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WHICH MACRO FACTORS INFLUENCE AGRICULTURAL PRODUCTION IN GHANA?

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ABSTRACT

This study identifies the macroeconomic factors which influence agricultural production in Ghana. The main purpose of the study is to find out the key macro factors that influence agricultural production in Ghana. The Cobb-Douglas production was employed and the Ordinary Least Squares estimation technique was used. Our dependent variable is agricultural output. The independent variables are labour force, inflation, real exchange rate and Real GDP per capita. We found that 1% increase in labour force caused agricultural production to decrease by 0.655946%. Also a 1% increase in inflation caused agricultural production to increase by 0.00459045%. In addition, a 1% increase in real exchange rate caused agricultural production to increase by 0.083949%. Finally, a 1% increase in real GDP per capita caused agricultural production to decrease by 1.05825%. Apart from inflation, labour force, real exchange rate and real GDP per capita were statistically significant. Therefore, the key macro economic factors that influence agricultural production in Ghana are labour force, real exchange rate and real GDP per capita. The agricultural sector should be made more attractive and conductive to ensure continuous production of food in Ghana.

Keywords: Agricultural Production, Labour Force, Real GDP per capita, Real Exchange rate, Ordinary Least Squares

INTRODUCTION

This study identifies the key macroeconomic factors that influence agricultural production in Ghana. It is a fact that the agricultural sector for every country is the basic catalyst and accelerator of growth of the industrial and services sectors notwithstanding the overall economic growth of that nation. Agriculture is the most important sector in the Ghanaian economy given its contribution to employment, foreign exchange, food, and its linkages with other sectors of the economy (ISSER, 2007). The agricultural sector in Ghana consists of six subsectors. They are agro processing, crops, livestock, fisheries, cocoa and forestry and logging. Indeed, the sector's performance directly mirrors that of the overall economy. Thus, it is seen as an engine of faster growth, poverty reduction and eradicates inequalities among the populace if the right policies are formulated and implemented within its rightful institutional framework. Ghana has become a success story in Africa in recent years.

After more than 20 years' of steady economic growth and significant poverty reduction, Ghana is aiming to become a higher middle income country by 2015. To achieve this target there should be rapid transformation and development of the economy especially at this time that oil is being produced in large quantities. Therefore, what will be the role of the agricultural sector in Ghana's new development process? The performance of the sector has been steadily declining for a year or two now (Bawumia, 2012; ISSER, various issues). This is due to the fact that there is a decline in soil fertility caused by the use of inappropriate farming practices such as shifting cultivation, continuous cropping, ploughing, ridging and planting across the slopes, over grazing, indiscriminate agrochemical use, and felling of trees and bush fires which are causing environmental degradation (ISSER, 2007). Also farm size,

climate and cost of inputs contribute to the decline in recent years (ISSER, 2008). All these variables are micro factors. What about the macroeconomic factors? To what extend will say inflation, GDP per capita and so on influence agricultural production in Ghana? Declining or abysmal trajectory performance of the agricultural growth has been speculated as a major determinant of poverty in the country (Ghana Statistical Service, 2012). Reversing this trend is no doubt an immediate development challenge for Ghana. This challenge requires in depth knowledge of what drives agricultural growth and productivity in Ghana.

Ghana has been an importer of food, more especially cereals from other countries. This might result in food insecurity if the exporters of food to Ghana decide not to export food to Ghana again (Drafor et al., 2010). For example China has banned rice and maize exports. India had banned the export of milk powder. Bolivia has banned the export of soybean oil to Chile. Colombia, Cuba, Ecuador, Peru, and Venezuela, and Ethiopia have banned exports of cereals (von Braun, 2008). The reason is that food surplus countries are now restricting exports to protect their own consumers.

Ghana continues to face food security problems due to stagnating productivity in the food sector and underdeveloped food markets (BDP report, 2012). Our questions here are that must Ghana continue to import food from other countries to satisfy her citizens? For how long must this continue? Ghana needs to be secured and self sufficient in terms of food production. This will enable her to continue to feed her people now and in the future. To be able to do this, it requires also an in debt understanding of the macro factors that influence agricultural production in Ghana. Thus, Ghana needs policies that will both accelerate agricultural production and protect her consumers.

More research work has been done on the micro factors that affect agricultural production (Imahe and Alabi, 2005; Abugamea, 2008; etc) in an economy including Ghana. What about the macroeconomic factors that influence agricultural production in Ghana? Therefore, this study seeks to determine the key macroeconomic factors that affect agricultural production in Ghana.

OBJECTIVES OF THE STUDY

The main objective of the study is to determine the major macroeconomic determinants of agricultural production in Ghana from 1980 to 2011 and then outline some policy suggestions that will help ameliorate agricultural sector in Ghana.

RESEARCH QUESTIONS

The study seeks to answer the following research questions:

1. What are the key macroeconomic determinants of agricultural production in Ghana?
2. To what extent can these macroeconomic factors influence agricultural growth and productivity in Ghana?
3. Are the effects of these macroeconomic factors on agricultural output relatively important?

HYPOTHESES

The following hypotheses will be tested:

1. There is a positive relationship between labour force and agricultural production in Ghana.
2. There is a positive relationship between inflation and agriculture output in Ghana.

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3. There is a negative relationship between real exchange rate and agricultural output in Ghana.
4. There is a positive relationship between Real GDP per capita and agricultural output in Ghana.

SIGNIFICANCE OF THE STUDY

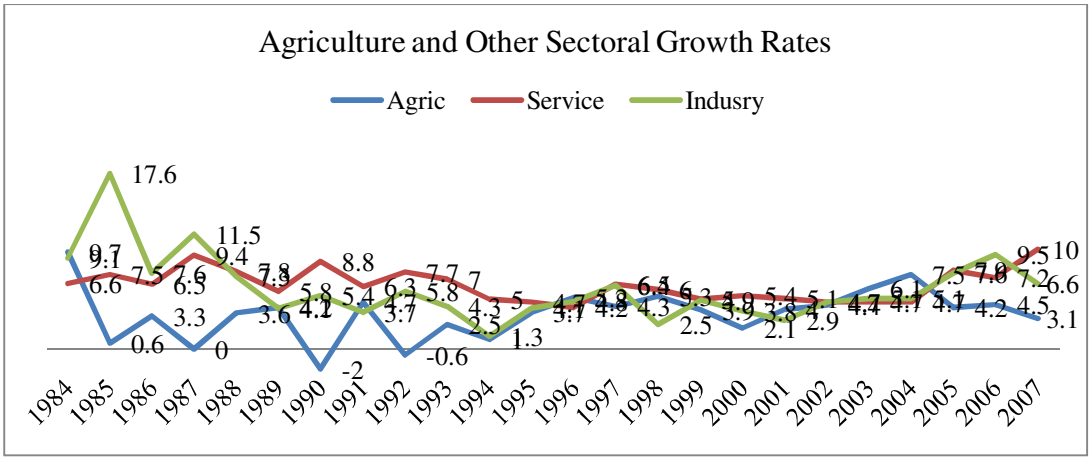
This study is very important because the study is on the macroeconomic determinants of agricultural output in Ghana and not on micro factors. Also, the study period is from 1980 to 2011. Furthermore, the study employs a basic econometric estimation technique called the ordinary least squares method.

SCOPE OF THE STUDY

The data span of this study is from 1980 to 2011. These periods are chosen because of the political stability and economic expansion Ghana has experienced during these periods.

PERFORMANCE AND THE ROLE OF THE AGRICULTURAL SECTOR IN GHANA

Agriculture is the backbone of the Ghanaian economy. Agriculture in Ghana could be the catalyst for the fastest growth and poverty reduction if the right policies are developed and implemented with the right institutional framework. The agricultural sector has impacted on the Ghanaian economy positively though its recent decline (ISSER, 2007). It contributes more than one-third of the Gross Domestic Product (GDP). It has generated about 75% of export earnings. It has created jobs that is about 60% of the economically active population are either engaged directly in agriculture or indirectly in agricultural – related activities and it has also generated tax revenue for the government (for instance, in 1990 agricultural contribution to tax revenue was 12% while in 2008 it was 5%) (ISSER, 2007).



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

Figure 1. Agriculture and Other Sectoral Growth Rates

The performance of the agriculture sector since 1984 is very worrying because of its importance in the Ghanaian economy (contribution to GDP, government tax and revenue, job creation for the economically active population and foreign exchange) and in particular the number of livelihoods (about 53% of the population) that depend on agricultural sector even though several policies have been developed and implemented since independence in 1957 to ensure food security in the country. For instance, "Food and Agriculture Sector Development policy which seeks to modernize the agricultural sector and serves as a catalyst for rural

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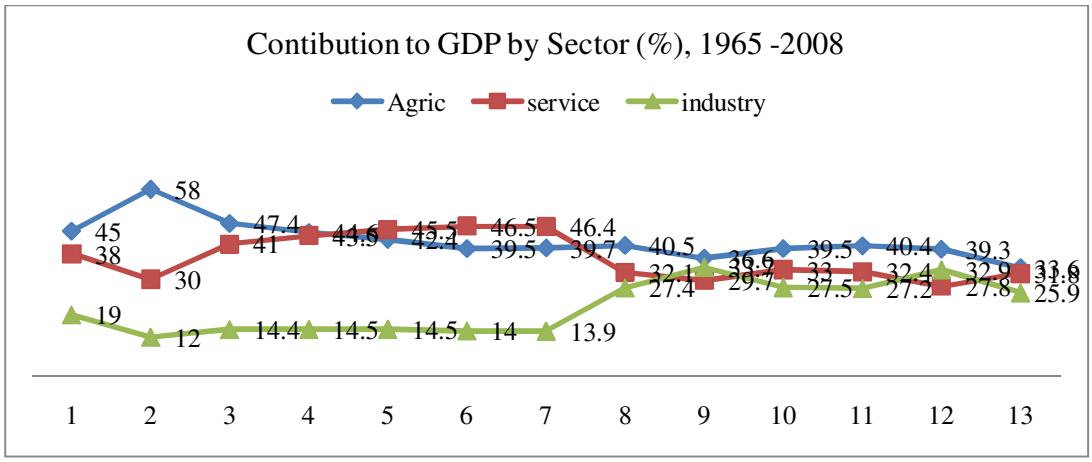
transformation, in line with the goals set for the sector in the Growth and Poverty Reduction strategy (GPRS II) and also the objectives of the New partnership for Africa's Development (NEPAD) and Millennium Development Goals (MDGs)" (ISSER, 2007). The data shows that rather than increasing, the agriculture sector of the Ghanaian economy has been declining steadily from 7.5% in 2005 to 3.1% in 2007. What macroeconomic factors might have led to this decline? Hence, the essence of this study.

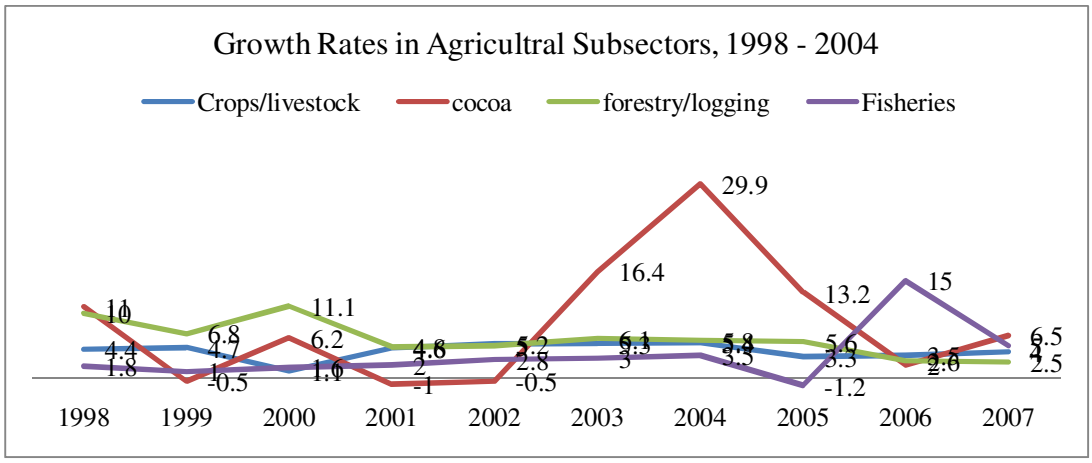


Source: The State of the Ghanaian Economy (Various Issues)

Figure 2. Contribution to GDP by sector (%), 1965 – 2008

The agricultural sector contributes the highest proportion to the gross domestic product (GDP). Even though agriculture contributes a very large proportion of the economy's output, the production in the sector is quite low compared with European and Northern American countries. Once again, what macroeconomic factors might have accounted for this? Therefore, the need for this study.

A part from the cocoa subsector, crop production/livestock recorded a less than 2% growth in the last two years. While the fisheries sector has seen a significant reduction in growth from 15% in 2006 to 5% in 2007.



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

Figure 3. Growth Rates in Agricultural Subsectors, 1998-2004

In today's globalizing world, if agricultural growth is expected to stimulate overall growth, then there is the need for appropriate policies to accelerate agricultural growth. In addition,

given the structure of the Ghanaian economy higher growth in the agricultural sector is needed in order to fuel growth in other sectors. Consequently, understanding the macroeconomic factors that affect agricultural growth in Ghana is very urgent.

THEORETIC LITERATURE REVIEW

The Cobb-Douglas Production Function

The Cobb- Douglas production function in which output (Q) is related to the inputs of labour and capital in a multiplicative function is $Q = f(K, L) = AK^aL^b$ where A, a, and b are all positive constant and Q is the output level; Q = total production (the monetary value of all goods produced in a year); L = labour input (the total number of person-hours worked in a year); K = capital input (the monetary worth of all machinery, equipment, and buildings); A = total factor productivity/neutral shift factor; a and b are the output elasticises of labour and capital, respectively. These values are constants determined by available technology (Koutsoyiannis, 2002).

The Cobb-Douglas production function is very frequently written as a homogenous function of degree one that is if a + b = 1, then this production function has constant returns to scale, thus it is linearly homogenous. However, if a + b < 1, returns to scale are decreasing, and if a + b > 1, returns to scale are increasing. The Cobb- Douglas function can exhibit any degree of returns to scale, depending on the values of **a** and **b** (Koutsoyiannis, 2002).

Numerous empirical studies suggest that this mathematical form of the production process is a reasonable representation of the activity that occurs with manufacturing firms. It has been employed in many production function studies utilizing time series as well as cross-sectional 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. That is $\ln Q = \ln A + a \ln K + b \ln L$. The constant as is then the elasticity of output with respect to capital input, and ***b*** is the elasticity of output with respect to labour input. These constant can sometimes be estimated from actual data, and such estimates may be used to measure returns to scale (by examining the sum $a + b$) and for other purposes (see Nicholson, 2005). In the Cobb- Douglas production function the elasticity of substitution between capital and labour is 1 for all values of capital and labour (Koutsoyiannis, 2002).

In general terms, most production functions especially the Cobb- Douglas Production Function can be generalized for many – inputs given in the form: $Q = \prod_{i=1}^{n} x_i^{\beta_i}$. This function exhibits constant returns to scale if $\sum_{i=1}^{n} \beta_i = 1$. In the constant – returns- to- scale Cobb- Douglas production function, β_i is the elasticity of Q with respect to input x_i . Since$0 \leq \beta_i \leq 1$, each input exhibits diminishing marginal productivity. Any degree of increasing returns to scale can be incorporated into this function, depending on $\sum_{i=1}^{n} \beta_i$.

The Cobb-Douglas production function is used commonly in both macro and micro examples. Also, the Cobb Douglas functional form is commonly used for its simplicity and flexibility coupled with the empirical support it has received from data for various industries and countries.

The output is usually measured by physical units produced or, perhaps, by their value.

EMPIRICAL LITERATURE REVIEW

Djokoto (2011) conducted a research on "Inward Foreign Direct Investment Flows, Growth, and Agriculture in Ghana: A Granger Causal Analysis." Djokoto (2011) found that neither FDI ratio nor agricultural growth caused each other. The results suggested that the variables in their computable form should not induce each other singularly.

Abugamea (2008) researched on a dynamic analysis for agricultural production determinants in Palestine: 1980-2003, a Johansen-Granger Co integration procedure. Abugamea (2008) found a significant negative effect and a positive relationship for capital and labour force on agricultural production, respectively. Meanwhile, short-run dynamics showed that capital and labour force were the main determinants of agricultural production in Palestine.

Imahe and Alabi (2005) examined the determinants of agricultural productivity in Nigeria. The results showed that arable land, per capita, average rainfall, fertilizer distribution, value of food imports, agriculture capital expenditure and the loans by commercial banks to agricultural sector contributed significantly to the systematic variation in agricultural productivity and output. The results pointed out that for the Nigerian agricultural sector to be one of the routes to her prosperity in the new millennium, the governments and the private investors should focus their attention on effective procurement and timely distribution of fertilizers.

Anyanwu (2009) studied the determinants of aggregate agricultural productivity among smallholder farmers in Rivers State. Multiple regression analysis was used in analyzing the data. Results of the analysis showed that farm land, labour input, planting materials, age of the farmers, farming experience and level of education were the main significant determinants of aggregate agricultural productivity in Rivers State. It was therefore recommended that appropriate policies and programmes be put in place to make more lands available to the food crop farmers. Credit facilities should also be extended to them to enable them purchase improved planting materials and hire more farm hands. For effectiveness, the credit facilities should be based on the level of farming experience of the recipient.

Odhiambo et al. (2004) explored the sources and determinants of agricultural growth and productivity in Kenya for the period 1965-2001. The growth accounting' approach was used to identify the sources of growth. The study established that most of the agricultural growth in Kenya was attributable to factor inputs such as labour, land and capital. Growth in output was not attributed to factor inputs or total factor productivity had in the entire period accounted for only 10 per cent of growth. Labour had been the most important source of growth and accounted for about 48 per cent of the total growth. Land was also a very important determinant of agricultural growth and productivity. The study had also established that Kenya's trade policy, climate, and government expenditure on agriculture were important determinants of agricultural total factor productivity growth.

Ekbom (1998) examined some determinants of Agricultural Productivity in Kenyan highlands. The model used for the estimation was a Cobb-Douglas production function. Results from Ordinary Least Squares-regression indicated that farm size and distance affected farm performance negatively and was statistically significant. Labour availability, costs of production inputs (such as fertilizers and improved seeds, and soil conservation quality) correlated positively and was statistically significant. Inter-temporal impacts of soil capital investments on agricultural productivity was positive, however, not statistically significant. Likewise, capital assets, proxied by value of domestic animals, access to credits, and on-farm non-agricultural incomes contributed positively to agricultural productivity in the Kenyan highlands.

Owuor (1997) investigated determinants of agricultural productivity in Kenya. Multi-stage probability proportional to size (PPS) sampling design was used to select farm households. Results from the study showed that: there was positive correlation between off-farm income and crop value per unit of land in Western transitional zone, Western highlands, and High potential maize zone and in Central highlands; off-farm income played an important role in allowing farmers to shift to higher-valued crops hence increased their agricultural productivity per unit of land. Horticultural production was highest in Central province. This was related to proper distribution of water supply. The policy implication was that there was the need to reduce costs in the food system so that households would be enabled to shift into higher-valued crops and increase their agricultural income without putting their families in jeopardy of acquiring food.

Teryomenko (2008) studied farm size and determinants of agricultural productivity in Ukraine. The hypothesis tested was the inverse relationship between farm size and farm productivity for Ukrainian farmers. It was found that the relationship between farm size and farm productivity was nonlinear – productivity rose first and then falls. Ukrainian farms were found to be highly unproductive due to inefficient used of land resources. The calculated optimum size of land plot was determined to be larger than the average actual size of own landholding.

Olujenyo (2008) studied on the determinants of agricultural production and profitability in Akoko Land, Ondo-State, Nigeria. The methods of analysis used were descriptive statistics, gross margin analysis and production function analysis using the Ordinary Least Square (OLS) criterion. Results showed that majority of the farmers were ageing and quite experienced in maize farming. There was high level of illiteracy as about 65% of total respondents had no formal education while 25%, 6% and 4% had primary, secondary and technical education respectively. Farming was mostly on subsistence level as the mean farm size was 0.39 hectares. Maize farming was profitable in the study area with gross margin and net returns of N2,637.80 and N2,141.00 respectively. Results also showed that farm operation was in stage II of the production function with RTS estimated as 0.62 and factors of production were efficiently allocated with elasticities that were positive but less than one. Results further showed that age, education, labour and cost of non-labour inputs were positively related to output while farm size and years of experience carried negative signs. However, only labour input has significant influence on output.

According to the International Fund for Agricultural Development (IFAD), civil unrest has had negative effects on food production and transport in countries such as Kenya, Uganda and Chad and that has pushed food prices up. Also, natural disasters such as drought and floods worsen the situation in countries like Ghana and Angola (IFAD, 2008).

The Ministry of Food and Agricultural (MoFA) of Ghana estimated that about 64% of farming households in the country grow maize. Maize yields are rather low and often less than 1 tonne/ha. This was due to biophysical and socio-economic constraints such as weeds, pests and diseases, unfavourable weather conditions, low soil fertility in the face of high fertilizer cost, poor infrastructure and high post harvest losses. Also, there is limited use of purchased inputs, and, according to MoFA (1998), Ghana has been among the world's lowest fertilizer consumers even during the days of heavy subsidization.

Drafor and Kunze (2010) studied "Rising food prices and their implications for the Ghanaian economy. They identified rapid increase in population, civil unrest, and low budget allocation to the agricultural sector, reduced soil fertility, inadequate irrigation facilities, inappropriate agricultural policies, and high fuel prices as factors that hinder food production in Ghana.

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Quaye (2008) also identified erratic rainfall patterns, high cost of agrochemicals, lack of knowledge on improved farming and post harvest practices as well as lack of production credit and market for farm produce as sources of affecting agricultural production and improvement in food security in the northern region of Ghana.

In summary, it can be seen from the above empirical literature reviews that little research works have been done on the macroeconomic determinants of Agricultural Productivity in Ghana. Therefore, this research work seeks to determine the macroeconomic determinants of agricultural production in Ghana from 1980 to 2012.

METHODOLOGY

Specification of the Regression Model

From the literature, the Cobb- Douglas production function through the application of Ordinary Least Squares (OLS) method is adopted to examine the macroeconomic determinants of agricultural outputs in Ghana. The dependent variable of the model is agricultural output (AQ) and the explanatory variables are labour force (L), inflation (INF), Real exchange rate, and Real Gross Domestic Product per capita (RGDPPC).

The multiple regression equation models to explore the macroeconomic factors that influence agricultural output in Ghana is stated as:

$$\ln(AQ_t) = \beta_0 + \beta_1 \ln(L_t) + \beta_2 \ln(INF_t) + \beta_3 (\ln REX_t) + \beta_4 \ln(RGDPPC_t) + u_t$$

Where

AQ_t = agricultural production measured as agricultural valued added as % of GDP at time t.

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

INF_t = inflation measured using consumer price index (annual %) at time t.

EXR_t = the real exchange rate measured as real effective exchange rate index (2005 = 100) at time t.

$RGDPPC_t$ = real GDP per capita at time t.

β_0 is the constant term and β_1, β_2, β_3, and β_4 are the partial elasticities.

u = Random error

Explanatory Variable	*Our expectation*
Labour force	Positive (+)
Inflation	Positive (+)
Real exchange rate	Positive (-)
Real GDP per capita	Positive (+)

Based on economic theory, empirical and experience

METHODS OF ANALYSIS

The study employed the Ordinary Least Squares (OLS) estimation criterion to estimate the parameters of the model. The t-test was used to test for the statistical significance of the parameters of interest. It was determined by dividing the estimated regression coefficient by its standard error. We compared the value of the t statistic with the critical value of t which

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was read from the t distribution table at the 5% level of significance. High t-values enhance confidence in the value of the coefficient as a predictor. Low t values (as a rule of thumb, under 2.0) are indications of low reliability of the coefficient as a predictor (Koutsoyiannis, 2006).

The coefficient of multiple determination (R^2) and the F-statistic were employed to check for the overall significance of the multiple regression equation. The R^2 measures how strong or weak the multiple regression equation is, statistically. Economically, it explains how the changes in the independent variables affect the total variation in the dependent variable. To establish the statistical significance of the R^2 we employed the formula $t^* = \frac{r\sqrt{n-k}}{\sqrt{1-r^2}}$ (where r = correlation coefficient; r^2 = coefficient of determination; n = number of observations; k = number of parameters). We first of all stated our hypothesis as $H_0: \rho \neq 0$ against $H_1: \rho = 0$. We then computed the test value and then compared it with the critical value of t. if the test value is greater than the critical value of t, we conclude that the R^2 is statistically significant or otherwise (Mendehhall et al., 1989, Shim et al., 1995).

Alternatively, to prove the overall significance of the model specified, we used the F – test. The F statistic is defined as $\frac{\text{explained variation}/k}{\text{unexplained variation}/k-1}$. If the F statistic is greater than the table value, then we conclude that the overall model is statistically significant or otherwise (Shim et al., 1995).

To determine whether our model will be acceptable or not, we compared the value of the Durbin-Watson Statistic (DW) from the multiple regression result with the value of the R^2. If the value of the DW is greater than the value of the R^2, then our model is not spurious and can be accepted or otherwise (Gujarati et al., 2009).

Finally, we ascertained whether our specified model was affected with the problems of Multicollinearity (investigated by using auxiliary regression – here we compared the R^2 of the main model specified with that of the auxiliary model. Using Klein's rule of thumb, if the R^2 for the auxiliary model is higher than for the main model, then there is probably multicollinearity), heteroscedasticity (detected by using the park test. According to the park test, if a statistically significant relationship exists between the log of the error term and the explanatory variable, then, the null hypothesis of no heteroscedasticity can be rejected) and autocorrelation (detected by using the Durbin-Watson statistic. If the value of the DW lies between 1.5 to 2.5, it indicates that there is no problem of autocorrelation) (Shim et al., 1995, Wooldridge, 2006).

Source of Data

Data were collected from the World Development Indicators 2012.

Econometric Package Used

The econometric software used in this study was gretl.

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EMPIRICAL FINDING

Presentation of Results

Table 1. Heteroskedasticity-corrected estimates using the 32 observations 1980-2011 Dependent variable: l_AQ

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Critical value of t*	*p-value*
Const	9.77507	0.747075	13.0844		<0.00001
l_P	-0.655946	0.217921	-3.0100		0.00561
l_INF	0.00459045	0.0221739	0.2070	2.052	0.83755
l_REX	0.083949	0.0259845	3.2307		0.00324
l_RGDPPC	-1.05825	0.100397	-10.5407		<0.00001

Unadjusted R^2 = 0.946856; Adjusted R^2 = 0.938983; F-statistic (4, 27) = 120.264 (p-value < 0.00001); Durbin-Watson statistic = 1.57913

Test 1: Test for the Presence of Multicollinearity Using Auxiliary Regression

Here, we compare the two R^2 values. Using Klein's Rule of Thumb, if the R^2 for the auxiliary regression is higher than for the main regression, then there is probably multicollinearity.

Function	*R^2 of the auxiliary regression*	*R^2 of the main regression*	*Conclusion*
lnL = f(lnINF, lnRGDPPC, lnREX)	0.910436	0.938983	No multicollinearity
lnINF = f(lnL, lnREX, lnRGDPPC)	0.258923	0.938983	No multicollinearity
lnREX = f(lnL, lnINF, LnRGDPPC)	0.581127	0.938983	No multicollinearity
lnRGDPPC = f(lnL, lnREX, lnINF)	0.796834	0.938983	No multicollinearity

Multicollinearity is not present in the regression since the value of the R^2 of the main regression is greater than the value R^2 of the auxiliary regression.

Test 2: Test for the Presence of Autocorrelation Using DW Test

Hypotheses:

H_0 : no autocorrelation

H_1: autocorrelation

DW test statistic:

DW = 1.57913

Decision rule

DW Statistic	*Conclusion*
Between 1.5 and 2.5	No autocorrelation
Below 1.5	Positive autocorrelation
Above	Negative autocorrelation

Source: Shim, J.K. et al (1995)

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The value of the DW statistic of 1.57913 lies within 1.5 and 2.5. This indicates the absence of autocorrelation in the regression.

Test 3: Test for the Presence of Heteroscedasticity Using the Park Test

We do not worry about the presence of heteroscedastic since one of the ways to lessen the effect of heteroscedasticity is to transform the data into logs (Koutsoyiannis, 2006).

DISCUSSION OF RESULTS

This regression result is not spurious since the value of the DW (1.57913) is greater than the value of the R^2 (0.946856). From tests 1, 2 and 3, it could be seen that the multiple regression results are not affected by the problems of multicollinearity, autocorrelation and heteroscedasticity. Therefore, this model for agricultural production in Ghana can be accepted and then meaningful conclusions can be drawn from it.

The value of the unadjusted R^2 is 0.946856. Statistically, the model has a very good fit. In economic terms, about 95% of the total variation in agricultural production is explained by our explanatory variables (labour force, inflation, real exchange rate and real GDP per capita). The unexplained variation is 5%. This implies that our explanatory variables highly explain the changes in agricultural production in Ghana. It is statistically significant since the value of the t statistic (21.933) is greater than the critical value of t (2.052). Overall, the agricultural production function for Ghana is statistically significant since the value of the F statistic (120.264) is greater than the F critical value (2.69).

In addition, if labour force, inflation, real exchange rate and real GDP per capita do not exist in the Ghanaian economy, the agricultural production of Ghana will be 9.77507%. It is highly significant at the 5% significance level.

The agricultural sector employs more than 50% of the Ghanaian labour force (ISSER, 2007). So, it was expected that there will be a positive relationship between labour force and agricultural production in Ghana. However, a negative relationship was realized. That is a 1% increase in the labour force will cause agricultural production to decrease by 0.655946% (inelastic). Alternatively, a 1% reduction in the labour force will cause agricultural output to increase by 0.655946%, all things being equal. This means that in terms of agricultural production, Ghana is operating in the third stage (irrational stage). It could also mean that more of the Ghanaian labour force including those trained in agricultural science is all moving into the industrial and the services sectors of the Ghanaian economy, neglecting the agricultural sector, hence, a reduction in agricultural production as labour force increases. This further implies that there will be pressure on the little food produced causing the price of foods to increase which if care is not taking might lead to starvation, more especially, to the very poor in our society. This finding seems to liking itself to Thomas Malthus theory on Population. Also, this finding contradicts the findings of Abugamea (2008), Imahe et al., (2005), Odhiambo et al. (2004) and Ekbom (1998). It is consistent with the findings of Drafor and Kunze (2010). The value of 0.655946 is highly significant at the 5% level of significance.

We hypothesized that there will be a positive relationship between inflation and agricultural production in Ghana. Our expectation was met. A 1% increase in the general price level will cause agricultural output to increase by 0.00459045% (inelastic). On other hand, a 1% decrease in the general price level will cause agricultural output to decrease by 0.00459045%. This finding follows the law of supply, which states that, the higher the price the higher the quantity supplied, all things being equal. This suggests that if the prices of agricultural produce are increased producers of farm produce are willing to produce more to meet demand. This is because at higher prices profit margins increase since this is an incentive for

food producers to produce more. This parameter is statistically insignificant at the 5% level of significance.

The study was expecting the link between real exchange rate and agricultural production in Ghana to be negative. The reason is that since the value of the dollar is always more than the cedi, it meant that if we should import agricultural equipment, it will increase cost of production, thereby reducing agricultural production. However, a positive sign was achieved. This means that a 1% increase in the real exchange rate will cause agricultural production to increase by 0.083949% (inelastic). Alternatively, a 1% decrease in the exchange rate will cause agricultural output to decrease by 0.083949%. This implies that the Bank of Ghana is doing well in stabilising both the monetary and fiscal policies in Ghana in the short term. This value is statistically significant at the 5% level of significance.

There is a negative relationship between real GDP per capita and agricultural production in Ghana. A 1% increase in real GDP per capita will cause agricultural production to decrease by 1.05825% (elastic). On the other hand, a 1% decrease in real GDP per capita will cause agricultural output to increase by 0.5825%. This implies that agricultural production in Ghana is an inferior one as compared to the other sectors of the Ghanaian economy. That is a small change in the producer's income will make them move to other attractive sectors instead of expanding their farm size in order to produce more agricultural goods. This might be due to the fact that the agricultural sector of Ghana is characterised by small acreage of farms, scarcity of water, poor quality of seed and stock, poor infrastructure, poor storage and preservation facilities, poor prices, lack of financial support, high rate of illiterate among farmers, lack of extension services and problems of marketing of agricultural produce in Ghana, lack of modern processing equipment and technical know-how, low patronage of locally processed products and so on (The State of the Ghanaian economy, various issues). The overall effect is a fall in agricultural output. Consequently, food prices will increase, cost of living will increase, standard of living will fall, balance of payments deficit will increase and sometimes starvation may result. This parameter is statistically significant at the 5% significance level.

From the above results and discussions it can be concluded that the key macro economic factors that influence agricultural production in Ghana are labour force, real exchange rate, and real GDP per capita.

POLICY RECOMMENDATIONS

From the findings of our study, the following policy recommendations are suggested:

1. The skilled and the unskilled labour force should be encouraged, motivated to go into agricultural production by creating a conductive atmosphere for them to exist since agricultural is the engine of growth in Ghana.
2. There should be massive campaign on birth control methods to reduce the population size.
3. Food prices should be increased moderately to increase food production in Ghana.
4. The stabilization of the monetary and fiscal policies should be continued both in the short run and long run.
5. The inefficiencies in the agricultural sector should be corrected in order to keep existing producers of farm produce and then attract other potential producers. For example the provision of infrastructural facilities such as good roads, pipe borne water, continuous supply of electricity and so on.

CONCLUSION

This study was about what macro factors that influence agricultural production in Ghana. The main purpose of the study was to identify the key macroeconomic factors that influence agricultural production in Ghana. The Cobb-Douglas production function was employed and the Ordinary Least Squares estimation technique was used. Our dependent variable was agricultural output. The independent variables were labour force, inflation, real exchange rate and Real GDP per capita. We found that 1% increase in labour force caused agricultural production to decrease by 0.655946%. Also a 1% increase in inflation caused agricultural production to increase by 0.00459045%. In addition, a 1% increase in real exchange rate caused agricultural production to increase by 0.083949%. Finally, a 1% increase in real GDP per capita caused agricultural production to decrease by 1.05825%. Apart from inflation, labour force, real exchange rate and real GDP per capita were all statistically significant. Therefore, the key macro economic factors that influence agricultural production in Ghana are labour force, real exchange rate and real GDP per capita. Therefore, the inefficiencies in the agricultural sector should be corrected in order to keep existing farm producers an attract potential farmers to the sector. This will ensure food security in Ghana.

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