

The Role of Monetary Policy in Exchange Rate Determination in Ghana

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Abstract: Exchange rate behaviour is one topical issue that generates great controversy and debate among economists and policy analysts in Ghana. This study seeks to explore the long run relationship between narrow money supply (M2) and Ghana Cedi US Dollar exchange rate. Applying Engle-Granger co-integration technique on annual data spanning thirty two (32) years, the study has revealed that there is no systematic equilibrium relationship between the Cedi-Dollar exchange rate and narrow money supply of Ghana. In other words, the available data does not support the view that the depreciation of the Ghanaian currency is attributable to the rise in domestic money supply. It is suggested that the cause of the continuous fall in the international value of the Ghanaian Cedi is sought elsewhere. We also suggest that the persistent trade deficit over the years should be looked at closely as a plausible cause of the woes of the Ghanaian Cedi.

Keywords: Co-integration, exchange rate, money supply, Ghanaian economy

INTRODUCTION

One macroeconomic indicator that attracts intense debate and public discussion among economists and policy analysts in Ghana is the nominal exchange rate, especially the Cedi US Dollar relationship. Ghana is a free market economy with a managed-float exchange rate regime. In addition, it is an import dependent country and hence any slight depreciation of its local currency have a lot of economic implications for the citizens.

At the household level, depreciation of the local currency would mean increases in the prices of basic commodities imported as a matter of necessity. This inflation would result in high cost of living thereby pushing many households into poverty. Many households will experience deterioration in their economic well-being especially if wage increases lag behind inflation.

At the national level, the depreciation of the local currency increases the foreign debt servicing obligations on the state. This is because more local currency will have to be converted into foreign currency to be able to settle external creditors. This diverts financial resources from crucial social and economic programmes for which the poor and the vulnerable bear the brunt.

This state of affairs has become a worry to many citizens and hence the yardstick for measuring the

success or otherwise of the economic policies of the government of the day.

Motivation for the Study

The continuous and persistent depreciation of the Cedi against major trading currencies has dominated public discussions on the Ghanaian economy. Some minority political parties have attributed the phenomenon to the excessive financing of the budget deficit by the Central Bank.

In a distinguished speaker series lecture delivered at the Miotso campus of the Central University College, Ghana on March, 25, 2014 as a visiting professor of economic governance, titled, 'RESTORING THE VALUE OF THE CEDI', Dr. Mahamudu Bawumia argued that an expansionary fiscal policy accommodated by increased central bank financing was a sure recipe for increased inflation and exchange rate depreciation. According to him, the fast depreciation of the Cedi could be attributed mainly to the printing of money to pay government salaries and interest on government debt.

On March 24, 2015, a year after the first programme, a similar lecture was delivered by the same speaker on the topic, 'THE IMF BAILOUT: WILL THE ANCHOR HOLD?' During this lecture, he reiterated the assertion that excessive fiscal expansion created problems in many developing countries because it tended to be largely monetized and the excess injection of liquidity resulted in inflation and local

currency depreciation. To him, this has been Ghana's experience in the last four years. The speaker went further to state that there had been a dramatic increase in central bank financing of government recently (i.e. equivalent to the printing of money), in addition to borrowing to finance the fiscal deficit. Central bank financing (net claims on government) had increased from GH¢1.45 billion in 2008 to GH¢13.95 billion by 2014, an increase by 863%.

To the likes of Dr. Mahamudu Bawumia, the main source of the depreciation of the Cedi against major trading currencies is the excessive money expansion by the central bank in an attempt to accommodate the ballooning budget deficit of the government.

In his exposition, the speaker relied heavily on descriptive statistics especially percentages and graphs. This approach of analysis is subject to abuse because the analyst could selectively pick periods that are favourable to his cause of study. What this study seeks to do is to subject the speaker's claim to a more rigorous empirical investigation to ascertain the veracity or otherwise of the assertion using data that spans a longer period.

Objective of the Study

This study seeks to investigate whether there is a long run relationship between Cedi-Dollar nominal exchange rate and money supply or not.

REVIEW OF LITERATURE

The large volatility in exchange rates following the demise of Bretton Woods System prompted theories of exchange rate determination. Notable among these theories are the Purchasing Power Parity, Uncovered Interest Parity, Dornbusch Sticky Price Model, Monetary Model and Portfolio Balance Approach. The relationship between money supply and exchange rate is rooted in two main theories of exchange rate determination- purchasing power parity and flexible price monetary model.

The traditional starting point of exchange rate analysis begins with the doctrine of Purchasing Power Parity (PPP). The PPP doctrine (in its absolute version) states that the equilibrium exchange rate equals the ratio of domestic to foreign prices [1]. In other words, PPP states that a given amount of money should buy the same basket of goods across different countries when expressed in one common currency. The PPP doctrine is based on the Law of One Price (LOOP), which states that for any good i ,

$$P_t(i) = E_t P_t^*(i) \quad (1.1)$$

where $P_t(i)$ is the domestic-currency price of good i in period t , E_t is the nominal exchange rate in

period t , defined as the domestic price of a unit of foreign currency and $P_t^*(i)$ is the foreign-currency price of good i in period t .

Equation (1.1) states that prices across countries should be identical when expressed in one currency. This is based on the idea of goods-market arbitrage argument, i.e. people will always buy goods from low price markets and resell in high price market for profit if adjustment is made for transport cost and tariffs. Since trade among countries involves more than one commodity, the LOOP can be extended to take account of many goods. In that case, the LOOP becomes

$$P_t = E_t P_t^* \quad (1.2)$$

where P_t is the price level of domestic goods in period t , P_t^* is price level of foreign goods in period t and E_t is the nominal exchange rate in period t .

From equation (1.2),

$$E_t = (P_t/P_t^*) \quad (1.3)$$

Modifying this equation slightly by multiplying the right hand side (RHS) of equation (1.3) by a factor, we obtain

$$E_t = A (P_t/P_t^*) \quad (1.4)$$

Differences in the way aggregate price levels are constructed in the domestic and foreign countries will generally rule out the possibility of $A = 1$ [Patterson, 2000]. Taking the natural logarithm of (1.4), we have

$$\ln E_t = \ln A + \ln P_t - \ln P_t^* \quad (1.5)$$

Totally differentiating (1.5), we obtain

$$d \ln E_t = d \ln P_t - d \ln P_t^* \quad (1.6)$$

where the differential of a constant is zero rule is applied to A . Recalling that the differential of the logarithm of a variable is a very good approximation to the rate of growth of that variable, we can rewrite (1.6) as

$$\hat{E}_t = \hat{P}_t - \hat{P}_t^* \quad (1.7)$$

where \hat{E}_t is the rate of depreciation of the domestic currency, \hat{P}_t is domestic inflation in period t , and \hat{P}_t^* is the foreign inflation in period t .

In many textbooks [2], equation (1.7) is referred to as the relative purchasing power parity. It can be seen from equation (1.7) that variations in the exchange rate result from variations in the relative prices. One can, therefore, conclude from equation (1.7) that an increase in domestic inflation relative to foreign inflation will cause the exchange rate to go up (i.e. depreciation) and vice versa.

One weakness of the PPP theory, however, is that it ignores the effect of capital flows on the exchange rate and the theory is solely built around goods market equilibrium. This shortfall calls for other theories that take account of other markets.

The Flexible Price Monetary Model

Purchasing Power Parity by itself may not be sufficient to explain the exchange rate. The monetary approach to the exchange rate determination, which emerged as the dominant exchange rate model at the start of the float of exchange rates in the early 1970s, starts from the definition of the exchange rate as the relative price of two moneys and attempts to model that relative price in terms of the relative supply of and demand for those moneys [3]. The framework makes use of the absolute PPP and the money market equilibrium condition. The demand for money is assumed to depend on real income and interest rate. The specification of the money equation is of the form.

$$MD = Y^\phi \exp^{-\lambda r} \quad (1.8)$$

Money supply is assumed to be determined exogenously. In equilibrium real money supply is equal to the real money demand. The real supply of money is specified as M/P . In equilibrium,

$$M/P = M^d = Y^\phi \exp^{-\lambda r} \quad (1.9)$$

Taking the natural logarithm of (1.9) and employing time series notation, we have

$$\ln M_t - \ln P_t = \phi \ln Y_t - \lambda r_t \quad (2.0)$$

Rearranging (2.0),

$$\ln P_t = \ln M_t - \phi \ln Y_t + \lambda r_t \quad (2.1)$$

Letting (2.1) be the domestic money market equilibrium and (2.2) for the foreign money market equilibrium be

$$\ln P_t^* = \ln M_t^* - \beta_1 Y_t^* + \beta_2 r_t^* \quad (2.2)$$

Invoking the PPP and taking natural log we have

$$\ln E_t = \ln P_t - \ln P_t^* \quad (2.3)$$

Substituting (2.1) and (2.2) into (2.3), we have

$$\ln E_t = \ln M_t - \ln M_t^* - \phi \ln Y_t + \lambda r_t + \beta_1 \ln Y_t^* - \beta_2 r_t^* \quad (2.4)$$

The general flexible price monetary model can be specified as follows:

$$e_t = \alpha_0 + \alpha_1 m_t + \alpha_2 m_t^* + \alpha_3 y_t + \alpha_4 y_t^* + \alpha_5 r_t + \alpha_6 r_t^* + \varepsilon_t \quad (2.5)$$

where the variables m_t , m_t^* , y_t , y_t^* , and e_t are in logs and ε_t is the disturbance term.

Equation (2.5) is the fundamental flexible-price monetary equation. We can see that an increase in the domestic money supply will lead to a rise in E_t —i.e., a depreciation of the domestic currency in terms of

the foreign currency. In this framework, capital is assumed to be perfectly mobile and investors are risk neutral. The implication of this assumption is that a condition known as uncovered interest parity, UIP, holds.

The role of UIP in the flexible price monetary model (FPMM) is to provide for equilibrium on the capital market. The FPMM thus consists of simultaneous equilibria on the money markets, capital markets and traded goods markets. For a comprehensive review of exchange rate economics, see Taylor [3].

Results from empirical studies of the monetary theory are mixed. Eichenbaum and Evans [4] in a study investigated the effect of monetary policy shock on the exchange rate involving five exchange rates in relation to the US Dollar. They found that contractionary shocks to US monetary policy were followed by sharp, persistent appreciations in US nominal and real exchange rates. Mumuni and Owusu-Afriyie [5] in a working paper did a study on the determinants of Cedi/Dollar exchange rate in Ghana by employing a modified flexible price monetary model. They found that all the variables except the political factor were significant in explaining variation in the nominal exchange rate.

There are earlier studies that did not support the monetary theory of exchange rate. Sarantis [6] investigated three variants of the long-run monetary model of exchange rate determination by applying the Johansen multivariate co-integration method to four bilateral sterling exchange rates over the period 1973Q1 – 1990Q3. The co-integration results provide dismal evidence for the forward-looking monetary approach to exchange rate determination irrespective of the measurement of money.

Data Sources

This study makes use of secondary data obtained from the World Bank database on Ghana. It is an annual data on nominal Cedi-Dollar exchange rate and domestic money supply proxied by the M2 definition of money supply. This definition of money supply consists of currency in circulation and demand deposits with the deposit taking financial institutions. The data covers the period between 1983 and 2014 inclusive.

The data taken from the World Bank database on Ghana spanning the period 1983 to 2013 was updated to 2014 level using growth rate in M2 as indicated in the Bank of Ghana 2014 annual report. The end of period Cedi/Dollar rate obtained from the same report is 3.2 in the year 2014. This time period is chosen because it falls within the period when

economic controls have been abolished and the market allowed determining relative prices and hence allocating resources.

METHODOLOGY

We employed the Engle-Granger procedure in analyzing the data. This methodology follows the steps outlined below:

- i. Run a regression of Cedi-Dollar exchange rate (Y_t) on M2 money supply (X_t) and obtain the residuals.
- ii. Test for the stationarity of the residuals using MacKinnon critical values since the residuals are derived and not directly observed.

RESULTS AND DISCUSSION

The time series plot of the M2 money supply and Cedi-Dollar exchange rate are shown in **Figures 1 and 2** respectively.

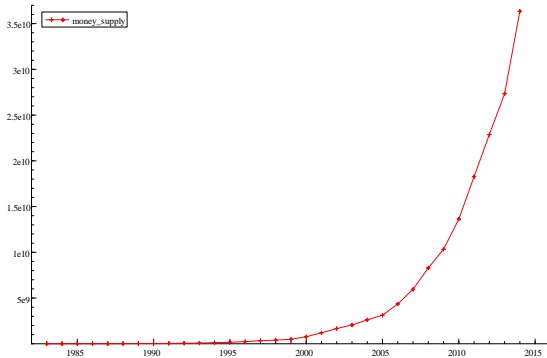


Fig-1: Time series plot of M2

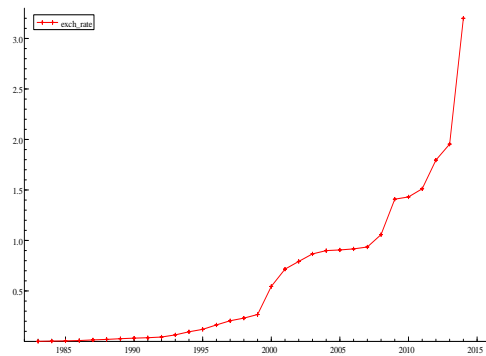


Fig-2: Time series plot of Cedi-Dollar rate

The variables appear quite trended, suggesting that the co-integration regression should include a trend variable. The model is of the form:

$$Y_t = \beta_0 + \beta_1 t + \beta_2 X_t + \varepsilon_t \quad (2.6)$$

Where $Y_t, X_t,$ and ε_t denote Cedi-Dollar exchange rate, M2 money supply and stochastic disturbance term respectively. The results of applying the relevant data to (2.6) using Ordinary Least Squares (OLS) is shown in **Table 1**. The standard errors are heteroscedasticity consistent (i.e., the residuals are homoscedastic) because a robust method has been used to obtain them.

Table-1: Regression of Nominal Exchange Rate on Money Supply (M2)

Variable	Coefficient	Robust Standard Error	Robust t-ratio
Constant	-0.9478720	0.15942	-5.9458**
Trend	0.03343460	0.00490246	8.200**
Money Supply	5.1917e-0119	3.738e-0125	5.385**
$DW = 0.933; \bar{R}^2 = 0.949447$			

**significant at 1%

Source: From the study

All the variables appear to be significant in explaining variation in the Cedi-Dollar exchange rate at 1% level. The adjusted \bar{R}^2 also suggests that approximately 95% variation in the Cedi-Dollar exchange rate is explained by money supply and the trend term. However, looking at the Durbin-Watson (DW) statistic raises serious suspicion. The DW statistic suggests that the residuals from the estimated model are strongly positively correlated.

It has been shown that the usual t and F tests are not generally reliable in the presence of serial correlation of residuals [7]. We therefore subject the residuals to a more formal test of stationarity.

Unit Root Test of Stationarity of Residuals

The first step in analyzing the residual is to plot it. Figure 3 shows the plot of residuals obtained from regression equation (2.6).

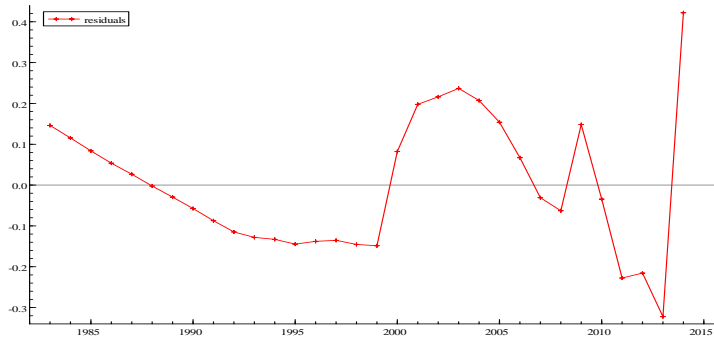


Fig-3: Plot of Residuals

The residuals appear to exhibit a random walk with drift behaviour. This suggests that we choose the following form of the Augmented Dickey-Fuller (ADF) equation.

$$e_t = \alpha_0 + \alpha_1 e_{t-1} + u_t, \quad (2.7).$$

where e_t is the residual obtained from equation (2.6), α_0 , and α_1 are coefficients to be estimated. The null hypothesis we seek to test is that the residuals (e_i) contain unit root (i.e. $\alpha_1 = 1$). Adding and subtracting e_{t-1} to the left hand side of (2.7) and simplifying, we have

$$\Delta e_t = \alpha + \rho e_{t-1} + u_t \quad (2.8).$$

Here, $\rho = \alpha_1 - 1$, and $\Delta e_t = e_t - e_{t-1}$.

To ensure that the disturbance term (u_t) in (2.8) is white noise, we add the lags of Δe_t to the right hand side of (2.8) resulting in

$$\Delta e_t = \alpha + \rho_1 e_{t-1} + \sum_{i=1}^k \gamma_i \Delta e_{t-i} + u_t \quad (2.9).$$

Under the null hypothesis of unit root, $\rho_1 = 1 - 1 = 0$. Alternatively, we are testing the null hypothesis that $\rho_1 = 0$ in equation (2.9).

We ran ten models with varying degrees of lagged difference term (Δe_{t-i}) and the results are shown in **Table 2**.

Table-2: Unit Root Test of Residuals

Lag length for first differences (k)	ADF statistic	AIC
9	-2.430	-3.565
8	-1.808	-3.467
7	-1.824	-3.535
6	-2.089	-3.624
5	-2.803	-3.712***
4	-1.196	-3.152
3	-1.783	-3.186
2	-2.271	-3.268
1	-2.090	-3.314
0	-2.147	-3.394

***ADF model with the least Akaike Information Criterion (AIC)

Source: From the Study

We then used the Akaike Information Criterion (AIC) to choose the model with $k = 5$. This model gives the least value of AIC as indicated in Table 2. The corresponding ADF computed critical value from this model is -2.803. We now compare the ADF computed critical value with the MacKinnon critical value. MacKinnon [8] has shown that Augmented Dickey-Fuller critical values are not appropriate in testing for the unit root in the residuals since the residuals are not directly observed but rather derived.

MacKinnon [9] has simplified how critical values could be obtained for a finite sample in testing for co-integration and unit root. To calculate the appropriate critical value needed to test co-integration regression model of equation (2.6) which has two integrated variables ($N = 2$) and a trend, we make use of the parameters in **Table 3** at their corresponding levels of significance.

Table-3: Response Surface Estimates of Critical Values

Level of significance	β_{∞}	β_1	β_2
1%	-4.3266	-15.531	-34.03
5%	-3.7809	-9.421	-15.06
10%	-3.4959	-7.203	-4.01
	$N = 2;$	With trend	

Source: MacKinnon [9]

N : Number of I(1) series for which null of non-cointegration is being tested.

Level: Level of one-tail test of the unit root null against the alternative of stationarity.

β_{∞} : Estimated asymptotic critical

β_1 : Coefficient on T^{-1} in response surface regression.

β_2 : Coefficient on T^{-2} in response surface regression.

According to MacKinnon [9], for any sample size T , the estimated critical value is

$\beta_{\infty} + \beta_1 T^{-1} + \beta_2 T^{-2}$. Applying this technique to our model involving thirty two (32) data points, the

relevant critical values at their corresponding levels of significance are shown in Table 4.

Table-4: MacKinnon Critical Values

Level of significance	Critical Values
1%	- 4.84515
5%	- 4.09001
10%	-3.72491
	$T = 32$

Source: From the Study Based on Response Surface Estimates of Critical Values

Comparing the absolute value of the computed ADF critical value with the tabulated MacKinnon critical values, it can be seen that the computed ADF critical value (2.803) is less than the MacKinnon critical values at all levels of significance, suggesting that the residuals contain unit root and hence non-stationary. We therefore fail to reject the null hypothesis that money supply and Cedi-Dollar exchange rate are not co-integrated.

There are earlier studies that support the results from this study. Sarantis [6] has investigated three variants of the long-run monetary model of exchange rate determination by applying the Johansen multivariate co-integration method to four bilateral sterling exchange rates over the period 1973Q1 – 1990Q3. The co-integration results provide dismal evidence for the forward-looking monetary approach to exchange rate determination irrespective of the measurement of money.

There are other studies that contradict our results. Eichenbaum and Evans [4] in a study found that contractionary shocks to US monetary policy has led to sharp, persistent appreciations in US nominal and real exchange rates. Similar results were obtained by Goldfajn and Gupta [10], and Bilson [11].

CONCLUSION AND RECOMMENDATIONS

The study has shown that there is no long run equilibrium relationship between money supply and Cedi-Dollar exchange rate over the study period in Ghana. We can therefore conclude that the available data does not support the claim that the depreciation of the Cedi to the US Dollar is attributable to the rise in money supply.

We recommend that the cause of the continuous depreciation of the Cedi should be sought elsewhere. It is also important to point out that it is a common knowledge in economics that the main cause of currency depreciation lies in the external trade deficit. Policymakers should therefore take a closer look at the current trade liberalization scheme being practiced by the country.

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