings support the previous studies by researchers such as Chaudhry et al. (2013); Siyakiya (2014) and Osinowo (2015). However, the findings are not in line with that of Adaora (2013) and Loto (2012).

Given the importance of the manufacturing sector to an economy, the current study investigates the inflation-manufacturing productivity nexus for Ghana for the period 1968-2013, using annual time series data. The empirical assessment was done by using the JT, VECM, and the OLS regression. The results indicate significant stable long run link between inflation and the manufacturing sector productivity. However, there is insignificant short run link between the two variables. The results of the OLS indicate significant negative relationship between inflation and the manufacturing sector productivity. The results of the study suggest inflation during the period under consideration has led to a decrease in manufacturing sector productivity. The policy implication is that inflation must be managed very well in order to improve manufacturing sector productivity.

Future study should examine the current issue of causality modelling, and structural breaks, since the present study did not consider these issues. Since the current study is based on bivariate analysis, future studies should consider multivariate analysis using other variables such as exchange rate, monetary variables, and government expenditure. Predictive conclusions could not be made since causality issues are not considered.

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