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Impact of Macroeconomic Factors on Economic Growth in Ghana: A Cointegration Analysis

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Abstract

The problem of the study is to ascertain the major macroeconomic factors that would drive Ghana's real per capita GDP growth (economic growth) and also determine which ways these factors influence economic policy formulation and implementation. As a result, this study examines the long-run macroeconomic factors of economic growth in Ghana using Johansen approach to cointegration which is more appropriate and efficient for determining the number of cointegrating vectors without relying on an arbitrary normalization. The study period spanned from 1980 to 2010. The time series properties of the data were, first, analyzed using the Augmented Dickey Fuller (ADF) test. The empirical results derived indicate that all the variables of interest were stationary after their first differencing. The study found cointegration relationship between real GDP per capita (economic growth) and its macroeconomic factors. The policy recommendation among others is that the government should be able to generate more revenue domestically than relying on foreign aid.

Keywords: Ghana, FDI, GDP, Inflation, Economic Growth

Introduction

Godwin (2007) defines economic growth as an increase in real gross domestic product (GDP). That is, gross domestic product adjusted for inflation. Gyimah-Brempong (1989) examined the effect of military spending on the economic growth of Sub-Saharan African countries using a simultaneous-equations model. He concluded that military expenditure had a negative impact on economic growth. However, the revision of his analysis showed that his reported results were weak and do not support his policy conclusions, because the calculated value of the defense burden/growth rate multiplier is not statistically significant. Salisu and Ogwumike (2010) contributed to the growing debate on aid-growth nexus. They examined the role of macroeconomic policy environment in aid-growth nexus; an area which had received less attention in Sub-Saharan Africa (SSA). The study concluded that the incessant socio-political crisis, policy inconsistencies, bad governance and macroeconomic instability evident in many SSA countries had crippled the effectiveness of aid in these countries. Sentsho did a study on Export Revenues as Determinants of Economic Growth: Evidence from Botswana. The main

objective of the paper was to assess whether export revenues derived from an 'enclave sector' like the case of mining in Botswana, can lead to significant and positive economic growth in a country. The paper used both statistical data and time series econometric analysis to test the causal relationship between exports and economic growth. The results indicated that primary export revenues have led to positive and significant economic growth in Botswana. Ojo and Oshiokoya (1995) studied the determinants of long term growth in a cross section of African countries over the period 1970 – 1991. The paper found that, on average the most significant variables influencing long-term growth in the sample of African countries over the study period were-investment, external debt, population growth, and the macroeconomic environment.

Ghura and Hadjimicheal (1996) investigated long run growth in sub-Saharan Africa over the period 1981–1992. Using feasible generalized least squares techniques on a panel of 29 sub-Saharan African countries; the authors found support for conditional convergence, even though the absolute convergence was rejected on the control variables, the authors found that both private and public investment had a positive and significant growth. Easterly and Levine (1997) contributed some valuable empirical perspective on the growth tragedy in sub-Saharan African in particular. The paper investigated both the direct and indirect effect of ethnic diversity on growth. The paper made some interesting observations first, it was reported that ethnicity had a significant negative direct effect on growth; second, it was found that high levels of ethnic diversity were strongly linked to high black market premiums, political instability, poor financial development, low provision of infrastructure and low levels of education. Aryeetey and Tarp (2000) reported in their study of "Structural Adjustment & After: Which Way Forward? in Economic Reforms in Ghana".

The miracle and the mirage that the growth of the 1980s came about as a result of the expansion of capital application, largely as a consequence of increased aid inflows, which was similar to the expansion that occurred in the 1960s financed largely through accumulated reserves from the 1950s. Booth, et al. (2004) identified economic liberalization in the 1980s and political liberalization in the 1990s as the key factors behind the fairly decent growth performance in Ghana. Lloyd, Morrissey and Osei (2001) did a study on aid, export and growth in Ghana. They modeled growth in private consumption. At the end of their analysis, they found out that export, aid and public investment all were positively related to long-run economic growth in Ghana. Oteng-Abayie, et al. (2006) examined the impact of FDI inflows and trade on economic growth in Ghana for the period 1970 – 2002. The method of analysis that was used is the bound testing procedure. They found out that labour, capital investment and trade are important in explaining Ghana's economic growth in the long run. The main objective of this study is to examine the impact macroeconomic factors on economic growth in Ghana between the periods 1980 and 2010 applying the Johansen method of cointegration developed by (Johansen, 1988).

Method of Study and Model Specification

Method of the study

The process started with a more thorough collection and analysis of data. The type of data used for this study was secondary data. Time series data on real GDP per capita, physical capital, labour force, foreign direct investment, foreign aid, inflation and government expenditure over the study period (1970 to 2010) were obtained from World Development indicators (2011). The secondary data was used for the analysis because the verification process is more rapid and the reliability of information and conclusion is greatly enhanced. The secondary data also provided enough

information to test the hypotheses of this study. Finally, it was readily available and hence, convenient to use (Ghauri, et al., 2002).

To carry out the estimation procedure of the link between real per capita GDP and its selected macroeconomic factors based on theoretical and empirical review, annual time series data from the period 1980 to 2010 were used. A multiple regression analysis (Johansen Cointegration estimation method) was used to analyze the data and to examine the major macroeconomic factors of economic growth in Ghana. The dependent variable is real GDP per capita. The explanatory variables are physical capital, labour force, foreign direct investment, foreign aid, inflation and government expenditure. These variables were chosen because of their authenticity in empirical literature on economic growth and the fact that the state and local policy debate frequently revolves around them. However, before the estimation of the specified long-run and the short-run growth models, the time series properties of the variables of interest were first explored to eliminate any trend element that could lead to spurious parameter estimates. In addition, to determine whether there exist any stable long-run relationships among the variables of interest, the Johansen Maximum Likelihood cointegration test was employed. The computer software used was E-Views (version 7.1).

Model Specification

Macroeconomic theory has identified various factors that influence the growth of a country from the classical, neoclassical and the new growth theories. These factors include natural resources, investment, human capital, innovation, technology, economic policies, governmental factors, foreign aid, trade openness, institutional framework, foreign direct investment, political factors, socio-cultural factors, geography, demography and many others. In order to examine the empirical evidence of the macroeconomic factors of economic growth in Ghana, the study considers most of these factors.

Following broadly the approach adopted in Lucas (1988), the researcher specifies the economic growth function for Ghana as follows:

Real GDP per capita is a function of physical capital, labour force, foreign direct investment, foreign aid, inflation and government expenditure.

It is mathematically expressed as follows:

$$\text{RPCGDP} = f(K, L, \text{FDI}, \text{Aid}, \text{INF}, \text{GE}) \quad (1)$$

Thus, our growth function becomes

$$\text{LnRPCGDP}_t = \beta_1 K_t + \beta_2 L_t + \beta_3 \text{FDI}_t + \beta_4 \text{Aid}_t + \beta_5 \text{INF}_t + \beta_6 \text{GE}_t + \varepsilon_t \quad (2)$$

Where,

LnRPCGDP_t Represents the log of Real GDP Per Capita at time t = real GDP per capita growth;

K_t Represents Physical Capital at time t , measured as Gross Fixed Capital Formation as a percentage of GDP;

L_t Represents Labour Force at time t , measured as the % of total population aged 15-64;

FDI_t Represents Foreign Direct Investment at time t , measured as Foreign Direct Investment as a percentage of GDP;

Aid_t Represents Foreign Aid at time t , measured as Foreign Aid as a percentage of GDP;

INF_t Represents the log of Consumer Price Index at time t ;

GE_t Represents Government Expenditure at time t , measured as Government Expenditure as a percentage of GDP;

t = time

ε_t Is the error term assumed to be normally and independently distributed with zero mean and constant variance, which captures all other explanatory variables which influence economic growth but are not captured in the model.

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ are the partial elasticity of real GDP per capita growth with respect to $K_t, L_t, FDI_t, Aid_t, INF_t, GE_t$ respectively.

Justification of the Variables

Economic Growth (RPCGDP_t)

There are many ways of measuring economic growth in a country. These include real output per capita and growth in real gross domestic product. This study however uses real Per Capita GDP to measure economic growth. This is because other researchers have used it in their work as dependent variable (Anaman, 2006, Khan and Bashar, 2007 and Frimpong, J.M and E.F. Abayie, 2006).

Physical Capital (K_t)

Physical capital is any manufactured asset that is applied in production such as machinery, buildings, and vehicles. In other words, it refers to any non-human asset made by humans and then used in production (Shim J.K. et al., 1995).

Adequate capital is one of the primary needs of economic growth on theoretical and empirical grounds. Capital flows out of savings and savings out of income. More capital means more production and more production means more output and hence, more growth. This is because when saving rate is high, a larger percentage of output can be allocated for investment which may lead to faster rate of capital accumulation and output growth, all other things being equal.

Labour Force (L_t)

Labour force is the total labour force or currently active population comprises all persons who fulfill the requirements for inclusion among the employed or unemployed during specified period (Shim J.K. et al., 1995). On theoretical grounds, the stock of labour must be included in this model. According to the classical growth theorists, an increase in labour force (L_t), which is measured here as the percentage of total population aged 15-64 years, is expected to lead to an increase in real GDP per capita (economic growth). All other things being equal, the higher the labour force, the higher the supply of labour and hence, output (McConnell, et al., 2002; Weil, 2005; Todaro, 2006). Therefore, the coefficient of labour is expected to be positive ($\beta_2 > 0$).

Foreign Direct Investment (FDI_t)

Foreign direct investment refers to long term participation by country A into country B. it usually involves participation in management, joint venture, transfer of technology and expertise (Shim J.K. et al., 1995). Foreign direct investment plays an important role in driving economic growth through increase in productivity levels. Foreign direct investment has been acknowledged as the most crucial factor in enhancing economic development and the standard of living for emerging economies consequently, the study expects the coefficient of FDI to be positive ($\beta_3 > 0$).

Foreign Aid (Aid_t)

Foreign aid is a voluntary transfer of resources from one country to another, given at least partly with the objective of benefiting the receipts country (Shim J.K. et al., 1995). Another factor closely related to investment is foreign aid. Consequently, it is expected that foreign aid will have a positive impact on growth ($\beta_4 > 0$).

Inflation (INF_t)

Inflation is a rise in the general level of prices of goods and services in an economy over a period of time (Shim J.K. et al., 1995). Inflation and economic growth rates are two of the most important and most closely watched macroeconomic variables. High inflation rate is a very common phenomenon in most developing countries, Ghana inclusive. Consequently, the study would expect a negative relation between inflation and economic growth in Ghana ($\beta_5 > 0$).

Government Expenditure (GE_t)

Government expenditure is government acquisition of goods and services for current or future use (Shim J.K. et al., 1995). The relationship between government spending and economic growth is very important for developing countries, most of which have experienced increasing levels of public expenditure over time, Ghana inclusive. Government consumption is a component of gross domestic product (GDP). Everything else held fixed, government consumption will increase GDP since it contributes to current demand. It will also have the same positive feedback loop on GDP as private consumption itself has, because it increases GDP which is a determinant of total consumption. Consequently, the study expects the coefficient of government consumption to be negative ($\beta_6 > 0$).

Physical capital, labour force, foreign direct investment, foreign aid, inflation, and government expenditure are chosen because of their authenticity in empirical literature research on economic growth and because of the fact that the state and local policy debate frequently revolves around them.

Table 1. Summary of the Explanatory Variables and their Expected Signs

Explanatory Variables	Expected Sign
Physical Capital	+
Labour Force	+
Foreign Direct Investment	+
Foreign Aid	+
Inflation	-
Government Expenditure	-

The error correction term lagged one period, which integrates short-run dynamics in the long-run growth function is shown below through error correction model (ECM):

$$\Delta \ln \text{RPCGDP}_t = \alpha_1 + \sum_{i=1}^p b_{2i} \ln \text{RPCGDP}_{t-i} + \sum_{i=0}^p c_{3i} \Delta K_{t-i} + \sum_{i=0}^p d_{4i} \Delta L_{t-i} + \sum_{i=0}^p e_{5i} \Delta \text{FDI}_{t-i} + \sum_{i=0}^p f_{6i} \Delta \text{Aid}_{t-i} + \sum_{i=0}^p g_{7i} \Delta \text{INF}_{t-i} + \sum_{i=0}^p h_{8i} \Delta \text{GE}_{t-i} + \lambda_9 \text{ECM}_{t-1} + \varepsilon_{2t} \quad (3)$$

Where, ECM_{t-1} is the error correction term (the residuals that are obtained from the estimated cointegrating model of equation (3)). It is the feedback and adjustment effect which indicates how much of the disequilibrium is being corrected. It further proves the stability of the long-run relationship when it is highly statistically significant (Bannerjee, et al., 1998). The composition of ε_{2t} is similar to that of ε_{1t} as observed in equation (3). The symbol Δ represents the first-differenced form of the variables in the model. The coefficient of the various explanatory variables, b_{2i} , c_{3i} , d_{4i} , e_{5i} , f_{6i} , g_{7i} , h_{8i} are the impact multipliers that measure the immediate impact that a change in the explanatory variable has on a change in the dependent variable. λ represents the speed of the adjustment parameter. The value of λ must be between the range $-1 \leq \lambda \leq 0$ and must be statistically significant.

Notably, the appropriate number of lags, which offers the value of 'p', is chosen automatically by E-views (Version 7.1) according to the Schwarz Bayesian Criterion (SBC). The Parsimonious empirical model will be determined based on the concurrent least value of SBC at the instance of no autocorrelation with reference to Durbin-Watson (DW) statistic. With this, the appropriate empirical method for estimation is selected. To ascertain the goodness of fit of the long run model, the diagnostic test is conducted. The diagnostic test examines the serial correlation associated with the model. The econometric package used is E-Views (Version 7.1).

Unit Root Tests

This study test for stationarity of the endogenous and exogenous variables within the framework of Augmented-Dickey-Fuller (ADF) test procedure. This test is important in order to avoid spurious regression which is a common problem when estimating a regression line with data whose generated process follows a time trend. The ADF test requires estimating an equation of the form:

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 t + \sum_{i=1}^p A_i \Delta y_{t-1} + Z_t; \quad H_0 : \beta_1 = 0; H_1 : \beta_1 > 0$$

Where,

y_t is a vector for all-time series variables under consideration in a particular regression model (our variables of interest);

t is a time trend variable;

Δ denotes the first difference operator;

Z_t is the error term;

p is the optimal lag length of each variable chosen automatically by E-views Version 7.1 according to the Schwarz Information Criteria (SIC) such that first-differenced terms make Z_t is the error term; white noise.

The ADF test is principally concerned with the estimate of β_1 , that is, the study tests the hypothesis $H_0 : \beta_1 = 0$. The rejection of the null hypothesis in favor of the alternative hypothesis implies that y_t is stationary and integrated of order zero, that is, $I(0)$. If the null hypothesis of unit root for the first difference is rejected, then the first difference is stationary and the variable is integrated of order one, that is, $I(1)$ (Johansen 1988; Maddala, 1977; Adenutsi, et al., 2007). The objective of this unit root test is to check whether the macroeconomic variables of interest are integrated of order one ($I(1)$) before proceeding to the estimation procedure (Engle and Granger, 1987).

The Johansen Cointegration Test

After checking univariate time series of all-time series properties of each of the variables in the specified model are found to be integrated of same order, the study proceeded with testing of cointegration among the variables of interest. The purpose of the cointegration test is to determine whether a group of non-stationary series is cointegrated or not. This study applied the Johansen Cointegration Maximum Likelihood Method of Cointegration developed by Johansen (1988) and applied by Johansen and Juselius (1990) to determine the number of cointegrating vectors. In this case, the study applied the trace test and maximum Eigenvalue test. On the other hand, if the variables are found to be integrated of different order, make them integrated of same order through differencing before determining the number of cointegrating vectors.

Empirical Results and Discussions

The Johansen Cointegration method of estimation was used to examine the major macroeconomic determinants of economic growth in Ghana over the period 1970 to 2010. Before that, the stationary properties of all the variables of interest were established using Argument Dicky Fuller test. Different forms of the models were estimated to find the correct model for estimation. First, none of the variables were logged; the results were dropped because the coefficients were too large and do not make sense statistically and economically. Second, all the variables of interest were logged and that was also problematic because the results did not have reasonable interpretation once foreign aid is percent of GDP it should not be logged again. Finally, only the dependent variable was logged and this was more reasonable thing to do hence the model specified for evaluation.

Results of Unit Root Test

The time series properties of the variables were explored to determine the order of integration of each variable in the model. Standard procedure in the time series literature suggests that the researcher should check for unit roots in each series before estimating any equations. If a unit root exists in any variable, then that particular series is considered to be non-stationary. Estimation based on non-stationary variables may lead to spurious results with high R^2 . (R^2 explains how much of the variances in the dependent variable is accounted for by the regression model from the sample) and t-statistics, but without any coherent economic meaning and inconsistent parameter estimator (Pyndick, 1998). The stationary test was performed to avoid spurious regression problems normally associated with time series econometric modeling.

The Augmented Dickey Fuller (ADF) test for estimating unit roots was applied in this study. The result of ADF testing can be seen in Table 2:

Table 2. ADF Test (Constant and Trend Included)

Variable	Levels		First Difference			
	ADF-Stat	Critical value (5%)	ADF-Stat	Critical Value (5%)	Order of Integration	Conclusion
LnRPCGDP	-1.662907	-3.536601	-5.192666	-3.540328	1	I(1)
K	-2.962836	-3.540328	-5.092125	-3.540328	1	I(1)
L	-2.255898	-3.544284	-4.255898	-3.544284	1	I(1)
FDI	-2.679188	-3.536601	-4.788471	-3.568379	1	I(1)
Aid	-2.949801	-3.536601	-8.874854	-3.540328	1	I(1)
INFL	0.096457	-3.536601	-4.4370882	-3.540328	1	I(1)
GE	-2.095500	-3.536601	-6.327220	-3.540328	1	I(1)

The results of the ADF testing for the variables reported in Table 2 indicates that all the variables were non-stationary in levels, I (0), but become stationary after first differencing, or integrated of order one, I(1), which provided a necessary, but not sufficient rationale for estimating cointegration and error correction models.

Results of Johansen Maximum Likelihood Cointegration Test

After conducting the unit root test, this study applies the Johansen and Juselius (1990) maximum likelihood method to investigate whether there is more than a single cointegration relationship among the variables of interest. At 5% significance level, the trace test indicates 2 cointegrating equations while the maximum eigenvalue test indicates 1 cointegrating equation among the variables. We conclude that there is one cointegrating equation among the variables based on the maximum eigen value test (Enders, 2004).

Table 3. Johansen Cointegration Test

Trace Test					Max-eigenvalue Test		
Hypothesized No. of CEs	Eigen value	Trace Stats	0.05 Critical value	Prob***	Max-Eigen Stats	0.05 Critical value	Prob***
None	0.808290	171.0570	134.6780	0.0001	59.46371	47.07897	0.0015
At most 1	0.654748	111.5933	103.8473	0.0139	38.28534	40.95680	0.0970
At most 2	0.593101	73.30792	76.9727	0.0920	32.37085	34.80587	0.0950
At most 3	0.414046	40.93707	54.07904	0.4241	19.24248	28.58808	0.4720
At most 4	0.254373	21.69459	35.19275	0.6160	10.56707	22.29962	0.7884
At most 5	0.160065	1.12753	20.26184	0.5299	6.279511	15.89210	0.7560
At most 6	0.125993	4.848017	9.164546	0.3005	4.848017	9.164546	0.3005
Trace Test Trace test indicates 2 cointegrating eqn(s) at the 0.05 level *denotes rejection of the hypothesis at the 0.05 level **Mackinnon-Haug-Michelis (1999) p-values							

Thus, the null hypotheses of no cointegration are rejected, implying long-run cointegration relationships amongst the variables, when normalized for a unit coefficient on LnRPCGDP, the cointegrating regression of economic growth in Ghana can be given in table 4:

Table 4. The Cointegration Regression of Economic Growth in Ghana

Variable	Coefficient	Standard Error	t-Statistics
K	0.036692	0.00876	4.18858
L	0.208855	0.18348	1.13830
FDI	-0.067767	0.02657	-2.55051
AID	-0.037652	0.00985	-3.82254
INF	0.001132	0.00083	1.36385
GE	-0.037110	0.00812	-4.570110
Trend(2)	-0.106689	0.06582	-1.62092

In the estimated model in table 4, none of the coefficients of explanatory variables of economic growth is found to be greater than unity, indicating low responsiveness of economic growth to changes in these variables.

Interpretation of the Results

The coefficient of the physical capital is positive as expected based on theory. It is statistically significant at 5 percent significance level. Specifically, a one percent increase physical capital will cause real GDP per capita to increase by 0.037 percent approximately, *ceteris paribus*. It can be inferred that physical capital has a positive impact on real GDP per capita in Ghana, in general. This means that in the long run, increases in physical capital is vital to economic growth in Ghana. This result is in support of theory and concurs with the result obtained by Danquah (2006); Aryeetey and Fosu (2005), though statistically insignificant and Oteng-Abayie, et al. (2006) who found it to be statistically significant at 1 percent significance level.

Truly, this study has found that there is a positive relationship between labour force and economic growth in Ghana though it is statistically insignificant at the 5 percent significance level. Specifically, a one percent increase labour force will cause real GDP per capita to increase by 0.209 percent approximately, all other things being equal. This result is consistent with economic theory and the findings of Danquah (2006). However, this result is inconsistent with the findings of Aryeetey and Fosu (2005); Oteng-Abayie, et al. (2006). The long run results reveal yet another petrifying outcome which is in contravention with expectation as economic theory suggests. We found that the coefficient of foreign direct investment (FDI) has a negative impact on growth. It is statistically significant at 5 percent significance level. A one percent increase in FDI will lead to a fall in real GDP Per Capita by 0.068 percent approximately, all other things remaining the same. This negative relationship between FDI and real GDP per capita in Ghana is consistent with a previous study by Frimpong, J.M and E.F Oteng-Abayie (2006) but inconsistent with theory and other empirical findings by Balasubramanyam, et al. (1999); Asheghian (2004); Vu, et al. (2006). This interesting result obtained from the empirical study confirms the mining sector FDI dominance which does not generate direct growth impacts on the wider economy (Frimpong, and Abayie, 2006). Some conditions that are often associated with official FDI to developing countries, Ghana inclusive, might not be directly favourable to initiating higher levels of industrial performance as well as economic growth. For instance, substantial FDI go to non-manufacturing sectors of the economy, particularly services sector for which reason FDI will not make any significant impact on industrial performance and also on economic growth (Adenutsi, 2008).

The coefficient of foreign aid is negatively signed and is statistically significant at 5 percent significance level. A one percent increase foreign aid will cause real GDP Per Capita to decrease by 0.038 percent, all other things remaining the same. This indicates that foreign aid do not have a substantial or statistically significant effect on Ghana's real GDP per capita growth in the long-run. This result obtained is inconsistent with theory and supports the study by Papanek (1973); Gupta (1975); Lloyd, Morrissey and Osei (2001). However, the result obtained is consistent with several studies in developing countries such as Griffin and Eno (1970); Voivdas (1973).

Interestingly, the study found that there is a positive relationship between inflation and real GDP per capita, though statistically insignificantly at the 5 percent significance level but statistically significant at 10 percent significance level. Thus the results indicate that, if inflation increase by one percent, then real GDP per capita will significantly increase by 0.001 percent, *ceteris paribus*. This means that the inflationary level that Ghana has experienced is good for Ghana's economic growth. The potency of government expenditure in explaining real GDP per capita in the country is negative and is statistically significant at 5 percent significance level. A one percent increase in government expenditure will cause real GDP per capita to decrease by 0.037 percent, *ceteris paribus*. This result obtained means that government has not been spending more on productive sectors (provision of safe water, primary health care, education etc) of the economy. From the long-run estimated result, physical capital, foreign direct investment, foreign aid, inflation and government expenditure are identified as the major macroeconomic determinants of economic growth in Ghana.

Results of the Estimated Short-Run Dynamic Model

Analysis of short run dynamic equation has two important objectives. First, it can be used to investigate whether the impact of any of the explanatory variables are permanent or temporary. If responses are significant only in the short run, then the effect of changes in any of the explanatory variables is temporary. However, if the response is significant in both the short run and the long run, then it can be said that changes of any of the explanatory variables are permanent. Finally, the Dynamic Error Correction Model (DECM) provides information about the speed of adjustment in response to a deviation from the long run equilibrium, which could be useful for policy analysis (Cholifihani, 2008).

Table 5. The estimation of the Dynamic Error Correction Model

Dependent Variable: D(RGDPPK)			
Variable	Coefficient	Std. Error	t-Statistic
Constant	0.066086	0.05078	1.30137
D(LnRPCGDP(-1))	0.190926	0.19441	0.98207
D(LnRPCGDP(-2))	-0.159901	0.20005	-0.79930
D(K(-1))	-0.001052	0.00342	-0.3072
D(K(-2))	0.001074	0.00349	0.30768
D(L(-1))	-1.079207	1.99043	-0.54220
D(L(-2))	0.799855	1.88382	0.42459
D(FDI (-1))	0.019565	0.01048	1.86755
D(FDI (-2))	0.008265	0.00702	-1.17752
D(Aid(-1))	0.008557	0.00487	1.75659
D(LnAid(-2))	0.004715	0.00437	1.07950
D(LnINFL(-1))	-0.000103	0.00026	-0.39367
D(LnINFL(-2))	-0.000282	0.00025	-1.11103
D(LnGEXP(-1))	-0.012282	0.00413	-2.97427
D(LnGEXP(-2))	0.008731	0.00372	-2.34775
ECM(-1)	0.203749	0.08256	-2.46793
R-squared	0.623901		
Adj. R-squared	0.326980		
Sum sq. resids	0.026924		
S.E. equation	0.037644		
F-statistic	2.101239		
Log likelihood	75.81386		
Akaike AIC	-3.417935		
Schwarz SC	-2.706919		
Mean dependent	0.002948		
S.D. dependent	0.045886		

In the above estimated model, foreign direct investment (lagged one year), foreign aid (lagged one year), and government expenditure (lagged one and two years) have been found important (significant) macroeconomic determinants of economic growth of Ghana in the short-run.

An examination of the econometric results shows that the overall fit is satisfactory with an R-squared of 0.624, thus 62.4% of the systemic variation in the dependent variable is explained by the ECM. The estimated coefficient of the error term (-0.203749) has been found statistically significant at 5% level with appropriate (negative) sign. This suggests that the system corrects its previous period's disequilibrium by 20.4 percent a year. The long-run model passed all the diagnostic tests: White heteroskedasticity - 3.9727 [0.2248], Serial correlation LM test - 2.1163 [0.1511] and Ramsey Reset - 3.2520 [0.1242].

Conclusions

The problem of this study was to ascertain the key macroeconomic factors that would drive Ghana's real per capita GDP growth and to determine which ways these determinants influence

economic policy formulation and implementation. In this regard, the main objective of the study is to examine the major macroeconomic factors of real GDP per capita growth in Ghana for the period 1980 to 2010 by means of Cointegration and error correction models using yearly data for the period and then recommend actions that should be taken to speed up the growth process in Ghana. Our study shows that long-run economic growth in Ghana is largely explained by physical capital, foreign direct investment, foreign aid, inflation and government expenditure. It is also evident that economic growth is not affected by short-term changes in labour force. The estimated coefficient of the ECM indicates a mild speed of adjustment to equilibrium. The sign of error correction term is negative and significant, confirming that there exists a long-run equilibrium relationship among the variables. It is recommended government must reform the tax system and improve its budget balance. Government should continue to direct foreign assistance into the programmes that produce public capital since this improves the productivity of the masses and hence, is likely to have a positive long run effect on growth in Ghana.

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