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Exchange Rate Policy and Inflation in Ghana

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Abstract

The study aims at examining the relationship between exchange rate policy (adjustment) and inflation in Ghana. Using the Auto Regressive Distributed Lag (ARDL) method was used to compare the effects of devaluation on inflation in short run and long run periods in the economy of Ghana. The findings revealed that both the long run and short run devaluations of the cedi have been inflationary. The long run nominal exchange rate coefficient of -0.4052 means a 1% devaluation of the cedi will result in 0.4052% increase in the general price level. Also the research shows that both the long run and the short run depreciation of the cedi have been inflationary. The long run co-efficient of -0.8244 means a 1% depreciation of the cedi will result in 0.8244% increase in the general price level in the long run. In the ECM model for fixed exchange rate the speed of adjustment of -0.5641 is quite high. The coefficient of -0.5641 implies that it will take less than 2 years for disequilibrium in the dynamic (short run) model to be restored. Also in the ECM model for flexible exchange rate the speed of adjustment is quite low. The co-efficient of -0.3126 means it will take over 2 years for disequilibrium in the dynamic model to be restored. The findings suggest that reduction in the value of the cedi, either through devaluation or depreciation has been inflationary. This is because devaluation under fixed exchange rate and depreciation under flexible exchange rate have the effect of increasing the prices of imported raw materials and capital equipment needed for production with the result of increasing cost of production and prices of final products. It is highly recommended that government pursue policies that will help stabilize the value of the cedi against the major currencies, so as to boost people confidence in the cedi and check inflation. In light of this, policies geared towards encouraging foreign exchange inflows need to be pursued vigorously. Government should also pursue policies to remove bottlenecks (rigidities) in production, so as to increase output and solve inflation.

Keywords: exchange rate; inflation; fixed exchange rate regime; flexible exchange rate regime; devaluation; depreciation; monetarist; structuralist; ARDL cointegration approach.

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1. Introduction

Until the introduction of economic recovery programme (ERP), the growth rates of developing countries including Ghana have been disappointing. For example the average growth rate of the country in the 70s stood at about 2%. Extensive implementation of liberalization and adjustment policies in the 1980s produces some growth in agriculture and manufacturing. For the entire period 1984-1988, GDP recorded annual growth rate of 5%. The country is also beset with high rate of inflation. Inflation became a serious problem in Ghana in the late 1970s. From the rate of 56% in 1976, inflation peaked at 117% in 1977 and the decade ended with 54%. This was a monetary phenomenon because while the GDP recorded negative growth rates of -12%, -4% in 1975 and 1976 respectively, money supply grew at the rate of 25% and 44% for 1974 and 1975 respectively. Inflation reached its peak again in 1983 of 123%. The main cause of inflation was explained by Sahelian drought and the widespread bush fires that destroyed farm produce, sharply reducing supply of food and other consumables. A number of factors could account for this poor performance. One of the main ones is thought to be policy – induce distortions in the economy. It was therefore thought that through appropriate exchange rates, fiscal, monetary, trade and payment policies, these distortions could be removed; creating a structure that would favour the productive sectors of the economy.

Ghana's exchange rate policy before the introduction of the economic recovery programme, had involved the maintenance of a fixed exchange rate with occasional devaluations (March 1957 –March 1983). Under this system the official exchange rate was over-valued. The Nkrumah government rejected pressure from the Bretton Woods Institutions (World Bank and IMF) to accept an orthodox stabilization policy, including devaluations as a means of correcting balance of payment deficit and increase GDP which had remained negative for four consecutive years since 1964(IMF World Report). The country continues to maintain an over-valued fixed exchange rate, until the overthrown of the CPP government in 1966 by the national liberation council (NLC) – a military government was established. Ghana experiences its first devaluation by (NLC) government, in November 1967. The cedi which was pegged at ¢ 0.71 to $1 in 1966 was devalued to ¢1.02 to $1. As a result there was an increase in exports by 6.04 percent between 1966 and 1967, while imports declined by 18.9 percent within the same period. The civilian government that followed the NLC, that is the progress party (pp) led by Dr. Busia devalued the currency the second time. The cedi which was pegged to the dollar at ¢1.02 in 1970 was devalued to ¢1.82 to the dollar in 1971, representing 44 percent, but later revalued to ¢1.28 = $1. One of the reasons cited by the Acheampong regime (SMC) for overthrowing the Busia regime was the massive devaluation. The cedi was revalued in 1973 and 1974 i.e. ¢1.17 = $1 and ¢1.15=$1 respectively. In June 1978, Ghana introduced a flexible exchange rate system under which the exchange rate for the cedi in terms of the US dollar was to be adjusted to reflect the underlying economic, financial and balance of payments situation. Such adjustments were discontinued in August 1978 when the rate of exchange was fixed at ¢2.75 = $1.00 by the (SMC II) government, since the rate was considered overvalued. This was the rate inherited by the Provisional National Defense Council (PNDC) in 1981.

The economic recovery period has been characterized by massive reforms in exchange rate policy. The country has shifted from the fixed exchange rate regime (that is those that peg the domestic currency to one or more currencies) of the pre-adjustment period to a regime of "managed float" in which rates are determine at weekly

auctions. The auction system is a transitional mechanism that will move the country pegged exchange rate regime to floating or flexible exchange rate regime (that is those that determine the external currency more or less by the market supply and demand for it). In October 1983, the exchange rate of the cedi to the dollar stood at ¢30 = $1, during 1985, the exchange rate of the cedi was adjusted three times, culminating in a rate of ¢60 = $1. In 1986 the exchange rate was again adjusted to ¢90 = $1, representing a depreciation of 33.3 percent.

The first auction, which was held on September 19 1986, was based on the marginal pricing auction systems (MAPS) in the determination of exchange rate, by the government of the Provisional National Defense Council (PNDC). These rates were to be determined by "market forces" through biddings. A bidder was required to state the currency, the amount being bid for and the bid price he/she was willing to pay. The primary objective of the auction system was to bring about a further depreciation of the cedi and to ensure a reduction in the spread between the official and the parallel market exchange rates. The auction system commence with two "windows" – 1 window for official transactions and 2 windows for all other transactions. At the beginning, transactions through window 1 were allowed at the fixed exchange rate of ¢90 to the dollar. In February, 1987, however, the two windows were merged and all foreign transactions were made at the auction – determined marginal rates.

In an attempt to eradicate the parallel market, the government legislate the setting up of purely private market – oriented foreign exchange bureau. The establishment of the Forex Bureau, couple with other trade and payment policies brought in since Economic Recovery Programme, liberalized the foreign exchange market, and consequently enhanced the government trade liberalization policies. The country foreign exchange policy is flexible exchange rate system. This policy has impacted positively on the economy of Ghana. There has been gradual increase in GDP (5%), inflation has been reduced to about 17% and there has been an improvement in the balance of payment position of the country. It should be noted however that this achievements was short live. For example inflation in the early 1990's averaged 25%.

Several factors could account for the poor performance (high inflation) one of the main ones, is thought to be policy-induced distortions in the economy. It is in the pursuit of this problem that the study seeks (aim) to investigate whether the foreign exchange rate adjustment is one of the main causes of inflation in Ghana. It is important for researchers to research into this area, so as to find out whether the change in the exchange rate policy has had any effect on inflation in Ghana. This will help reveal the problem of improving inflation and finally present a study capable of making an original contribution to knowledge. The study is also very relevant, because the exchange rate policy and trade liberalization have been integral preoccupation of various governments of Ghana since the IMF Economic Recovery Programme of 1983. Also most of the research carried out by researchers on the effect of exchange rate policy and inflation in Ghana cover only the fixed exchange rate regime or a short period into the recovery programme.

2. Theoretical framework

2.1 Theoretical framework of exchange rate

The exchange rate by definition; is the price of foreign currency in terms of domestic currency. It can be rigidly

fixed or freely determined by the market forces. That is, the demand for and the supply of foreign exchange. With this definition a rise in the exchange rate means that foreign currency has become more expensive and therefore corresponds to a weakening or depreciation of the domestic currency. Similarly a fall in the exchange rate corresponds to an appreciation of the domestic currency. This definitions imply that the real exchange rate- the price of foreign goods in units of domestic goods denoted *e* is *EP*/P*, where E is the nominal exchange rate, P*= price of foreign goods and P = price of domestic goods. A higher real exchange rate implies that foreign goods have become more expensive relative to domestic. Both domestic residents and foreigners are therefore likely to increase their purchases of domestic goods relative to foreign ones. The reverse is the case.

According to [1] as a price, similar to the price of other commodities, the exchange rate is determined by the supply and demand for foreign exchange. References [2] and [3] postulate that prominent among the competing theories of exchange rate determination in a regime of floating exchange rate, which emerged as the dominant exchange rate model at the start of the recent float in the 1970s is the monetary approach. This approach rest on the view that the exchange rate between two national currencies is determined by their respective national money supplies and demands and the resulting effects on their general price levels. The main assumption necessary for monetary approach to exchange rate determination can be summarized as follows;

First assumption is that demand for money is a stable function of real income and interest rate. Under this assumption numerous studies have been carried out to establish the stability of demand for money and there is no consensus among researchers about the exact nature of the demand for money functions (see [4] for excellent review of this debate). Second, assume that there are no trade barriers. The international price equalization or the law of one price states that given the free trade, two economies in the long-run face the same general price level.

Given the above assumption, monetary approach to exchange rate determination claim that the excess supply of money in an economy creates capital outflows, and if exchange rates are flexible then leads to a depreciation of the value of domestic currency. On the other hand, factor that causes excess demand for money can create appreciation of the domestic currency. Thus, the determination of exchange rate is the same as the determinants of excess supply (or excess demand) of money in the economy. Beginning with the demand for money function, it is assumed that

$$M_d = K.P.Y^a.I^b \qquad (1)$$

Where M_d = Money demand, P = General Price level (CP1), Y= Real national income, I = Nominal interest rate, K= Constant term and a, b are parameters such that a = Income elasticity, b = Interest rate elasticity of demand for money. Assuming that purchasing power parity holds the exchange rate is determined as in equation (2).

$$E = \frac{p}{p^*} \qquad (2)$$

Substituting the value of P and P^* from equation (a) in equation (b),(making P the subject of the

equation (a)) we get the following;

$$E = \frac{\frac{M_d}{K.Y^a.I^b}}{\frac{M_d^*}{K^*Y^{a*}.I^{b*}}}$$

$$\therefore E = \frac{M_d.K^*.Y^{a*}.I^{b*}}{M^*d.K.Y^a.I^b} \qquad (3)$$

Assuming fully flexible interest rates we can take the demand for money equal to supply of money in both countries and therefore equation (4) is obtained.

$$Md = M \qquad (4)$$

Hence equation (3) can be written as in equation (5).

$$E = \frac{M.K*.Y^{a*}I^{b*}}{M*.K.Y^a.I^b} \qquad (5)$$

Taking the logarithms of both sides of equation (5) we get the reduced form equation of exchange rate determination as stated in equation (6).

$$LogE = logM + a*logY + b*logI - log\ M* - alogY - blogI + e \qquad (6)$$

Where *e* is the error term.

The form of equation 6 can be simplified for the sake of estimating it's co-efficient by using the following alteration.

$$LogE=a + a_1logM + a_2logM* + a_3logY + a_4logY* + a_5logI + a_6log\ I* + \quad u \qquad (7)$$

Where the expected signs of the estimated co-efficient are $a_1 > 0$. Since we expect that with increase in domestic money supply there is excess supply of money given the stable demand for money. This leads to a depreciation of the domestic currency and appreciation of the foreign currency $a_2 < 0$ since we expect that with increase in foreign money supply**,** domestic currency would appreciate. By similar reasoning:

$a_3 < 0$, $a_4 > 0$, $a_5 > 0$ and $a_6 < 0$

A simplifying modification is made by many monetarists by assuming that interest rate, money supply and income effects on exchange rate are the same for domestic as well as foreign country, so that $a_1=a_2$, $a_3=a_4$ and$a_5=a_6$. Because of the assumption of this form, we can specify the model as in equation (8).

$$LogE=bo + b_1log(M/M^*) + b_2log(Y/Y^*) + b3Log(I/I^*) + e \quad (8)$$

Secondly, the real interest rate variable appears to work the best when, it is divided into two of its components nominal interest rate and inflation rate. Here, at the cost of inviting the problem of multicollinearity. We introduce three measures of interest rate: real interest rate, nominal interest rate and inflation rate separately for the estimated equation. Hence, logarithm of exchange rate is seen as a function of logarithms of relative growth rate in money supplies, income levels, price levels, nominal Interest rates and real Interest rates. Therefore,

$$logE = C_o + C_1log(M/M^*) + C_2log(Y/Y^*)+ C_3log(I/I^*) + C_4log(P/P^*) + C_5log(i/i^*) + e \quad (9)$$

Where $C_1 > 0$, because of the domestic money supply grow faster than foreign money supply, exchange rate is expected to depreciate. $C_2 < 0$ because as domestic GNP grows faster than foreign GNP, demand for money increases and exchange rate appreciates. $C_3 > 0$, because when domestic nominal interest rate goes up faster than the foreign interest rate, demand for money (nominal) decreases and exchange rate depreciates. $C_4 < 0$, because when domestic price level relative to the foreign price level increases, demand for money goes up and exchange rate appreciates. $C_5 > 0$, because as real interest rate goes up faster than foreign real interest rate, the nominal demand for money is expected to go down causing depreciation of the local currency . From above it is clear there is relationship between exchange rate and GDP and inflation. Other theories are Purchasing Power Parity theory (PPP) and The Portfolio Balance Hypothesis.

2.2 Theoretical Review on Determinants of Inflation

Inflation is the persistent and appreciable increase in the average price of goods and services in terms of money. Different views both empirical and theoretical have emerged in the literature as far as the determinant of inflation is concerned. The monetary approach stresses the relationship that exists between money supply and prices. Monetarists therefore argue for policies that aim at curbing money supply whether domestic or foreign. The second approach analyses structural and cost-push factors. The structuralist dwells on structural factors – such as whether the market works and cost-related pressures including import prices. Yet another group emphasize that monetary expansion occurs in response to misalignment or imbalances and that monetary expansion is itself a reflection of other elemental causes such as fiscal imbalances; this constitutes the public finance approach and is essentially a variant of the structuralist. Debate about the causes of inflation in the literature is therefore generally between the monetarist and the structuralist.

2.3 Studies on Exchange Rate and Inflation

There is a view that currency devaluations associated with structural adjustment in the 1980s constituted one of the major causes of .inflation. Empirical results regarding the inflationary effects of official exchange rate depreciation in cross country and individual country studies are also conflicting. [5] studied the exchange rate regimes and inflation in Tanzania and examined the influence of the major determinants of inflation with a particular focus on the role of exchange rate policy changes. The gradual change in policy orientation from “controls” to “market” in Tanzania is associated with a change from a highly controlled exchange rate (until 1985) to a more liberalized regime from 1986 to the present (2002). The parallel exchange rate dominated price

changes from the late 1970s to 1985; the parallel premium tapered off gradually from 1986, almost disappearing by 1992. The problem of inflation cuts across both regimes despite improvements in the past four to five years. The model estimations using quarterly data for 1967–1995 show that the parallel rate had a stronger influence on inflation up until the early 1990s compared with the official rate. The study used foreign prices, official exchange rate, wage rate, real GDP and price level of goods which price are controlled as the main determinants of inflation. The reduced form equation is $Pt= (P^{f}t, Et, Wt, Yt, Pt^{CD})$

2.4 Studies in Ghana

The literature on inflation in Ghana is limited. The few available papers were mostly conducted during the economic reforms of the early 1980s and 1990s. Nonetheless, the limited amount of work can still be catalogued on the basis of the monetarist and structuralist paradigms.

Reference [6] in his paper, modeling of Ghana inflation experience (1960-2003) published in 2007 ascertain the key determinants of inflation in Ghana for the past 40years. Stylized facts about Ghana's inflation experience indicate that since the country's exit from the West African Currency Board soon after independence, inflation management has been ineffective despite two decades of vigorous reforms. Using the Johansen cointegration test and an error correction model, the paper identified inflation inertia, changes in money and changes in Government of Ghana treasury bill rates, as well as changes in the exchange rate, as determinants of inflation in the short run. Of these, inflation inertia is the dominant determinant of inflation in Ghana. It is therefore suggested that to make treasury bill rates more effective as a nominal anchor, inflationary expectations ought to be reduced considerably.

3. Methodology and conceptual framework

3.1 Method of Study

In this research study, data was collected mainly from secondary sources. Annual data from 1965 -2015 was obtained. The period covered was subdivided into two to cater for fixed exchange regime and flexible exchange regime. The period 1965-1982 coincided with fixed exchange rate regime, while 1983-2015 was used for flexible exchange rate regime. This is to enable the study compare the relative performance of the two regimes. Data on GDP were obtained from statistical service department (Accra) various issues. Real GDP growths, inflation, money supply (M2) were obtained from Bank of Ghana annual report (Various issues). Other sources for obtaining data are International financial statistics (Various issues).

3.2 The Inflation Model of Exchange Rate

The inflation model, examines the determinants of inflation and the relative role of exchange rate, using annually time series. It is constructed on the basis of different previous models of inflation, particularly developing countries. Different studies place varying weights on different sources of inflation. Monetarist models emphasize monetary growth, while Sructuralist models emphasize cost-push or supply-related factors such as wage costs, Interest rates, output and for an open economy, external factors, foreign prices and exchange

rates. Still others incorporate, with varying emphasis, both demand (monetarist) and supply factors. Examples of previous works on which elements of this model are drawn include [7,8,5].

The reduced form equation or model for examining the determinants of inflation and the relative role of exchange rates is base on [5] in his research paper 'exchange rate regimes and inflation in Tanzania modified a bit by the author by dropping control price as one of the regressors, as shown below

$$Pt = f\,(P^{f}t,\ Et\ ,W,\ Yt,\ Mt) \tag{11}$$

Reduce form of the equation is,

$$P_t = \gamma_1 Pt^{f} + \gamma_2 E_t + \gamma_3 W_t + \gamma_4 Y_t + \gamma_5 M_t + e \tag{12}$$

Where $P^{f}t$=foreign price, Pt = domestic price, Et = nominal exchange rate, Wt=wage rate, Yt = GDP and Mt= increase in money supply. The expected signs of inflation model in both short run and long run are the following;

(1) $\delta P_t/\delta P_t^{f} > 0$, Increase in foreign price, in this case US consumer price index, since is taken as major trading partner, would increase inflation in the country in both short run and long run
(2) $\delta P_t/\delta E_t < 0$; Devaluation/Depreciation of the currency is expected to be inflationary in both short run and long run.
(3) $\delta P_t/\delta W_t > 0$ Higher wages is expected to increase inflation in both short run and long run. This is because it has potential effect of increasing cost of production.
(4) $\delta P_t/\delta Y_t < 0$ A decrease in GDP will create shortage and will be inflationary in both short run and long run.
(5) $\delta P_t/\mathrm{M}_t > 0$ The derivative for money supply is expected to be positive, since expansionary monetary policy is inflationary in both the short run and long run.

It should be noted that the equations above when estimated with OLS, it will lead to spurious result due to the fact that the data used are time series which happen to be non stationary with moving average and trend, hence cointegration approach was adopted.

3.3 Unit Root Test, Co-integration and the ARDL Approach

A two variable cointegration test requires that the variables be integrated of order one. In other words the series data should be stationary only in their first differences, and not in levels. A number of alternative tests are available for testing whether a series is stationary or not, the Augmented Dickey-Fuller (*ADF*), , as well as the Phillips Perron (PP) test developed by [9]. The *PP* tests are based on the following *ADF* regression, and the critical values are the same as those used for the *ADF* tests:

$$\Delta X_t = \lambda_0 + \lambda_1 X_{t-1} + \lambda_2 T + \sum_{i=1}^{n} \psi_i \Delta X_{t-1} + \varepsilon \tag{13}$$

Where Δ is the difference operator, *X* is the natural logarithm of the series, *T* is a trend variable, λ and ψ are the parameters to be estimated and ε is the error term.

In both the *PP* and *ADF* unit root tests the null hypothesis is that the series is non-stationary and this is either accepted or rejected by examination of the t-ratio of the lagged term X_{t-1} compared with the tabulated values. If the t-ratio is less than the critical value the null hypothesis of a unit root (i.e. the series is non-stationary) is accepted. If so the first difference of the series is evaluated and if the null hypothesis is rejected the series is considered stationary and the assumption is that the series is integrated of order one (1).

Depending on the result of the test above, the regression is specified either as error correction model subject to the test of co-integration or the use of Ordinary Least Squares (OLS) after the data has been differenced. If all variables are Integrated of the same order, I(d) and the residuals are found to be integrated of order I(0), then P(domestic price level) and their dependant variables are co-integrated. This research used Autoregressive Distributed Lag (ARDL) 'bound test' approach, because the sample size became small after dividing the total data sample into two for fixed and flexible exchange rate regimes. Also the ARDL could be used whether the variables are integrated in order I(0) or I(1). There are basically three main ways of estimating co-integration parameters include Johansen Juselious (J-J) approach (1988), Engle and Granger (E-G) approach (1987) and Autoregressive Distributed Lag (ARDL). Johansen is the most commonly use suitable for larger samples.

3.4 The ARDL Co-integration Approach

According to (10), the ARDL approach requires the following two steps. In the first step, the existence of any long-term relationship among the variables of interest is determined using an F-test. The second step of the analysis is to estimate the coefficients of the long-run relationship and determine their values, followed by the estimation of the short-run elasticity of the variables with the error correction representation of the ARDL model. By applying the ECM version of ARDL, the speed of adjustment to equilibrium will be determined.

1. The inflation model $P_t = f\left(P_t^f, E_t, W_t, Y_t, M_t\right)$

$$\text{Linear version } P_t = \delta_0 + \delta_1 P_t^f + \delta_2 E_t + \delta_3 W_t + \delta_4 Y_t + \delta_5 M_t + \varepsilon_t \tag{14}$$

Following (10) the error correction representation of the *ARDL*(*ECM-ARDL*) model is

$$\Delta P_t = \alpha_0 + \delta_1 P_{t-1} + \delta_2 P_{t-1}^f + \delta_3 E_{t-1} + \delta_4 W_{t-1} + \delta_5 Y_{t-1} + \delta_6 M_{t-1} + \sum_{i=1}^{n} \beta_i \Delta P_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta P_{t-i}^f + \sum_{i=1}^{n} \pi_i \Delta E_{t-i}$$
$$+ \sum_{i=1}^{n} \eta_i \Delta W_{t-1} + \sum_{i=1}^{n} \theta_i \Delta Y_{t-i} + \sum_{i=1}^{n} \varpi_i \Delta M_{t-i} + \lambda ECM + \varepsilon_t \tag{15}$$

It should be noted at this juncture that the parameters $\delta_i = 1, 2, 3, 4, 5, 6$ are long run coefficients, while the

other parameters are the short term dynamic co-efficient of the underlying ARDL and λ is the speed of adjustment to long-run equilibrium following a shock to the system. It should be noted; all estimations were done using Microfit 4.1 and Eviews 5.0 econometric packages.

4. Empirical results and analysis

4.1 Unit Root and Co-integration Test Result

Two tests as indicated previously were conducted to establish whether there exist a unit root in the variables using PP and ADF. In other words, they were used to check the order of integration of these variables. The results reported in table 2 for flexible exchange rate system (1983-2015), the variables were tested with trend and without trend. The variables are non-stationary at both trend and without trend (see panel A). They all became stationary after first differencing (see panel B).

Table 1: Results of the Unit Root Test

Panel A : At Levels				
Variable	**ADF**		**PP**	
	Constant No Trend	Constant Trend	Constant No Trend	Constant Trend
P	-2.018273	-2.575801	-2.018323	-2.575801
P^f	1.082651	1.758055	13.576613	1.872422
E	-0.832760	-1.105575	-0.662257	-1.105575
W	0.155632	0.320242	1.031171	-0.308622
M	-1.325434	-1.770311	-1.325434	-1.085546
Variable	**ADF**		**PP**	
	Constant No Trend	Constant Trend	Constant No Trend	Constant Trend
Data Period: 1965-1982				
ΔP	-4.330133**	4.035045**	-4.206258***	-3.823818**
ΔP^f	4.040605**	-3.450057*	-3.547307*	-4.176052**
ΔE	-4.405060***	-4.261334**	-4.535775***	-4.403130**
ΔW	4.311128***	4.385773***	-4.114363***	-5.538231***
ΔM	-4.770800**	3.464701*	-4.524110**	4.464701**

The null hypothesis is that the series is non-stationary, or contains a unit root.*, ** and *** indicate the rejection of the null hypothesis of non-stationary at 10% , 5% and 1% significance level, respectively

The determination of co-integration among the variables was conducted by F-statistics, indicated in the Tables 3 and 4.

Table 2: Results of the Unit Root Test

Panel A : At Levels

Variable	**ADF**		**PP**	
	Constant No Trend	Constant Trend	Constant No Trend	Constant Trend
Data Period: 1983-2015				
P	-0.658141	-0.240134	-1.658141	-1.240134
P^f	-2.128686	-2.101826	4.000881	1.60564.1
E	1.266383	-1.210630	1.168064	-1.221122
W	3.026050	2.358701	12.75042	5.780133
M	-3.024477**	-3.000334	-3.012158**	-2.743562

Panel B

Variable	**ADF**		**PP**	
	Constant No Trend	Constant Trend	Constant No Trend	Constant Trend
Data Period: 1983-2015				
ΔP	-3.280101**	-3.150244	-21541360***	-22.44301***
ΔP^f	-3.311008**	-3.231080**	-3.111220**	-3.011416**
ΔE	-1.655204	-4.480172***	-3.715123***	-4.515154***
ΔW	-6.114561***	-6.018216***	-6.701875***	-6.308210***
ΔM	-7.075260***	-7.012452***	-7.0647215***	-7.750025***

The null hypothesis is that the series is non-stationary, or contains a unit root.*, ** and *** indicate the rejection of the null hypothesis of non-stationary at 10% , 5% and 1% significance level, respectively

The null hypothesis of no co-integration was tested against the alternative hypothesis of existence of co-integration, with the bound test. In all the computed F-statistics indicated in the table (3) and (4) are greater than the upper bounds values meaning the null hypothesis of no co- integration were rejected in favour of the alternative hypothesis of existence of co--integration at 10% significant level for both fixed and flexible regimes respectively.

Table 3: Bound Testing the Existence of a Long Run Relationship (1965 - 1982)

Models	**Computed F-Statistics**	**Critical Values of the F-Test**	
		F-Statistic	Significance Level
$P_t = f(P_t^*, E_t, W_t, Y_t, M)$	4.57208	2.205 –3.422	10%

Table 4: Bound Testing the Existence of a Long Run Relationship (1983 - 2015)

Models	**Computed F-Statistics**	**Critical Values of the F-Test**	
		F-Statistic	Significance Level
$P_t = f(P_t^*, E_t, W_t, Y_t, M)$	3.61067	2.205 – 3.543232	10%

4.2 Empirical Result of the Inflation Model

4.2.1 Estimates of the Long run Co-integration Inflation Model under Fixed Exchange rate

Table5: The Results of the Long-Run Co integrating Inflation Model: Fixed Exchange Rate

Dependent variable: $\ln P_t$ **ARDL(1,0,1,1,0,1)selected based on Schwarz Bayesian Criterion**			
Regressor	**Coefficient**	**Standard Error**	**T-Ratio**
Constant	6.7312	16.6116	0.3156
P_t^f	0.5642	0.4203	1.3175**
E_t	-0.4052	0.41012	-1.2016**
W_t	-0.2324	0.52512	-0.4603
Y_t	-0.6242	0.16556	-2.1453***
M_t	0.6036	0.34410	23435**

Source: Author Estimate

The co-efficient of the nominal exchange rate has the theoretical correct sign as expected.

4.2.2 Result of Short Run Vector Error Correction (Inflation) Equation under Fixed Exchange Rate

Table 6: The Results of the Short-Run Vector Error Correction Equation: Fixed Exchange Rate

Dependent variable: $In\Delta Pt$	**ARDL(1,0,1,1,0,1) selected based on Schwarz Bayesian Criterion**		
Regressor	**Coefficient**	**Standard Error**	**T-Ratio**
Constant	5.1457	12.3153	0.32402
ΔP^{f}_{t-1}	-0.40152	2.34203	-0.26016
ΔE_{t-1}	-0.34640	0.11414	-1.64362**
ΔW_{t-1}	-0.03211	0.36604	0.05126
ΔY_{t-1}	-0.54030	0.08630	-5.4630***
ΔM_{t-1}	0.12214	0.14245	0.41022
ECM_{t-1}	-0.56413	0.11454	-5.14063***
$R^2 = 0.97$ $\bar{R}^2 = 0.93$		Log likelihood = 6.0163	
F-statistic = F(6, 10)38.1169***		Schwarz criterion = -8.1498	
Akaike information criterion = -3.9837			

Source: Author Estimate

The inverse relationship between devaluation and inflation implies that reduction in the parity rate of the cedi against the dollar will result increase in inflation. This finding is supported by the research carried out by (11) for Tanzania. The co-efficient of -0.4052, implies that a1% devaluation will cause 0.4052% increase in the general price level domestically, and is statistically significant at 5%.

Nominal exchange rate elasticity still maintains its negative sign implying that devaluation in Ghana has been inflationary. The reason is not far-fetched; this may be partly due to inelastic demand for our imports. Devaluation has the effect of increasing prices of imported commodities with the motive of reducing imports, thereby improving the current account. Unfortunately for Ghana such imports is made up of capital equipments needed for our developmental efforts, medicine, food (rice) etc, which cannot be easily dispensed with, hence causing inflation. The co-efficient of -0.34640 implies 1% devaluation will cause inflation of 0.34640% and is statistically significant at 5%.

The coefficient of the ECM for inflation model under fixed exchange rate of -0.56413 and imply that the deviation from the short term in inflation is corrected by 56.413% in the long run and it is statistically significant at1%. This depicts that the speed of adjustment is high. It has the appropriate sign (-).

The high R^2, of 0.97 as shown on the table means that the equation is statistically significant and about 97% of changes in inflation is explain by the explanatory variables. The F-statistics is also statistically significant at 1% meaning that explanatory variables jointly explain changes in inflation.

4.3.3 The Results of the Long Run Co-integration Inflation Model under Flexible Exchange Rate

Table7: The Results of the Long-Run Co integrating Inflation Model: Flexible Exchange Model

Dependent variable: $\ln P_t$ **ARDL(0,0,1,1,1,1) selected based on Schwarz Bayesian Criterion**			
Regressor	**Coefficient**	**Standard Error**	**T-Ratio**
Constant	-2.4334	2.6345	-0.85621
P^f_t	0.4031	0.53212	1.0124*
E_t	-0.8244	0.31651	-1.1554*
W_t	-0.4487	0.46281	-2.6980**
Y_t	0.5412	0.14535	3.1045***
M_t	0.7543	0.15114	2.6502***

Source: Author Estimate

Just as under the fixed exchange rate, depreciation of the nominal exchange rate has the effect of causing inflation in the country. The co-efficient of -0.8244 implies a1% depreciation of the cedi will cause 0.8244% increase in inflation and it is statistically significant at 10%.

4.3.4 The Result of the Short Run Vector Error Correction (Inflation) Equation under Flexible Exchange Rate

Exchange rate depreciation has the appropriate sign, meaning that depreciation in the short run will cause inflation. The co-efficient of -0.2461 implies, a 1% depreciation of the cedi against the dollar will cause 0.2461% increase in the general price level and it is statistically significant at 5%.

Table8: The Results of the Short-Run Vector Error Correction Equation: Flexible

Exchange Model

Dependent variable: $In\Delta Pt$ $\ln P_t$ **ARDL(0,0,1,1,1,1) selected based on Schwarz Bayesian Criterion**			
Regressor	**Coefficient**	**Standard Error**	**T-Ratio**
Constant	-1.4333	1.4235	-0.54521
ΔP^f_{t-1}	0.5032	0.43322	1.23641**
ΔE_{t-1}	-0.2461	0.09546	-2.70395**
ΔW_{t-1}	-0.0419	0.34884	-0.083431
ΔY_{t-1}	0.5122	0.12936	3.24332***
ΔM_{t-1}	0.2437	0.24327	0.08572
ECM_{t-1}	-0.3126	0.11530	-2.33335**
$R^2 = 0.88$ $\bar{R}^2 = 0.77$		Log likelihood = 2.5084	
F-statistic F(6,14) = 12.9180***		Schwarz criterion = -12.7142	
Akaike information criterion = -7.4916			

Source: Author Estimate

The co-efficient of the ECM has the appropriate sign (-). Its value of -0.3126 implies that the deviation from the short term in inflation is corrected by 31.25% in the long run. The speed of adjustment is a bit low.

The high R^2 of 0.88 implies the equation is statistically significant and about 88% of changes in the dependant variable inflation is explain by the explanatory variables.

5. Recommendations

This section highlight on the valuable recommendation that suggest alternative ways of helping Ghana to improve upon her policies towards improving macroeconomic performance (reducing inflation)It is obvious from the study that exchange rate adjustment has been inflationary. The following policy recommendations are suggested to put the economy onto a sustainable growth path;

1. It is highly recommended that government pursue policies that will help stabilize the value of the cedi against the major currencies, so as to boost people confidence in the cedi and check inflation. In light of this, policies geared towards encouraging foreign exchange inflows need to be pursued vigorously. Government should embark on policies to attract direct foreign investment, which will make foreign exchange available in the economy besides increasing output and help stabilize the local currency. Ghanaians living abroad should be encouraged to increase their remittances at home. There should also be peaceful political atmosphere to attract foreign investment.

2. With regards to the choice of regime, despite the fact that, the study has shown that neither of the two policies (fixed or flexible) can be unambiguously rated over each other, it is recommended that when inflation is very high a pegged exchange rate may be the key to a successful short run stabilization program. Later, perhaps in response to surging capital inflows and the risk of overheating more flexible is likely to be required to help relieve pressures and to signal the possible need for adjustment to contain an external in balance.

3. It is also recommended that, the government should pursue sound economic policy and developed the banking sector, since the success of exchange rate policy hinges on these two factors.

Apart from the aforementioned recommendation the following policy measures are also put forward to improve upon the inflation.

4. The government is also advised to tighten her spending especially on unproductive ventures to avoid waste in the economy. It also suggested that Ghanaians should patronize made in Ghana products.

5. Monetary, exchange rate and real sector policies should be well knitted to ensure macroeconomic stability. In this regard, Government should implement sectoral and structural policies that promote food production in order to dampen inflationary pressures.

5.1 Limitations of the study

It will be inappropriate to say that, the study, though successful is without any limitation. Firstly the study relied on proxy as some of the data were difficult to get. For example US price index was used as a proxy for foreign prices in the inflation model. Also the equations does not cover other details as extremes of weather (drought and flood), usually captured by dummy variables. In as much as they affect agriculture output, transport and distribution differently, they may as well be assumed to be reflected in the Inflation variables. The author therefore believes, if measures are taken to ratify these limitations, the study would be improved.

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