IMPACT OF MACROECONOMIC FACTORS ON INDUSTRIAL PRODUCTION IN GHANA

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Abstract

The article looks at the impact of macroeconomic indicators on industrial production in Ghana. The ordinary least squares estimation technique is utilized given the sample size of 21 due to the unavailability of data. The study identified real petroleum prices (-), real exchange rate (-), import of goods and services (+) and government spending (+) as the key macroeconomic factors that influence industrial production in Ghana. Based on the findings, we recommend that the government of Ghana should continue to stabilize the macroeconomic environment of Ghana in order to achieve industrial growth and development.

Keywords: Industrial Production, Macroeconomic Factors, Ordinary Least Squares Estimation Technique

1.0 Introduction

The study is about the impact of macroeconomic factors on industrial production in Ghana. The main objective of the study is to find out the key macroeconomic indicators that influence industrial production in Ghana. The ordinary least squares estimation technique is used and a sample size of 21 due to the unavailability of data. The study indentifies petroleum prices, real exchange rate, import of goods and services and government spending as the key macroeconomic factors that influence industrial production in Ghana.

Economic growth and development go with industrialization. Experience has shown that over the past 4 to 5 decades industrialisation has played crucial role in transforming many low-income countries to middle-income countries, like South Korea, Malaysia, and Singapore. Africa's economic growth highly depends on production and export of primary commodities. Enu et al. (2013) studied "Achieving higher GDP growth in Ghana: which sector is to lead?" and the results showed that a 1% increase in the growth of the agricultural, service, and industrial sectors would cause GDP growth to increase by 0.452849%, 0.376697% and 0.182838% respectively. Also Elhiraika (2008) studied on the topic promoting manufacturing to accelerate economic growth and reduce volatility in Africa by using data from 36 African countries; the paper examined the key determinants of manufacturing share in aggregate output and its relationship with real GDP growth and growth volatility. The analysis indicated that an increased share of manufacturing in total output has the potential to raise GDP growth and reduce growth volatility. It therefore argued that African countries should design and implement effective industrial policies to promote manufacturing and other innovative activities as a means to boost economic transformation and achieve economic and social development goals, including employment creation and poverty reduction. These substantiate the fact that industrial production is very important to Africa's growth and development (see also Anaman and Osei-Amponsah, 2007).

The industrial sector of the Ghanaian economy comprises of mining and quarrying, manufacturing, construction, electricity and water. Mining sector dominates foreign exchange earnings for Ghana (the State of the Ghanaian Economy (SGE), 1992). Industry is the second fastest growing sector in the Ghanaian economy with 7% average annual rate of growth during 1987 – 1990 (SGE, 1992). For Ghana to further enhance its middle income status with a per capita income of US$1000 the industrial sector must play a critical role. Unfortunately, the industrial sector performance has not been very encouraging. For example, the industrial sector employment fell from 62% in 1983 to 53.5% in 1988.

Over the years, the industrial sector has been stagnated because of poor performance of the agricultural sector which serves as a source of raw materials for the industrial sector (SGE, 2004). The industrial sector of Ghana fell into a deep trough in the late 1970s and early 1980s, the sector has not even recovered to its levels of the early 1970s (SGE, 2004). For instance, in the manufacturing sector, although capacity utilization has increased from its low level of 18% in 1984 to 40% in 1988, it has started to decline since then, registering 38% in 1989 and 37% in 1990. The rate of growth of output has also slowed down from 25% recorded in 1985 to only 1.7% in 1989 (SGE, 1992). In 1989, the rate of growth of industrial gross domestic product fell to 2.6% which was well below the previous year's level of 7.2% (SGE, 1992). What factors might have accounted for these declines?

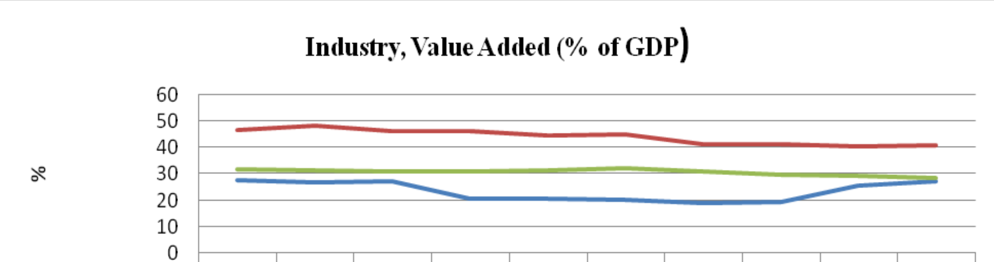
Policy makers in their bid to arrest the situation introduced some policy initiatives which included the economic recovery programme, structural adjustment programme, industrial sector adjustment credit and vision 2020. Yet the needed target was not achieved. The economic liberalization through the introduction of the structural adjustment programme led to comparatively strong industrial growth in the second half of the 1980s. Things took a turn for the worse after 1991 to the extent that by 2000, Ghana's position showed a marked deterioration in the rankings of the United Nations Industrial Development Organization (SGE, 2004). The relative share of manufacturing value added to GDP, for instance, has declined in Ghana from 11% to 9% in real terms over the last two decades and manufacturing value added per capita is down from US$48 to US$42 during the same period (SGE, 2004). Even though the industrial sector showed some signs of recovery in the early 2000s, there has been stagnation in the sector in the past two years, with the provisional outturn of national accounts for 2004 indicating a growth rate of 5.1%, the same rate as in the previous year (SGE, 2004). This was not only below the growth target of 5.2% but also below the 5.8% growth rate of the whole economy in 2004 and far lower than the estimated average growth rate of 6% for developing countries for the year (SGE, 2004). Moreover, it fell far short of the target average growth rate of 12% necessary to meet the government's goal of increasing industry's share of GDP to 37% by 2007 from the current level of 24.7% in current prices. The contribution of the manufacturing sector to the country's GDP was 10.2% in 2006; this fell to 6.8% in 2010 and to 6.7% (SGE, 2005).

Again, new initiatives, and sectoral developments and policies were introduced by the government over the years to arrest the situation in the year 2000s. The initiatives included National Industrial Policy, the Private sector Development Strategy, the Industrial Sector Support Programme, and the National Export Strategy to improve Competitiveness and enhance job-creation. The Sectoral Developments and Policies included tax policies which sought to reduce duties on imported inputs and reduce excise taxes as well as corporate taxes. Also, the investment code was revised to make it more attractive to investors. In addition, special policy measures such as those aimed at supporting local (small-scale) industries in both the manufacturing and mining sectors were also implemented. Rehabilitation of the railways, growth and poverty reduction strategies to create a modern productive economy, with high levels of value-addition were other policy measures that were put in place to expand productive employment in the manufacturing sector and expand technological capacity. There was also the transformation of agriculture through agro-based industrial development projects which provided consumers with fairly-priced better quality products and services and were competitive in both the domestic and international markets.

Ghana's government policy thrust is the promotion of accelerated and sustainable industrial development within a liberalized economic environment (SGE, 2004). Again, the main long-term policy objective of Ghana is to move the industrial sector from third to first position in terms of contribution to GDP. However, these initiatives have not yielded the desired results. The implication here is that the industrial sector has not fully recovered from the decline in its relative contribution to GDP that began in 2000 (for example in 2005 agric, service and industry composition of GDP were 37%, 29% and 24.7% respectively (Ghana Statistical Service; Budget statement, 2005). This also means that the level of industrial activity appears too low to influence any substantial growth in per capita income and contribute to the massive reduction in poverty levels that would help attain the MDG goals within the 2015 target which is very close.

Comparing Ghana to Malaysia and South Africa (which are middle income countries) in terms of industry, value added (% of GDP) from 2003 to 2012, averagely Malaysia recorded (44%), and South Africa recorded (31%) while Ghana recorded (24%). Ghana's industrial growth fluctuates greatly as compared to Malaysia and South Africa which have more steady growth rates over the years 2003and 2012. Ghana's industrial growth declined sharply between 2005 and 2006. The industrial sector's performance remained just about the same with almost no improvements until 2010 when it began to increase again but these growth rates are relatively low compared to that of South Africa and Malaysia as shown in Figure 1 below.

Fig 1: Industry, Value Added (% of GDP)



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Ghana	27.8	27.1	27.5	20.8	20.7	20.4	19	19.4	25.8	27.3
Malaysia	46.6	48.5	46.4	46.5	44.6	45.1	41	41.1	40.3	40.7
South Africa	31.7	31.3	31.2	31.2	31.3	32.3	31	29.8	29.2	28.4

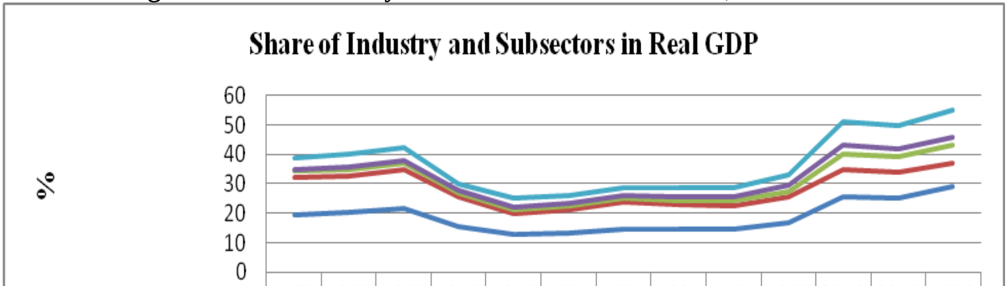
Source: World Development indicators 2013

How can Ghana grow her industrial sector to become like that of Malaysia or South Africa? The current best is not enough. The diagnosis could be either that, not enough effort is being devoted to meet the challenges of the industrial sector, or the right strategy is not being used to address the problems. In order to transform Ghana into an industry driven economy that delivers high level of productivity as well as decent jobs, a sufficient condition is that policy makers must understand how macro indicators affect industrial production in Ghana so that they can better suggest the way forward for Ghana. Unfortunately, there is limited literature on the sources of industrial production in Ghana. This calls for an investigation into the factors that influence industrial production in Ghana. This will better inform policy makers as to what to do so as to arrest the industrial declines Ghana has experienced over the years. Hence, the need for this study.

2.0 Performance Of The Industrial Sector In Ghana

Contribution to GDP

Fig 2: Share of Industry and sub-Sector in Real GDP, 1970 – 2008



	1970	1973	1976	1979	1982	1985	1988	1991	1994	1997	2000	2003	2008
Construction	3.9	4.3	4.7	2.3	3	2.5	2.6	2.8	3	3.5	7.9	8	9.3
Electricity & Water	0.3	0.7	0.7	0.7	0.9	0.9	1.2	1.4	1.5	2	2.8	2.5	2.5
Mining & quarrying	2.4	2.3	2	1.3	1.2	1.2	1.2	1.3	1.5	1.7	5.6	5.2	6.2
Manufacturing	12.7	12.7	13.8	10.7	7.4	8.5	9.4	8.8	8.3	9.3	9.2	9.1	8.1
Industry	19.3	19.9	21.2	15.1	12.6	13	14.4	14.3	14.3	16.5	25.5	24.9	28.9

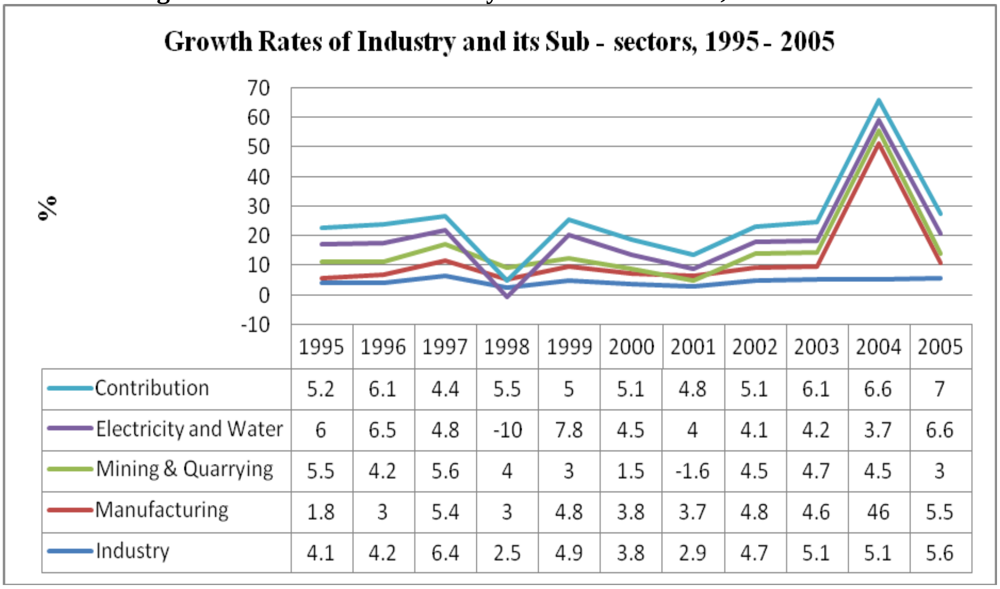
Source: The State of the Ghanaian Economy (SGE), Various Issues.

The share of industry in real GDP has averaged approximately 14.2% over the past 20 years (1987-2003) as compared to that of South Korea and Malaysia which is 80%. Although this performance is an improvement over the earlier years of the 1980s, it is below the 1970s average (20%) and particularly 1977 which was 21.5%. The question that comes to mind is what is not being done right in terms of policy formulations and implementations?

The sub-sector experienced a reduction in its growth rate in the year 1998 (1997 = 5.6%, 1998 = 4%) due to electricity outages experienced. The manufacturing sector witnessed a reduction in growth rate (1995 = 1.8%, 1997 = 5.4%, 1998 = 3%) due to power crises. Consequently, firms cut down production and laid of some workers which contributed to a fall in industrial output. Water and Electricity also witnessed a negative growth rate in 1998

(1996 = 6.5%, 1997 = 4.8%, 1998 = -10%). What other factors might have accounted for these declines? See further evidence below.

Fig 3: Growth Rates of Industry and its Sub-sectors, 1995 - 2005

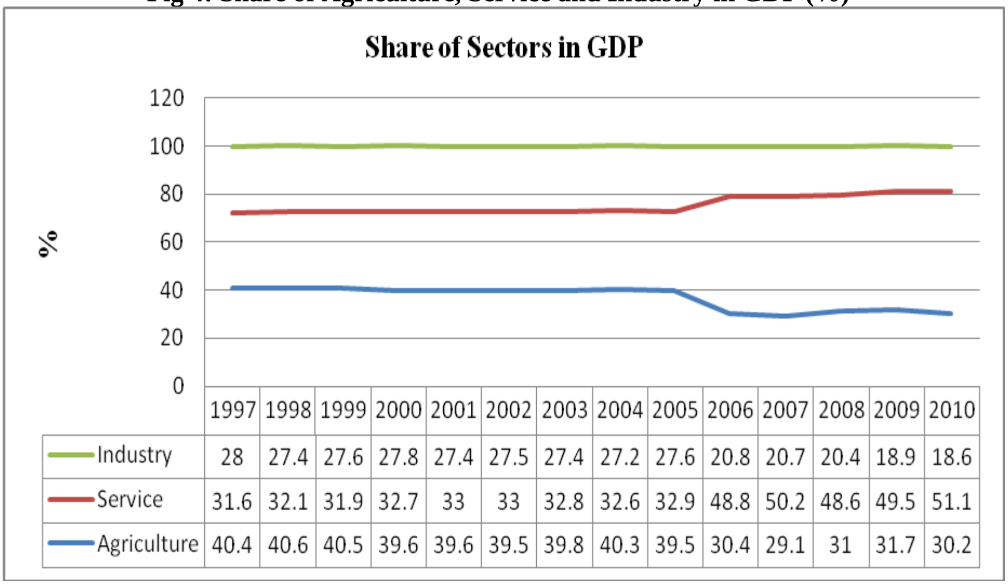


	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Contribution	5.2	6.1	4.4	5.5	5	5.1	4.8	5.1	6.1	6.6	7
Electricity and Water	6	6.5	4.8	-10	7.8	4.5	4	4.1	4.2	3.7	6.6
Mining & Quarrying	5.5	4.2	5.6	4	3	1.5	-1.6	4.5	4.7	4.5	3
Manufacturing	1.8	3	5.4	3	4.8	3.8	3.7	4.8	4.6	46	5.5
Industry	4.1	4.2	6.4	2.5	4.9	3.8	2.9	4.7	5.1	5.1	5.6

Source: State of the Ghanaian Economy (SGE), various issues.

The worst hit sector was the industrial sector in terms of sectoral comparism. Averagely (1997-2010), the share of the service, agriculture and industry in GDP are 39%, 37% and 25% respectively.

Fig 4: Share of Agriculture, Service and Industry in GDP (%)



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Industry	28	27.4	27.6	27.8	27.4	27.5	27.4	27.2	27.6	20.8	20.7	20.4	18.9	18.6
Service	31.6	32.1	31.9	32.7	33	33	32.8	32.6	32.9	48.8	50.2	48.6	49.5	51.1
Agriculture	40.4	40.6	40.5	39.6	39.6	39.5	39.8	40.3	39.5	30.4	29.1	31	31.7	30.2

Source: The State of the Ghanaian Economy (SGE), various issues.

What macro factors might have contributed to this abysmal performance of the industry sector?

3.0 Theoretical Literature Review

Production means transformation of inputs (goods and services) into output. It is also the creation (addition) of wealth or value. Factors affecting production are natural factors, technical progress, political factors, infrastructure facilities, character of people. The main production inputs are land, labour, capital, management services, materials, technologies and organization or enterprise.

There are a range of factors in the business environment such as infrastructure, the efficiency of markets, market incentives, taxation and regulation which affect the productivity of firms and the efficiency of the economy as a whole. Investment in infrastructure affects the costs of firms of accessing resources and markets, and market conditions affect firm incentive to invest, be enterprising and innovate.

The Cobb-Douglas Production Function, the Constant Elasticity of Substitution Production Functions and Stochastic Production Frontiers are kinds of production functions.

Cob-Douglas Production Function

A production function in which output is related to the inputs of labour and capital in a multiplicative fashion of the following form: $Q = AK^{a}K^{b}$ where A is neutral shift factor and **a** and **b** are constant values of each input's relative share. The Cobb-Douglas production function is very frequently written as a function of homogenous of degree of one, that is, with $a + b = 1$ and is characterised by unitary elasticity of substitution. The fact that $a + b = 1$ means constant returns to scale. If $a + b > 1$ means increasing returns to scale. If $a + b < 1$ mean decreasing returns to scale. Numerous empirical studies suggest that this mathematical form of the production process is a reasonable representation of the activity that occurs within manufacturing firms (see Nto et al., 2012; Onyeranti, 2012). It has been employed in many production function studies utilizing time series as well as cross-section data, and it has been applied at various times to countries, industries, and firms. A Cobb-Douglas production function may be easily estimated using linear regression analysis after taking the logarithm of both sides of the function. The translog production function is a generalization of the Cobb-Douglas production function (Koutsoyiannis, 2006; Truett and Truett, 1987; Shim et al., 1995).

The Constant Elasticity of Substitution (CES) Production Functions

The constant elasticity of substitution production functions dominates in applied research. The parametric structure is $Y = A[\theta(a_k K)^\gamma + (1 - \theta)(a_N N)^\gamma]^{1/\gamma}$. Where $0 < \theta < 1$ is the share parameter and γ determines the degree of substitutability of the inputs. The parameters A, a_k, and a_N depend upon the units in which the output and inputs are measured and play no important role. The value of γ is less than or equal to 1 and can be $-\infty$. The two extreme cases are when $\gamma = 1$ or $\gamma = -\infty$. When $\gamma = 1$, it is the case of perfect substitution. The function becomes $Y = A[\theta a_k K + (1 - \theta) a_N N]$ and the isoquants are straight lines for this production function. When, it is the case of no substitution. The function is $Y = A \min [a_k K, a_N N]$. The Isoquants are at right angles. Factors are used in fixed proportions (Wikipedia, the free encyclopedia).

Stochastic Production Frontiers

Stochastic frontier analysis (SFA) is a method of economic modeling. It has its starting point in the stochastic production frontier models simultaneously introduced by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977). The production frontier model without random component can be written as: $y_i = f(x_i;\beta) \cdot TE_i$ where y_i is the observed scalar output of the producer i, $i = 1,..I$, x_i is a vector of N inputs used by the producer i, $f(x_i;\beta)$ is the production frontier, and β is a vector of technology parameters to be estimated. TE_i denotes the technical efficiency defined as the ratio of observed output to maximum feasible output. $TE_i = 1$ shows that the i-th firm obtains the maximum feasible output, while $TE_i < 1$ provides a measure of the shortfall of the observed output from maximum feasible output.

A stochastic component that describes random shocks affecting the production process is added. These shocks are not directly attributable to the producer or the underlying technology. These shocks may come from weather changes, economic adversities or plain luck. We denote these effects with $\exp\{v_i\}$. Each producer is facing a different shock, but we assume the shocks are random and they are described by a common distribution.

The stochastic production frontier will become: $y_i = f(x_i;\beta) \times TE_i \times \exp\{v_i\}$. We assume that TE_i is also a stochastic variable, with a specific distribution function, common to all producers. We can also write it as an exponential $TE_i = \exp\{-u_i\}$, where $u_i \geq 0$, since we required $TE_i \leq 1$. Thus, we obtain the following equation: $y_i = f(x_i;\beta) \times \exp\{-u_i\} \times \exp\{v_i\}$ Now, if we also assume that $f(x_i, \beta)$ takes the log-linear Cobb-Douglas form, the model can be written as: $\ln y_i = \beta_0 + \sum_n \beta_n \ln x_{ni} + v_i - u_i$ where v_i is the "noise" component, which we will almost always consider as a two-sided normally distributed variable, and u_i is the non-negative technical inefficiency component (Wikipedia, the free encyclopedia).

4.0 Empirical Literature Review

A number of studies have estimated the relative contributions of the factors of production through estimating production functions at the firm, industry and national level.

Goldar et al. (2003) using industry level data from Annual survey of industries and incorporating some trade-related variables explicitly into econometric analysis, concluded that tariff reforms have favourable and significant effects on TFPG whereas the deceleration in productivity growth in the 90s is perhaps due to slower growth in agriculture and gestation lag in investment project.

Akinlo (2006) examined the effects of macroeconomic factors on productivity in 34 sub-Saharan African countries for the period 1980 to 2002. The result showed that external debt, inflation rate, lending rate among others negatively influenced productivity. Human capital, credit to private sector % of GDP, foreign direct investment % of GDP, manufacturing value added as a share of GDP have significant positive influence on productivity.

Msuya et al., (2008) tried to explain productivity variation among small holder maize farmers in Tanzania using Stochastic Frontier Production Function (SFPF). They found that low level of education of farmers, lack of extension services; limited capital, land fragmentation and unavailability of inputs among others were the major determinants of productivity in Tanzania.

Constantin et al., (2009) used the Cobb – Douglas functional form of Stochastic Frontier Production function to examined productivity of Brazilian agribusiness. They identified harvest area, credit, and lime stone as significant variables that influence productivity in Brazil.

Nto and Mbanasor (2011) in a study on "productivity in agribusiness firms and its determinants in Abia State, Nigeria", they observed that the major determinants of productivity are skilled labour and raw materials. While skilled labour exerted positive influence on productivity with coefficient of 0.823, cost of raw materials negatively influenced productivity among agribusiness firms in the area.

Nto et al. (2012) examined the determinants of productivity among manufacturing firms in South-Eastern Nigeria. The study employed the Cobb-Douglas Production Function in the analysis of the data. The study revealed that the major determinants of productivity are amount spent on unskilled labour (+), cost of raw material (+) and net productivity asset (+) with all exhibiting expected positive influence on productivity at 1% probability level respectively.

Ray (2012) determined the determinants of total factor productivity growth in selected manufacturing industries in India. Using OLS technique, the econometric result suggested that explicit trade variables as well as macro economic variables have relevant significant impact on total factor productivity growth of those industries. The unmistakable implication for Indian policymakers is the need to open up more to foreign imports, which will help to bring about institutional and technological progress conducive to TFP growth.

Anaman et al. (2009) examined the determinants of the output of the manufacturing industry in Ghana from 1974 to 2006. They employed cointegration and error correction model analysis to establish the determinants. They showed that the level of output of the manufacturing industry was driven in the long-run period by the level of per capita real GDP (+), the export-import ratio (+) and political stability (+). In the short run period the level of output of the manufacturing industry was influenced by the export-import ratio (+) and political stability (+). They suggested that increasing level of manufacturing in Ghana would partly depend on the growth of export – based manufacturing firms.

There is little work done on macroeconomic factors that influence industrial production in Ghana, as a result, this research paper.

5.0 Methodology

Model Specification

The Cobb -Douglas production function through the application of the Ordinary Least Squares method is employed to examine the impact of macroeconomic indicators on Ghana's industrial production.

The multiple regression equation model to determine the impact of macro factor on industrial production is Ghana is specified as:

$$\ln IQ_t = \alpha_0 + \alpha_1 \ln(L_t) + \alpha_2 \ln(RPP_t) + \alpha_3 \ln(REX_t) + \alpha_4 \ln(IMP_t) + \alpha_5 \ln(GE_t) + \varepsilon_t$$

Where;

IQ_t = Industrial Output measured as industry, value added as a % of GDP at time t.

Lt = labour force measured as population growth rate at time t.

RPPt = real petroleum prices at time t.

REXt = real exchange rate at time t.

IMPt = import of goods and services measured as import of goods and services as a % of GDP at time t.

ln = natural logarithm

GE = is government expenditure measured as government expenditure as a % of GDP at time t.

ε_t = the stochastic term

α_0 is the value of the intercept while α_1, α_2, α_3, α_4, and α_5 are the partial elasticities with respect to the independent variables respectively.

$\alpha_0 > 0$, $\alpha_1 > 0$, $\alpha_2 < 0$, $\alpha_3 < 0$, $\alpha_4 < 0$, and $\alpha_5 > 0$

Method of Estimation

This study utilized the ordinary least squares estimation technique. The reason is that it is one of the simplest methods of linear regression. It goal is to closely fit a function with data and it does so by minimizing the sum of square errors from the data.

Statistical criteria

R^2-coefficient of determination

It shows the percentage of variation in the dependent variable that was accounted for by variations in the explanatory variables. It measures the explanatory powers of the model. It is usually between zero and one. The implication of it is to determine whether the model has a good fit or not. (Atoyebi et al., 2012).

Testing for the statistical significance of the individual parameters

We utilized the t-test. The t –statistic shows the significance of each explanatory variable in predicting the dependent variable. The t-statistic is defined as $\text{t-statistic} = b_i / s_{bi}$. Generally, a t-statistic greater than +2 or less than -2.0 is acceptable (Shim et al., 1995). Also, the p-value was employed to further ascertain the significance of the individual parameters. If the p-value is greater than 0.05 (> 0.05), we failed to reject H_o and conclude that there is no significant. If the p-value is less than 0.05 (< 0.05), we reject Ho and conclude that the parameter is significant.

Testing for the Overall Significance of the Model

We used the F-statistic. The F-statistic is used to test for the overall significance of the estimated regression. We computed the F-statistic given as $\text{F-Statistic} = \dfrac{(\text{explained variation})(n - k - 1)}{(\text{unexplained variation})(k)}$. The F-calculated is compared with F-tabulated. If F-cal is greater than F-tab we reject the null hypothesis and conclude that the variable is statistically significant in explaining the dependent variable. The higher the value of the F-statistic, the greater the overall significance of the estimated regression. If the F-calculated is greater than the F-tabulated, the F-statistic shows a higher degree of association between the dependent variables. (Atoyebi et al., 2012).

Econometric criteria
Multicollinearity

Linear relationships among the sample values of the explanatory variables. The variance inflation was used to determine whether the independent variables were multicollineared. The variance inflation factor is given as $\mathrm{VIF}(\hat{\beta}_i) = 1/(1 - R_i^2)$. Here, we run a regression of the explanatory variable Xi (ith independent variable) on all remaining explanatory variables in the equation. We then found the R_i^2 statistic for the regression. We calculated the variance inflation factor. The decision rule is that a variance inflation factor greater than 5 to 10 indicates severe multicollinearity or otherwise (Koutsoyiannis, 2006).

Autocorrelation

Error term, dependent and independent variables may be correlated with each other or error term in one period may affect the error term in the next or other time period(s). DW indicates whether there is a serial correlation in the model. If there is serial correlation in the model it therefore implies that the model has lost its predictive power (Atoyebi et al., 2012). To detect the presence of autocorrelation, the conventional and widely agreed method used was the Durbin Watson Statistic which is given as $DW = \sum_{t=2}^{N}(e_t - e_{t-1})^2 \Big/ \sum_{t=1}^{N} e_t^2$ where e_t is the tth residual. If the DW lies between 1.5 and 2.5, it indicates no autocorrelation. If it lies below 1.5, it indicates positive autocorrelation and if it is above 2.5, it indicates negative autocorrelation (Shim et al., 1995).

Heteroscedasticity

To detect the presence of heteroscedasticity we employed the park test. With the park test, we run the original regression and generate the residuals (e_t). We square the residuals to obtain e_t^2. We obtained the log values of e_t^2 and the independent variables. We then run the log of each of the independent variables on the log of e_t^2. If a statistical significant relationship exist between log of e_t^2 and log of each of the independent variables, then the null hypothesis of no heteroscedasticity can be rejected in which we will have to take some remedial measures.

Comparing DW and R2

If the DW is greater than the R2, it indicates no spurious regression. However, if the DW is less than the R2, it indicates spurious regression. Hence, the need for cointegration analysis.

Source of Data/Sample Size

Data for all the variables of interest were taken from the World Development Indicators 2012. The data cover the time series period from 1990 to 2010. This period was chosen because this was the time that Ghana started recording positive growth trends (The State of the Ghanaian Economy, 1990).

Statistical Package used

The econometric package used for all the analysis was gretl.

6.0 Empirical Results And Discussions

Model 4: Heteroskedasticity-corrected estimates using the 21 observations 1990-2010

Dependent variable: lnQ

Variable	Coefficient	Std. Error	t-statistic	Critical value of t ($\alpha = 5\%$)	p-value	Critical value of F ($\alpha = 5\%$)	VIF
const	3.80185	0.953736	3.9863		0.00119		
lnPop	-0.615226	0.340679	-1.8059		0.09104		2.040
lnRPP	-0.225834	0.0254435	-8.8759		<0.00001		1.615
lnREX	-0.322787	0.109107	-2.9584	2.13	0.00976	2.90	3.453
lnIMP	0.331532	0.0714997	4.6368		0.00032		3.446
lnGE	0.408656	0.0864207	4.7287		0.00027		1.281

Sum of squared residuals = 87.0556; Standard error of residuals = 2.40909; Unadjusted R^2 = 0.914373; Adjusted R^2 = 0.88583; F-statistic (5, 15) = 32.0356 (p-value < 0.00001); Durbin-Watson statistic = 2.24466; First-order autocorrelation coeff. = -0.122825; Akaike information criterion = 101.458; Schwarz Bayesian criterion = 107.725; Hannan-Quinn criterion = 102.818; Mean of dependent variable = 3.17725; Standard deviation of dep. var. = 0.199813; Sum of squared residuals = 0.0814398; Standard error of residuals = 0.0736839

The Robustness of the Model

R^2 is the coefficient of determination measures the goodness of fit of the model. The model has a very good fit. The value of the R^2 is 0.914373 which implies that about 91% of the variation in industrial output is explained by the regression. The remaining is about 8.6%. This value might be due to the other factors not considered in this model and possible errors of measurement in industrial output. The value of the F-statistic is 32. 0356.

This value is statistically significant since the value of the F-statistic is greater than the critical value of F (32.0356 > 2.90). The p-value also confirms the statistical significance of the F-statistic (0.00001 < 0.05). So we accept the model is significant overall. The value of the DW is greater than the value of the R^2 (2.24466 > 0.914373). This indicates that this model is sensible and acceptable and meaning that meaningful inferences can be made from it. There is no problem of multicollinearity since the value of the Variance Inflation Factor (VIF) for each of the independent variable is less 10. In addition, there is no problem of autocorrelation since the value of DW lies between 1.5 and 2.5. Finally, since we took the logarithm of the equation we do not worry about the problem of heteroscedasticity. This is done in order to avoid the problem of heteroscedasticity (Maddala, 1992).

Interpretations of the various coefficients

If there are no macroeconomic indicators, averagely, the growth rate of Ghana's industrial sector is 44.784% ($e^{3.80185}$). It is statistically significant at the 5% significance level.

We postulated the relationship between labour force and industrial output to be positive. Surprisingly, our expectation did not come true. It was rather the opposite. That is a negative relationship. The relation is -0.615226. This value is less than unity implying an inelastic effect. It can be inferred from this value that a 1% increase in total labour force leads to a decrease in total industrial production in Ghana by 0.615226%, all things being fixed. This value is statistically insignificant since the p-value (0.09104) is greater than 0.05. The implication is that Ghana does not have the needed skilled labour force to grow and develop her industrial sector though the labour force keeps on increasing year after year. This finding contradicts with the finding of Akinlo (2006) and Nto et al., (2011).

The results of the log linear regression model fitted to the annual data show that the regression coefficient of log real petroleum price (RPP) is significantly negative and less than unity implying an inelastic effect. That is -0.225834. It can be inferred from this that a 1% increase in real price of petroleum causes a decrease in industrial output by 0.225834%, all else equal. On the other hand, a 1% decrease in real petroleum price leads to an increase in Ghana's industrial production by 0.225834%, ceteris paribus. This coefficient is statistically significant since the value of the t-statistic is greater than the value of the t-critical (8.8759 in absolute terms > 2.13). This implies that as petroleum price increases it will affect industrial output negatively due to an increase in cost of production.

The regression results show that the coefficient of log of real exchange rate is negatively significant showing that a 1% increase in real exchange rate is associated with the decrease of 0.322787% in industrial output (inelastic), all things being equal. Alternatively, a 1% decrease in real exchange rate causes industrial production to increase by 0.322787%, all else equal. It is statistically significant at the 5% level. This further implies that if the value of the foreign currencies exceeds that of the local currency due to demand and supply of foreign currency as against local currency prices on imported raw materials will be very expensive which will adversely affect industrial production. The reverse is also true.

The coefficient of log of import of goods and services as percentage of GDP is 0.331532 (inelastic) evincing the fact that a 1% increase in the import of goods and services leads to a 0.331532% in industrial output. On the other hand, a 1% decrease in import of goods and services causes industrial output to decrease by 0.331532%, ceteris paribus. It is statistically significant at the 5% significance level. This further implies that Ghana imports some goods and services such as raw materials, machinery and technology which help in the expansion and development of her industrial production.

The sign of the coefficient of log of government expenditure is positive (0.408656) showing that a 1% increases in government spending causes industrial output to increase by 0.408656%. On the other hand, a 1% decrease in government leads to a 0.408656% decrease in industrial output, all else equal. This value is statistically significant at the 5% significance level. This implies that government interventions in the areas of electricity, water, good roads, and factory buildings and so on are crucial for Ghana's industrial growth and development.

7.0 Policy Recommendations

From the above analysis the following policies are recommended.

1. The labour force should be trained more technically than administratively.
2. Ghana should speed up and increase her oil production than relying on external suppliers which comes with an extra cost.
3. The fight to stabilize the monetary policy environment should be continued.
4. Ghana has to open up more to foreign imports such machinery, raw materials, technologies and so on which will help to bring about institutional and technological progress.
5. The government of Ghana should continue to spend in the productive sectors of the Ghanaian economy like electricity, water, good road, factory building, health, education and so on.

8.0 Conclusion

The study was about the impact of macroeconomic indicators on industrial production in Ghana. The main objective of the study was to find out the key macroeconomic indicators that influence industrial production in Ghana. The ordinary least squares estimation technique was utilized given the sample size of 21 due to the unavailability of data. The study identified real petroleum prices, real exchange rate, import of goods and services and government spending as the key macroeconomic factors that influence industrial production in Ghana.

References:

Anaman, K.A. and Osei – Amponsah, C. (2007). Analysis of the Causality Links between the Growth of the Construction Industry and the Growth of the Macro economy in Ghana. Construction Management and Economics, 25 (September), pp. 951 – 961.

Anaman, K. A. and Osei-Amponsah, C. (2009). Determinants of the Output of the Manufacturing Industry in Ghana from 1974 to 2006. The Ghana Policy Journal, Vol. 3, pp. 69 – 89.

Aigner, D.J.; Lovell, C.A.K.; Schmidt, P. (1977) Formulation and estimation of stochastic frontier production functions. Journal of Econometrics, 6:21–37.

Akinlo, A.E. (2006). Macroeconomic Factors and Total Factor Productivity in Sub-Saharan African Countries. International Research Journal of Finance and Economics. Issue 1 (2006).

Coelli, T.J.; Rao, D.S.P.; O'Donnell, C.J.; Battese, G.E. (2005) An Introduction to Efficiency and Productivity Analysis, 2nd Edition. Springer, ISBN 978-0-387-24266-8.

Constantin, P.D., Martin, D.L. and Rivera, E. B.B.R. (2009). Cobb-Douglas, Translog Stochastic Production Function and Data Envelopment Anaysis in Total Factor Productivity in Brazilian Agribusiness. The Flagship Research Journal of International Conference of the Production and Operations Management Society, Vol.2, No. 2 July – December, pp. 20 – 33.

Christopoulos, D.; McAdam, P. (2012) Openness, Efficiency and Technology: An Industry Assessment. School of Economics Discussion Papers DP 08/12, University of Surrey.

Elhiraika A. B. (2008). Promoting Manufacturing to Accelerate Economic Growth and Reduce Volatility in Africa. African Economic Conference: Globalisation, Institutions and Economic Development of Africa, 12 – 14 November 2008, Tunis, Tunisia.

Enu, P. Havi, E.D.K., Osei-Gyimah, F., Atta-Obeng, P., Opoku, C.D.K. (2013). Achieving Higher GDP Growth Rates in Ghana? Which Sector is to Lead? Academic Research International, Vol. 4, No. 4, pp. 457 – 468.

Enu, P and Attah-Obeng, P. (2013). Which Macroeconomic Factors Influence Agricultural Production in Ghana? Academic Research International, Vol. 4, No. 5, pp. 333 – 346.

Koutsoyiannis, A. (2006). Modern Microeconomics. 2nd Edition. London: Macmillan Press Ltd.

Kumbhakar, S.C.; Lovell, C.A.K. (2000) Stochastic Frontier analysis. Cambridge University Press, Cambridge.

Maddala, G.S. (1992). Introduction to Econometrics, 2nd edition, Macmillan.

Msuya, E.E., Hisano, S. and Narius, T.(2008). Explaining Productivity Variation among Smallholder Maize Farmers in Tanzania. Paper Presented in the xii World Congress of Rural Sociology Association, Goyang, Korea, Pp. 1- 31.

Nto, P.O.O and Mbanasor, J.A. (2011). Productivity in Agribusiness Firms and its Determinants in Abia State, Nigeria. Journal of Economics and International Finance, Vol 3, No. 12, Pp. 662 – 668.

Nto, P.O.O, Igberi, C.O. and Mbanasor, J.A. (2012). Determinants of Productivity among Manufacturing Firms in south- Eastern Nigeria: Cobb – Douglas Stochastic frontier Production Function Approach. Micheal Okpara University of Agriculture, Umudike, Abia State and Ebonyi State University, Abakaliki.

Onyeranti, G.A. (2012). Concept of Measurement of Productivity. Department of Economics, University of Ibadan.

Ray, S. (2012). Determinants of total Factor Productivity Growth in Selected Manufacturing Industries in India. Research and Social Practices in Social Sciences, Vol. 7, No. 2, Pp. 25 – 43.

Shim, J.K & Siegel, J.G. (1995). Dictionary of Economics. USA: John Wiley & Sons, Inc.

Truett, L. J. & Truett, D.B. (1987). Microeconomics. Toronto: Times Mirror/Mosby College publishing.