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Macroeconomic Behaviour and Economic Growth in Ghana

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Abstract

This study tries to ascertain the behaviour of some major macroeconomic factors that would drive Ghana's economic growth using Johansen approach to cointegration. The study uses quarterly data from 1980:Q1 to 2013:Q4. The data were first analyzed using the Augmented Dickey Fuller (ADF) and Philips-Perron (PP) tests which indicate that all the variables of interest were stationary after their first differencing. The study found cointegration relationship between real GDP (economic growth) and its macroeconomic factors. The study found that in the long run physical capital, labour force, real effective exchange rate, stock market prices have positive effects on real GDP growth while consumer price index, interest rate, money supply, and government expenditure have negative effects on real GDP growth.In the same way, in the short run, physical capital, labour force, real effective exchange rate, stock market prices have positive effects on real GDP growth while consumer price index, interest rate, money supply, and government expenditure still had negative effects on real GDP growth. Based on the study findings, it recommended that the Government together with the Bank of Ghana should develop and pursue prudent both fiscal and monetary policies that would aim at stabilising the macroeconomic indicators.

Key words: Macroeconomic, Cointegration, Unit Root Tests, Economic Growth, Time Series
JEL Code: E1, E130, E6

1. Introduction

The current uncertainties regarding the fragile global economic recovery continue to highlight the importance of accurately studying and forecasting the path of the leading indicators especially macroeconomic indicators of the economy. Nevertheless, for all countries, both developed and developing, one of the fundamental objectives of macroeconomic policy is to ensure economic stability. In Ghana, monetary and fiscal policies are aimed at sustaining high growth rates together with lower unemployment rate, stable exchange rate, and low inflation by way of price stability.

Ghana has been targeting a single digit average inflation rate. The monetary policy committee (MPC) of Bank of Ghana in 2011 reduced its monetary policy rate from 13.5% to 13% as a result of improvement in the economy even though such an improvement is not limited to only this period (Agalega & Antwi, 2013). This decision was expected to trigger a reduction in the interest rate of the commercial banks and consequently make the cost of borrowing cheaper. Boyd et al. (2001) examined five –year average data on bank credit extension to the private sector, the volume of bank liabilities outstanding, stock market capitalization and trading volume, and inflation for a cross section sample over 1960-1995 and find that, at low to moderate rates of inflation, increases in the rate of inflation lead to markedly lower volumes of bank lending to the private sector, lower levels of bank liabilities outstanding and significantly reduced levels of stock market capitalization and trading volume.

The main motivation for this study stemmed from the fact that one of Ghana's development goals or aims is to push the country to become a higher middle income earning country by the year 2020. This goal can only be realised if there is a high and sustainable rate of growth above 8% annually (The Coordinated Programme of Economic and Social Development Policies, 2010 – 2016). The pattern of Growth rates in the country have been all that stable to propel the country to achieve its target even though positive rates have been recorded in the past years. It is to be noted that, the behaviour of the growth rates is been influenced by many unstable macroeconomic variables (Havi, Enu, Osei-Gyimah, Obeng, & Opoku, 2013). Again, both the real and nominal exchange rates play a key role in the international transmission mechanism and therefore changes in their dynamic behavior have important consequences for a small open economy like Ghana. Second, changes in the nominal and real exchange rates affect foreign currency denominated assets and liabilities, with dare consequences for the stability of financial system. For instance, with the government of Ghana's issue of international (Euro) bond, changes in the nominal and real exchange dynamics have implications for debt servicing and eventual payment of the principal on maturity. Third, changes in nominal exchange rate dynamics have repercussions on the country's economic growth. The knowledge of the precise magnitude of the pass-through effect is therefore important for the conduct of monetary policy under inflation targeting regime. Last but not least, the study will provide a clear understanding on the relative importance of various kinds of shocks (monetary, demand, and supply) on both the exchange rate dynamics and the pass-through effect. This will aid policy prescription as it will highlight whether demand side or supply side policies or a combination are likely to be more effective in managing exchange rate movements and pass-through effect on economic growth.

Although studies have been done to explore the relationships between these variables, some of the core macroeconomic variables such as inflation, monetary policy rate, money supply, stock market prices etc. which are unstable (Agalega & Antwi, 2013) and have long standing effects on economic growth have not been much explored to a give a clear picture of the relationships. Therefore a study which will explore these and other macroeconomic variables to give clear picture of their relationships and to suggest some of the possible ways of stabilising these variables in order achieve high economic growth rates for the country to achieve its goal is what this paper seeks to do.

According to Frimpong and Oteng (2010), a high rate of inflation beyond 14% will always hurt GDP, the reason for Bank of Ghana monetary planning committee always targeting a single digit rate. Macroeconomic variables such as inflation, interest rate, exchange rate, money supply, stock prices etc. have been established by considerable research to be of great

determinants of economic growth in developed economies. Successive governments in Ghana had initiated several fiscal and monetary policies aimed at bringing inflation and interest rate down as well as ensuring stable exchange rate and stock prices with the view to boosting economic growth. Whiles these policies might be good, the effects of these macroeconomic variables on the economies of developing countries have not been well established.

Literature on these variables is sparsely available and scattered. Again, studies in this area is really limited in Ghana and we are not also sure of the exact correlation between some of these variables especially inflation, monetary policy rate, exchange rate, stock market prices and economic growth. The questions that need to be asked are: To what extent should the government pursue its objective of single digit inflationary target? Are inflation, exchange rate, stock prices, money supply, and monetary policy rate determinants of economic growth in Ghana? These and many more are the macroeconomic problems that ought to be answered in Ghana. The paper investigates the effect of changes in the inflation rate, exchange rate, stock market prices, money supply, and monetary policy rate on the economic growth of Ghana for the period 1980 to 2013 using cointegration approach with the associated impulse response function and variance decomposition.

On the empirical side, Lupu (2009) established that there is a positive relationship between inflation and economic growth in Romania in the short run. Drukker, Hernandez-Verme, and Gomis-Porgueras (2005) established that, if inflation rate is below 19.16%, increases in inflation do not have a statistically significant effect on growth, but, when inflation is above19.16%; further increases in inflation will decrease long run growth. This affirmation is in line with Lupu (2009) but only that, it establishes a threshold beyond which the assertion of Lupu (2009) will not hold. Obamuyi (2009) established that lending rates have significant effects on economic growth. This implies that there exists a unique long run relationship between economic growth and interest rates and that the relationship is negative. This means when interest rate reduces, economic growth in the short run will increase, but when interest rate declines economic growth will increase.

Mallik & Chowdury (2001) established a long run positive relationship between economic growth rate and Inflation among four South Asian Countries. However, Kasim and Munir (2009) were able to establish the non-linearity between inflation rate and economic growth rate in Malaysi. Their study analysed the relationship between inflation rate and economic growth rate. The findings suggest that there is one inflation threshold value that exist for Malaysia. This evidence strongly supports the view that the relationship between inflation rate and economic growth is nonlinear. Baily (2003) conducted a research on “sources of economic growth in the Organisation for Economic Cooperation and Development (OECD) countries”. The methodology employed was aggregate regression analysis with particular emphasis on the ways in which policies affect outcomes. Baily (2003) found out that investment in physical and human capital, sound macroeconomic policies, government spending, research and development by the business sector, financial market, and international trade were all important factors to economic growth in OECDs. Furthermore, the study found that a larger sized government spending, direct taxes and research and development by the public sector all contributed negatively to economic growth.

Agalega and Antwi (2013), in their study using a multiple linear regression model for the period 1980 to 2010 established that there exist a positive relationship between inflation, interest rate and GDP growth in Ghana. However, their study did not look at the other macroeconomic variables such as money supply, monetary policy rate, stock market prices

etc. which also have strong effects on economic growth. These variables may give a clear picture for policy purposes.

Enu, Osei-Gyimah, Obeng, and Opoku (2013) using cointegration approach for the period 1970 to 2011 looked at the macroeconomic determinants of economic growth in Ghana. In their study, they found that physical capital and labour force have positive effects on economic growth while inflation and government expenditure have negative effects on economic growth. However, other variables such stock market prices, money supply, exchange rate etc. were not captured here as well as feedback checks among the variables to see how they interrelate to each to other. The rest of the paper is organised as follows: section 2 considers the methodology, section 3 discusses the empirical results, and the last section presents the conclusion and recommendations of the study.

2. Methodology

2.1 Sources of Data and Data Collection Procedure

The sources of the data collected for the study is secondary; the procedure for the data collection was relatively simple. More specifically, data on Gross Domestic Product (proxy for Economic Growth), Money supply, Inflation rate, Real exchange rate, Gross fixed capital formation, and Labour force were collected from the World Development Indicators (World Bank), while data on Monetary policy rate were collected from Bank of Ghana and the data on stock market prices from the Ghana Stock Exchange. The data collected with regard to all the variables covered the period 1980:Q1 to 2013:Q4.

2.2 Model Specification

Macroeconomic theory has identified various factors that influence the growth of a country from the classical, neoclassical and the new growth theories. The paper looks at the effects or the relationship between a dependent (response) variable and a number of independent (explanatory) variables using the neoclassical growth model of Solow. This is because the Neoclassical Growth Model of Solow focuses mainly on the supply side.

Theoretically, the Solow growth model is specified as:

$$Y_t = \text{f}\,(K_t^{\alpha}, A_t^{\beta}, L_t^{\gamma}, e^{\varepsilon t}) \quad (1)$$

Where Y_t is output, K_t, is the physical capital, A_t is the total factor productivity, L_t is the labour force, and e is error term and $\alpha + \beta + \gamma = 1$ reflecting constant returns to scale. With regard to this study, A_t is therefore specified as:

$$A_t = \text{f}\,(LNCPI_t, INT_t, REER_t, MS_t, GEXP_t, SMPX_t) \quad (2)$$

This implies that:

$$A_t = (LNCPI_t^{\beta 1}, INT_t^{\beta 2}, REER_t^{\beta 3}, MS_t^{\beta 4}, GEXP_t^{\beta 5}, SMPX_t^{\beta 6}) \quad (3)$$

Where A_t is the total factor productivity at time t, $LNCPI_t$ is the consumer price index at time t, INT_t is the interest rate at time t, $REER_t$ is the real effective exchange rate at time t, MS_t is the money supply time at t, $GEXP_t$ is the government expenditure at time t, and $SMPX_t$ is the stock market price at time t. β's are the coefficients.

By substituting equation (3) into (1) and by specifying an extended Cobb-Douglas production function to represent the production of technology of an economy, the study obtains:

$$Y_t = \mu(K_t^{\alpha}, LNCPI_t^{\beta 1}, INT_t^{\beta 2}, REER_t^{\beta 3}, L_t^{\beta 4}, MS_t^{\beta 5}, GEXP_t^{\beta 6},) SMPX_t^{\beta 7}, e^{\varepsilon t} \quad (4)$$

By taking the logarithm of the variables involved in equation (4):

$$lnY_t = \ln\mu + \alpha(K_t) + \beta_1 lnCPI_t + \beta_2(INT_t) + \beta_3 lnREER_t + \beta_4(L_t) + \beta_5(MS_t) + \beta_6(GEXP_t) + \beta_7 lnSMPX_t + \varepsilon_t lne \quad (5)$$

Where Y_t is real GDP, $\ln\mu = \beta_0$ and $lne = 1$. It is to be noted that, the variables in the brackets were in percentages and for that matter they were not logged. Therefore equation (5) can be rewritten as:

$$lnY_t = \beta_0 + \alpha(K_t) + \beta_1(lnCPI_t) + \beta_2(INT_t) + \beta_3 lnREER_t + \beta_4(L_t) + \beta_5(MS_t) + \beta_6(GEXP_t) + \beta_7 lnSMPX_t + \varepsilon_t \quad (6)$$

For the purpose of estimation and in line with the objective of the study, turning the production function in equation (6) to a growth equation is very useful. Differencing equation (6) gives us:

$$ln\Delta Y_t = \beta_0 + \alpha\Delta K_t + \beta_1\Delta lnCPI_t + \beta_2\Delta INT_t + \beta_3\Delta lnREER_t + \beta_4\Delta L_t + \beta_5\Delta MS_t + \beta_6\Delta GEXP_t + \beta_7\Delta lnSMPX_t + \varepsilon_t \quad (7)$$

Equation (7) gives the growth in output

Where; ln and Δ are the natural logarithmic operator and difference operators respectively. The coefficients α, β_1, β_2, β_3, β_4, β_5, β_6, and β_7 are the elasticities of the respective variables, β_0 is the drift component, t denotes time, and ε is the error term. The apriori signs of the explanatory variables are:

$\alpha > 0$, $\beta_1 < 0$, $\beta_2 < 0$, $\beta_3 > 0$, $\beta_4 > 0$, $\beta_5 < 0$, $\beta_6 < 0$, and $\beta_7 > 0$

2.3 Variable Definition and Measurement

Y_t represents the log of Real GDP at time t which is measured as the total final value of all goods produced minus inflation ≡ real GDP growth.

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

$LNCPI_t$ represents consumer price index at time t which is measured as the annual percentage change in consumer prices.

INT_t represents the interest rate at time t and it is the rate charged by financial institutions on borrowings (loans). Interest rate is measured using the Bank of Ghana's monetary policy rate.

$lnREER_t$ represents the log of real effective exchange rate at time t and it is measured as the average exchange rate divided by a price deflator.

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

MS_t represents the money supply(M2) at time t and is measured as M2 as a percentage of GDP.

$GEXP_t$ represents Government Expenditure at time t, measured as Government Expenditure as a percentage of GDP.

$lnSMPX_t$ represents the stock market prices at time t and it is measured using all share index.

The Vector Autoregressive (VAR) equations or representations of the variables concern is specified below:

$$Y_t = \emptyset + A_1 Y_{t-1} + \ldots A_p Y_{t-p} + u_t \quad (8)$$

Where Y_t is a (K*1) vector of endogenous variables, $\emptyset$ is a (K*1) vectors of intercepts, A_p are the (K*K) fixed VAR coefficients matrices and $u_t = (u_{1t}, \ldots, u_{kt})$, is an unobserved error term, with the properties:

E $[u_t] = 0$ and E $[u_t u_t] = \sum_u$(time invariant variance-covariance matrix)

E $[u_t u_s] = 0$, $\forall_t \neq$ s. It is to be noted that, K is the number of variables.

Given the trending properties of the time series, the study employs the information criteria to select the lag length of the VAR, including a constant and a deterministic trend. The study selects the lag length based on the Akaike Information Criterion (AIC) and Swartz Bayesian Criterion (SBC).

2.4 Estimation Procedures

2.4.1 Unit Root Tests

This study began by testing for the stationarity properties of variables within the frameworks of Augmented-Dickey-Fuller (ADF) and Phillips-Perron (PP) test procedures. These tests are 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 tests the null hypothesis that the variables have unit root (meaning the variables of interest are nonstationary) as against the alternative hypothesis that the variables are stationary. While the PP tests the null hypothesis that the variables are stationary as against the alternative hypothesis that the variables are nonstationary.

2.4.2 The Johansen Cointegration Test

After checking the univariate time series of all-time series properties of each of the variables in the specified model and found to be integrated of the 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 and maximum eigenvalue tests. Here, if these tests give contradictory results at 5% significance level, the researchers would check whether they give similar results at 10% significance level instead. If yes, then, the researcher would keep results based on 10% significance level. However, if at 10% significance level the tests still give condictionary results, the researchers would stick to the results based on maximum eignvalue test, which is usually preferred for try to pin down the number of cointegrating vectors (Enders, 2004).

Moreover, if the variables are found to be integrated of different orders, we will make them integrated of the same order through differencing before determining the number of cointegrating vectors. For instance, if some variables are I(1) and some variables are I(2), we can first difference I(2) variables in order to make them I(1), and then check for the number of cointegrating vectors. On the other hand, if some variables (except dependent variable) are I(0) and some variables are I(1), ignore I(0) variables while conducting Johansen-Juselius (1990, 1992, 1994) maximum likelihood method of cointegration. In case where the dependent variable itself is I(0) regardless of the order of integration of the other variables, it is not possible to conduct cointegration analysis, implying that there exist no long run relationship among the variables. In this case, the research can run OLS after differencing the I(1) variables. If the variables are found to be cointegrated, the researchers would estimate the error correction model using standard methods and diagnostic tests.

3. Results and Discussion

The results of the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests for the variables under consideration are shown in Table 1 below.

From the ADF test in Table 1 below, all the variables are stationary at 1 percent level of significance with constant as well as with constant and trend. In the case of the PP test in Table 2, all the variables are stationary at 10 percent, 5 percent, and 1 percent level of significant with constant as well as with constant and trend. Therefore, all the variables, real GDP growth, physical capital, inflation rate, interest rate, labour force, consumer price index, and government expenditure are integrated at first order, I(1). As a result, the Johanson's cointegration approach can be used to determine the number of cointegrating equation.

Table 1: Results of the ADF test

	Constant			Constant and Trend		
Variable	Level	1st Difference	Conclusion	Level	1st Difference	Conclusion
LNRGDP	2.7417	-16.4088***	I (1)	2.8302	-16.6790***	I (1)
K	-2.2963	-5.6119***	I (1)	-2.6178	-5.6893***	I (1)
LNCPI	-1.4649	-8.7593***	I (1)	-1.4558	-8.6436***	I (1)
INT	-1.6526	-8.5553***	I (1)	-1.7992	-8.6547***	I (1)
LNREER	-1.2048	-5.6599***	I (1)	-2.1333	-5.5616***	I (1)
LF	-1.6931	-12.6303***	I (1)	-1.5747	-12.4961***	I (1)
MS	-1.8040	-6.3292***	I (1)	-2.2394	-6.3080***	I (1)
GEXP	-1.4520	-4.4841***	I (1)	-2.4421	-5.0323***	I (1)
LNSMPX	-2.2724	-7.9824***	I (1)	-1.9324	-8.0808***	I (1)

Note: *** denotes 1% significant level. The null hypothesis is that the variable has a unit root. The rejection of the null hypothesis for ADF test is based on the MacKinnon (1996) critical values at 5, 10 or 1 percent.
Source: Author's Computation

Table 2: Results of the PP test

	Constant			Constant and Trend		
Variable	Level	1st Difference	Conclusion	Level	1st Difference	Conclusion
LNRGDP	-2.0521	-3.3338**	I (1)	4.8569	-3.4090*	I (1)
K	-1.9022	-5.8337***	I (1)	-2.0017	-5.8325***	I (1)
LNCPI	-1.1784	-10.8317***	I (1)	1.1873	-10.9634***	I (1)
INT	-1.4986	-8.5515***	I (1)	-1.5063	-8.6484***	I (1)
LNREER	-1.0725	-5.0603***	I (1)	-2.2440	-5.1412***	I (1)
LF	-1.4543	-3.4359**	I (1)	-1.5591	-3.4959**	I (1)
MS	-1.5155	-5.9172***	I (1)	-2.0688	-5.9051***	I (1)
GEXP	-2.6017	-3.6377***	I (1)	-3.2846	-3.5553**	I (1)
LNSMPX	-2.1008	-7.5916***	I (1)	-1.6753	-7.5481***	I (1)

Note: *, **, and *** denote 10%, 5%, and 1% significant levels respectively. The null hypothesis is that the variable has a unit root. The rejection of the null hypothesis for test is based on the Mackinnon (1996) critical values at 5, 10, or 1 percent.
Source: Author's Computation

After the unit root tests, Vector Autoregressive (VAR), is used to determine the optimal lag length for the Johanson cointegration test which is based on the AIC as shown in Table 3. From the results, the optimal lag length based on AIC is 2. Using the selected optimal lag length of 2, the likelihood ratio test which depends on the maximum Eigen values of the stochastic matrix of the Johanson (1991) procedure for exploring the number of cointegrating vectors was used.

Table 3: Selection of Optimal Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-634.4032	NA	1.88e-07	10.05318	10.25371	10.13465
1	858.3442	2752.253	4.96e-17	-12.00538	-10.00004	-11.19060
2	1190.824	566.2547	9.91e-19*	-15.93475	-12.12462*	-14.38667*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5%level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 4: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.772706	433.9639	228.2979	0.0001
At most 1 *	0.378393	236.9228	187.4701	0.0000
At most 2 *	0.290944	173.6882	150.5585	0.0013
At most 3 *	0.248617	127.9600	117.7082	0.0096
At most 4 *	0.198962	89.94327	88.80380	0.0413
At most 5	0.174846	60.43764	63.87610	0.0941
At most 6	0.139501	34.87706	42.91525	0.2502
At most 7	0.068229	14.89479	25.87211	0.5833
At most 8	0.040481	5.495973	12.51798	0.5268

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4 and 5 below show the results for the cointegrating test. From Table 4, the Trace statistics show that there are five (5) cointegrating vectors at 5 percent level of significance. The null hypothesis of zero cointegrating vectors is rejected against the alternative of one cointegrating vector. Similarly the null hypothesis of at most 1, at most 2, and at most 3

cointegrating vectors are also rejected against the alternative hypothesis. Therefore, it is concluded that there are five cointegrating vectors specified in the model.

On the other hand, from Table 5, the Maximum Eigenvalue statistics show that there are two (2) cointegrating vectors at 5 percent level of significance. The null hypothesis of zero cointegrating vectors is also rejected against the alternative of one cointegrating vector. Therefore, here too, it is concluded that there are three cointegrating vectors specified in the model.

Table 5: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.772706	197.0411	62.75215	0.0000
At most 1 *	0.378393	63.23455	56.70519	0.0098
At most 2	0.290944	45.72820	50.59985	0.1470
At most 3	0.248617	38.01674	44.49720	0.2133
At most 4	0.198962	29.50563	38.33101	0.3565
At most 5	0.174846	25.56059	32.11832	0.2549
At most 6	0.139501	19.98227	25.82321	0.2441
At most 7	0.068229	9.398815	19.38704	0.6829
At most 8	0.040481	5.495973	12.51798	0.5268

Max-eigenvalue 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

The equation below shows the results of the coefficient of β matrices in terms of normalised cointegrating coefficient of first equation. The results were based on the trace test. This is because it gave us the expected results. These results indicate the long run relationship among the variables. All the variables turn out to be significant and have their expected signs.

LNRGDP = -0.010182*K + 0.224244*CPI+ 0.004019*INT - 0.090274*LNREER -0.015121*LF
(0.00666) (0.01990) (0.00231) (0.02877) (0.00658)
[-1.52825] [11.2682] [1.73810] [-3.13813] [-2.29706]
+ 0.010869*MS + 0.049643*GEXP – 0.069720*LNSMPX
(0.00513) (0.00838) (0.01743)
[2.11909] [5.92230] [-4.00099]

Thus, from the results above, physical capital had direct impact on economic growth. This shows that a unit increase in physical capital in the long run increases economic growth by 0.010182 units. This means that a 0.1 unit increase in physical capital leads to more than a percentage increase in real GDP growth. Also, both Inflation rate (Consumer Price Index) and interest rate had their expected signs. That is, 0.1 unit increases in inflation rate and rate will lead to 0.224244, 0.004019 percentage decreases respectively in economic growth in the long run. Thus, inflation and interest rates had negative effects on the long run economic growth. Furthermore, real effective exchange rate and labour force had positive effects on economic growth. That is, 1 percent increase in real effective exchange rate and labour force

will increase long run economic growth by 0.0902740, 0.015121 percentage points respectively.

On the other hand, money supply and government expenditure also had their expected signs. Thus, from the results, 0.1 unit increases in both money supply and government expenditure will lead to 0.010869, 0.049643percentage decreases respectively in economic growth in the long run. Finally, stock market prices had a direct impact on economic growth in the long run. That is, a 1 percent increase in stock market prices will lead to 0.069720percentage increase in economic growth in the long run. Therefore, in the long run, labour force, money supply, stock market prices are significant determinants of growth in real GDP.

The short run dynamics among the variables are explored by employing vector error correction model (VECM). These results are based on equation (6). Error correction model allows the introduction of previous disequilibrium as independent variables in the dynamic behaviour of existing variables. Table 6 presents the short run dynamic relationship and the set of short run coefficients in the vector error correction model.

Table 6: The Result of Error Correction Model for Short Run Dynamics

	Error Correction: D(LNRGDP)		
Variable	Coefficient	Standard Error	T-value
Constant	-0.02714	0.01105	-2.45612**
D(LNRGDP(-1))	2.23289	0.64804	3.44562***
D(LNRGDP(-2))	1.19193	0.18706	6.37191***
D(K(-2))	0.02745	0.01136	2.41637**
D(LNCPI(-1))	-0.83552	0.09238	-9.02484***
D(INT(-2))	-0.04638	0.01158	-4.00518***
D(LNREER(-1))	0.21797	0.03680	5.92310***
D(LF(-1))	0.06957	0.02959	2.35113**
D(MS(-1))	-0.02268	0.08869	-2.55722**
D(GEXP(-1))	-0.06183	0.02309	-2.67778**
D(LNSMPX(-2))	0.40930	0.10210	4.0088***
ECM(-1)	-0.08034	0.00997	-8.05817***
R-squared	0.689557	Akaike AIC	-1.159730
Adj. R-squared	0.661335	Schwarz SC	-0.898946
F-statistic	24.43329***	Sum sq. resid	2.038657
Mean dependent	-0.012137	Log likelihood	89.12204
S.E. equation	0.129801	Durbin-Watson stat	2.0088244
S.D. dependent	0.223046		

Source: Author's Computation

The VECM associates the changes in growth in real GDP to the changes with the other lagged variables and the disturbance term of lagged periods. The coefficient of the speed of adjustment (i.e. ECM (-1)) is negative and significant at 1 percent. The estimated coefficient of the ECM (–1) is -0.08034 (significant at 1%) suggesting that in the absence of changes in the independent variables, deviation of the model from the long term path is corrected by 8% per- cent per quarter. The short-run results further indicate that, the first and second lags of

the first difference of LNRGDP exert significant and positive effect on ΔLNRGDP consistent with the findings of Enu, Osei-Gyimah, Obeng, and Opoku (2013). From Table 6, physical capital, consumer price index, and interest rate are statistically significant at 5 percent, 1 percent, and 1 percent respectively. Thus, the results show that the past two years of physical capital and interest rate and the past one year of consumer price index had positive and negative impacts on the growth in real GDP respectively. This implies that the behaviour of these variables have consequences on economic growth. Therefore, 0.1 unit increases in the past two years of physical capital will cause growth in real GDP to increase by 0.03 percent while 0.1 unit increases in the past one year and two years of both consumer price index and interest rate will cause growth in real GDP to decrease by approximately 0.84 and 0.05 percents respectively. Further, real effective exchange rate and labour force are statistically significant at 1 percent and 5 percent significance levels respectively. That is, 1 percent increase in real effective exchange rate and 0.1 unit increase in labour force will increase growth in real GDP by approximately 0.22 percent and 0.07 percent respectively. This implies that the behaviour of these variables have consequences on economic growth. In addition, the results in Table 6 indicate that money supply and government expenditure are both statistically significant at 5 percent significance levels. Thus, the results show that 0.1 unit increases in both money supply and government expenditure will approximately decrease growth in real GDP by 0.02 and 0.06 percents respectively.

Finally, the results show that the past two years of stock market prices had positive effect on real GDP growth. Thus, 1 percent increases in the past two years of stock market prices will cause growth in real GDP to increase by 0.41 percentage points. This implies that the behaviour of the Ghana Stock Exchange has consequences on economic growth. Therefore, in the short run, the above variables are important determinants of real GDP growth in Ghana.

3.1 System Stability

Cointegration analysis merely establishes the existence of long-run relationships among variables but does not fully establish the stability of such relationships especially in the occurrence of a shock to the system. We employed the variance decomposition and impulse response function to examine how LNRGDP responds to shocks in the system variables. Table 7 presents the Forecast Error Variance Decomposition while Figure 1 contains the impulse response functions.

In this paper, the variance decomposition is done for ten periods which is presented in Table 7 below. The results in Table 7 suggest that, in the early periods, innovations in the real GDP growth are explained accordingly by the preponderance of its own past values (100%) and none by the other variables but the contribution of real GDP growth to its own decreases with time. As can be seen, by period four, contribution has dropped from a high of 100% down to around 61%. It increased again and later fell and so no. On the other hand, the innovations in the physical capital is mainly explained by real GDP changes (90%), followed by consumer price index (5.74%), by real effective exchange rate (1.11%), by interest rate (0.99%), by government expenditure (0.90%), by its own past values (0.51%), Labour force (0.39%), money supply (0.31%), and stock market prices (0.004%). The impact of deviations in the inflation rate increases initially and falls with time especially from period one to period four though there was an increase later. Interest rate also fluctuates around 3.44%, 3.11%, and

0.99% and that of the real effective exchange rate fluctuates around 4.0%, 3.1% and 2.3% respectively. Innovations in labour force is mainly explained by changes real GDP growth (90%), followed by consumer price index (5.74%), real exchange rate (1.11%), interest rate (0.98%), government expenditure (0.90%), followed by its own (0.51%), money supply (0.31%), and stock market prices p(0.005%). Labour force later increases and decreases. Deviations in money supply also fluctuate around 20%, 30%, and 70%. Impact of deviations in the government expenditure increases with time but later falls from the ninth and tenth periods. Finally deviations in stock market prices continue to increase at a moderate pace.

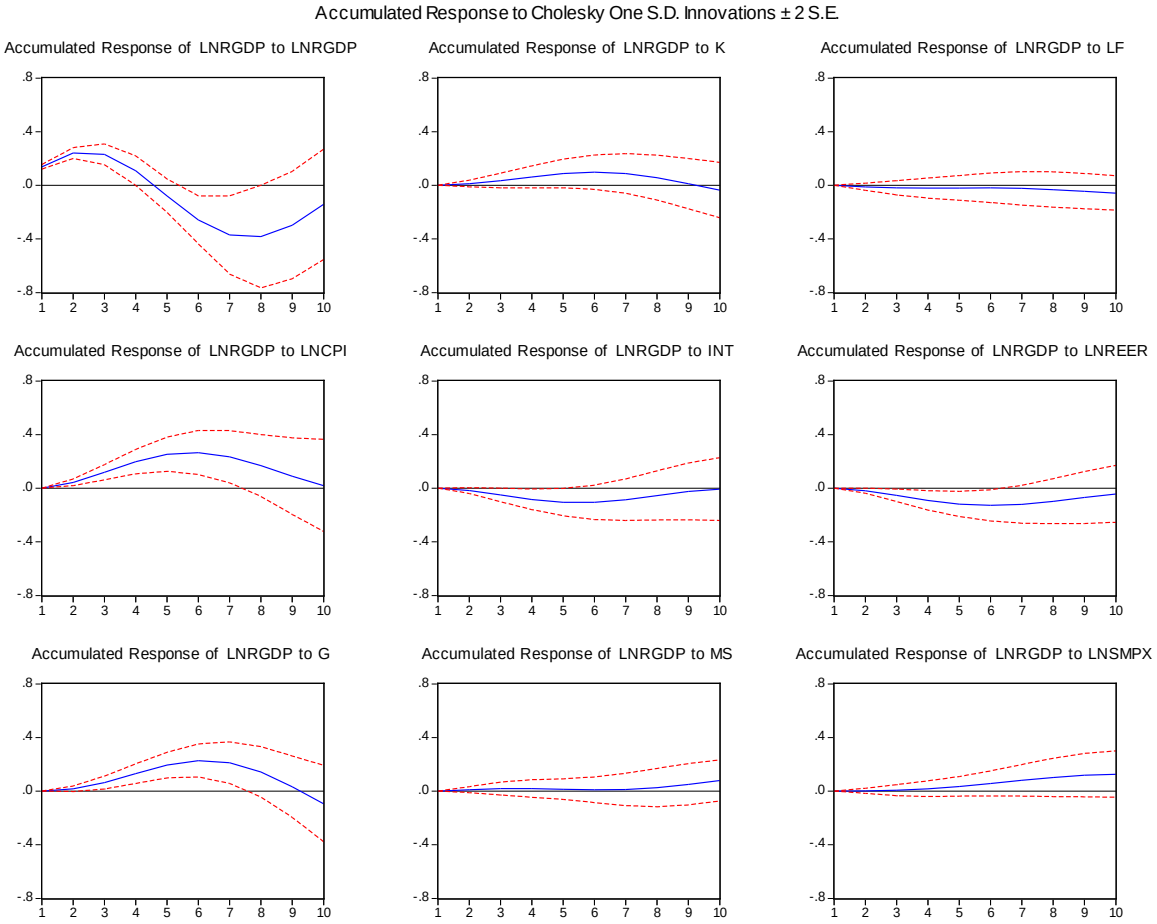
From figure 1, the response of real GDP growth (LNRGDP) to its own shock is statistically significant and positive initially from 1st quarter to the 3rd quarter but it was negative between the 5th and 8th quarter. It increases again between the 9th and the 10th quarters. Also, sudden shock to the physical capital (K) leads to a sharp increase in real GDP up to the 10th quarter both in the short run and in the long run. Thus, when there is a shock arising from physical capital, it takes the economy ten (10) quarters to adjust back to equilibrium. Further, a sudden shock to consumer price index (LNCPI) only leads to a continuous increase in LNRGDP from the 1nd to the 10th quarters. A shock to interest rate (INT) results in a continuous fall from the 1st to the 9th quarters and thereafter leads to a steady state in LNRGDP up to the 10th quarter. A shock to money supply (MS) leads to an immediate and continuous rise in real GDP growth stabilises and thereafter increases. A shock to the real effective exchange rate (LNREER) stabilises real GDP growth from the 1st to the 3th quarters and results in an increase in real GDP growth after which it results in a fall in the long run. In addition, a shock to government expenditure (GEXP) leads to increases in real GDP growth from the 1st to the 8th quarters and thereafter decreases. This confirms the results of the cointegration. A shock to labour force (LF) leads to stabilisation in real GDP growth between 1st and 6th quarters and decreases between 7th and 10th thereafter. Finally, a shock to the stock market prices (LNSMPX) initially stabilises real GDP growth and increases thereafter. Generally, the real GDP growth adjusts quite slowly to shocks to macroeconomic variables.

Table 7: Forecast Error Variance Decomposition of LNRGDP

Period	S.E.	LNRGDP	K	LF	LNCPI	INT	LNREER	G	MS	LNSMPX
1	0.137758	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.181050	90.05304	0.506258	0.392523	5.735453	0.989429	1.109872	0.895973	0.312467	0.004981
3	0.208719	67.94974	1.524234	0.447964	17.32757	3.113609	3.546991	5.629611	0.387747	0.072534
4	0.270160	61.40182	1.957323	0.272777	18.97087	3.408716	4.020015	9.524079	0.232656	0.211753
5	0.342084	68.07208	1.719584	0.172234	14.41213	2.507282	3.148753	9.420763	0.165022	0.382156
6	0.388934	73.98801	1.405830	0.133485	11.25840	1.939717	2.501672	8.021222	0.140652	0.611011
7	0.407764	74.88882	1.334613	0.129876	10.85038	1.998563	2.317147	7.455261	0.132384	0.892955
8	0.422652	69.79484	1.764517	0.165972	12.48350	2.407382	2.426631	9.634327	0.227803	1.095034
9	0.457288	63.15995	2.485826	0.217891	13.64286	2.491569	2.454326	14.01964	0.467722	1.060207
10	0.508659	60.40477	2.924769	0.243058	12.95561	2.125232	2.263690	17.48898	0.710719	0.883174

Source: Author's Computation

Figure 1: Response of LNRGDP to 1 S. D. Shocks in Macroeconomic Variables



4. Conclusion and Policy Recommendations

The study examined the effects of macroeconomic behaviour on economic growth in Ghana using cointegration approach with forecast error variance decomposition and impulse response functions. The empirical analysis is based on time series econometrics. From the study, it is found that all variables; growth in real GDP, physical capital, consumer price index, interest rate, real effective exchange rate, labour force, money supply, government expenditure, and stock market prices turned out to be non stationary at their levels but became stationary at their first differences.

The results of Johansen's cointegration test indicates that there exist a long run and short run relationships between growth in real GDP and the independent variables under consideration in Ghana. The study finds out that in the long run physical capital, real effective exchange rate, labour force, and stock market prices had positive effects on growth in real GDP. As a result, increase in these variables will lead to improvements in real GDP growth. However, consumer price index, interest rate, money supply, and government expenditure had negative effects on growth in real GDP. Therefore, increases in these variables will cause a reduction in real GDP growth. Furthermore, from the short run results, there is a 0.08 percentage point adjustment taking place each quarter towards the long run periods. That is, the past two years record of physical capital, interest rate and the past one year of consumer price index had positive and negative impacts on the growth in real GDP respectively.

Also, real effective exchange rate, stock market prices, and labour force had positive effects on the real GDP growth while money supply and government expenditure had negative impacts on the real GDP growth. These impacts were statistically significant. The forecast error variance decomposition and impulse response functions conducted also indicated that there were feedbacks among the variables. Also, the results show that real GDP growth was sensitive to the shocks by the explanatory variables. It is worth noting that this study did not consider variables such as political stability, monetary policy making because of non availability of data for the period chosen. Also, foreign aid was not included because moving from developing to a middle income status has taken to a different level and that foreign aid is dying out and that its impact is not much felt by the country.

It is therefore recommended that the Government together with the Bank of Ghana should develop and pursue prudent both fiscal and monetary policies that would aim at stabilizing both the micro and macroeconomic indicators such as inflation targeting, interest rate, exchange rate, money supply, so as to boast the growth of the economy.

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