"EXCHANGE PRESSURE, STERILIZED INTERVENTION AND MONETARY POLICY IN GHANA"

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Abstract

The empirical findings show that the country absorbs exchange pressure through depreciation and loss of net foreign assets (NFA) with the former bearing the brunt of the pressure. Monetary policy in Ghana is subject to global monetary developments. Changes in domestic credit, prices and real income cause depreciation of the cedi, while foreign inflation largely causes the cedi to appreciate. There is a growing need for the country to build up its NFA to enable the monetary authorities (MA) to employ sterilized interventions to arrest the unidirectional depreciation drift the cedi frequently experience, introduce Deposit Insurance Corporation and revamp some of the foreign currency account policies to boost up the public's confidence in the banking system. Furthermore, adoption of inflation targeting system with institutional commitment of the government to maintain fiscal discipline will relieve the MA from the difficult task of directly managing the exchange rate.

Keywords: Ghana, depreciation, exchange market pressure, and foreign currency account.

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INTRODUCTION

The bank of Ghana (BOG) has embarked on official launching of a monetary policy committee (MPC) to execute its monetary and financial policies. This initiative is consistent with its objective to make the said policies effective in directing economic activities and stabilizing prices in the country. It also requires improvement in the existing institutional framework and support to facilitate the realization of those goals. The task is further complicated by: (1) the fact that most Ghanaians prefer to conduct economic transactions by cash, (2) the tempting desire to speculate against the cedi because of its unidirectional depreciating drift and/or (3) to hedge against inflation which until as recent as 2002 has been in double digit.

The past inflation experiences have caused some members of the public to hoard national and foreign currencies, especially the United States (U.S.) dollars which is the primary repository of purchasing power in the country in their houses rather than with banks because of the following developments: (a) the cedi-equivalent stipulation of the existing banking reserve requirement on foreign exchange accounts; (b) the $5.00 monthly fee which is referred to as a commission on turnover on foreign currency accounts for transactions due that period[1]; (c) the fractional withdrawal fee charged on foreign currency accounts; and (d) the fact that withdrawals from foreign exchange accounts for transactions outside Ghana are usually subject to the BOG's approval.

As a result, a fraction of the money supply is kept as a store of value outside the banking system instead of being used principally as a medium of exchange for transaction purposes. This behavior has reduced the money multiplier and resulted in a multiple deposit contraction in the country. It is, therefore, difficult for the BOG to know how much exactly is the volume of money in circulation (growth in money supply) that ought to be sterilized in order for it to attain independent foreign exchange rate and money supply targets in the short term.

In view of the above reasons, the motivation of this paper is to employ the exchange market pressure (EMP) model to measure the extent by which the MPC instituted in 2002 can pursue independent monetary policy to control monetary and exchange rate policies effectively in the current global environment where capital is extremely mobile.

The term EMP is defined by D. Girton and L. Roper (1977, p.537) as the dependent variable of net foreign assets/reserves and changes in exchange rates which capture the pressure exerted by excess growth in money supply over money demand under either an independently or managed float regime. They developed a two-country single equation EMP model for Canada by modifying the monetary approach to balance of payments (MABP) developed by H. Johnson (1972) and surveyed by M. Whitman (1975) which assumed small open country conditions with fixed exchange rates, and combined it with the monetary approach to determine the exchange rate (MADER). We have therefore extended their concept by defining the EMP as a measure of exchange rate variation needed to remove international excess demand of a national currency when expectations are based on the exchange rate policy actually implemented, and there is no intervention in the foreign exchange market. See D.N. Weymark (1995, 1997). This means that the EMP model is applicable to open economy and does not mimic closely the MABP.

The EMP model was also employed as a single equation model for small open economies which face fixed world prices and monetary conditions to study Brazil's experience over 1955-1975 by M. Connolly and J.D. da Silveira (1979), Argentina's experience during the 1970s by N.C. Modeste (1981), Korea's experience by I. Kim (1985), Costa Rica's experience by J. Thornton (1995) and Jamaica's experience by E.E. Ghartey (2002). The EMP model is appropriate for Ghana because it is a small open economy which faces a given world prices and monetary conditions. Additionally, it is constantly faced with pressure on its foreign exchange reserves and exchange rates because of its independently floating regime.

We shall therefore employ the EMP model to measure the degree by which the BOG can sterilize external (most importantly capital) fluctuations; find out how the monetary authorities (MA) absorb exchange pressure; and finally, determine the exchange rate regime which is closer to the country's exchange rate practices within the current operations of the MA. If a flexible exchange rate regime is found to be closer to the country's practiced exchange rate regime, then the adoption of a transparent, credible and responsible inflation targeting system[2] by the MA supported by the institutional commitment of the government to pursue fiscal discipline, and eschew fiscal dominance, will assist the country to achieve the triple monetary policy goals of: (i) stable exchange rate, (ii) low inflation and stable prices, and (iii) low and stable interest rates.

The overview of monetary policy strategy implemented by the BOG during the period of study is reported in Section 2 and the model is developed in Section 3. The empirical results are discussed in Section 4. The study is concluded with a summary of the empirical results and detail monetary policy recommendations which are gleaned from the empirical findings to address some of the institutions and policies that render the exchange rate susceptible to vagaries of external fluctuations in Section 5.

2: OVERVIEW OF MONETARY POLICY STRATEGY DURING THE STUDY PERIOD

The bank of Ghana's (BOG) Act of 1963 required that it increases the money supply annually by 15 percent. This policy rule strategy continued till 1972 when the government of the National Redemption Council (NRC) which had isolated the country from international financial market, with its avowed declaration not to honor external obligations of the previous governments, resorted to inflation finance the national budget - a practice which continued in varying degrees until 2002.

Direct controls in the form of ceiling on commercial bank credit to the private sector and regulation of interest rates were the main policy implemented by the BOG. High reserve requirement ratios prevailed during the period and were used to supplement the bank-credit controls. There were no Treasury securities, so the government depended on direct borrowing from the BOG to finance its deficits. Treasury securities were introduced in 1986 but it was traded weekly. In 1988 when the liberalization policy of the Economic Recovery Program (ERP) were introduced to free market forces to determine the market interest rates, the BOG introduced 30-Day and 182-Day Treasury securities to conduct its short term monetary management. Discount houses were also introduced to link the BOG to the banking system and strengthen the effectiveness of monetary policy in the country. In 1992 the BOG abolished direct controls and the banking sector became indeed completely liberalized. Monetary policy tools at that period included reserve requirement ratio, discounting process, foreign exchange trade and open market operations.

The banks failure to participate fully in the discount houses, and under-subscription of the wholesale auctions by both banks and other primary dealers retarded the development of the secondary market. As a result, the BOG continued to use the bank rate as its favored tool, with reserve money serving as its operating target. The intermediate target of the BOG remained to be broad money (M2) until 1997. In 1998, intermediate target was shifted to M2+ which includes broad money and foreign deposits account, and the reserve requirements on currency was extended to cover foreign deposits accounts which are required to be paid in cedi equivalent. It also introduced foreign exchange swap to assist the banks to deal with liquidity constraint brought about by the introduction of cedi equivalent reserve requirement ratio on foreign deposits accounts, until the introduction of the prime rate in April 2002 to replace the bank rate, and the subsequent launching of the MPC on September 2002 of that year. Furthermore, both the Governor and the then Minister of Finance and Economic Planning also agreed to inflationary finance not more than 10 percent of the budget deficit as a percentage of the gross domestic product (GDP) to infuse fiscal discipline, and terminate the perennial fiscal dominance which have plagued the country since the NRC regime in 1972.

3: THE MODEL

The EMP model was first applied as a two-country single equation model to study Canada's volume of interventions required to attain exchange rate targets for the post second world war experience. During that time, Canada was a relatively small open economy which exported mostly raw materials and as a result was vulnerable to external environment, especially, the U.S. Since then, the EMP model has been employed as a single equation model for small open economies which face fixed world prices and monetary conditions to study the experiences of Brazil, Argentina, Korea, Costa Rica, and Jamaica.

The EMP model is a synthesis among demand for money, supply of money, and purchasing power parity (PPP)[3]. Like the previous studies cited above, the classical form of money demand is adopted for the study because money demand is insensitive to interest rate in Ghana. See H.G. Johnson (1977, p. 448) and Connolly and da Silveira (1979, p.448), and Ghartey (1998) for a stable money demand function for Ghana which justifies using the MABP in conjunction with MADER. Additionally, in the EMP model the inclusion of interest rate in the money demand specification is likely to introduce simultaneous equation bias problem, especially if the MA change domestic credit to offset variations in net foreign assets. See Ghartey (2002), Thornton (1995), Modeste (1981), Connolly and da Silveira (1979), M. Obstfeld (1982) and P.J.K. Kouri and M.G. Porter (1974), although Girton and Roper (1977) and Weymark (1995, 1997) define money demand for Canada to include the nominal interest rate in similar studies.

The three strands of the model are specified, respectively, as follows[4]:

(1) $MD = M(P, Y, v)$, money demand

(2) $MS = NFA + DC$ or $MS = mm(NFA + DC)$, money supply

(3) $XR = P/P^f$, absolute PPP

where, P is consumer price index (CPI); NFA is net foreign assets of the consolidated banking system which consists of central bank and private depository institutions in cedis, the International Monetary Fund (IMF) line 31n; DC is domestic credit from the consolidated banking sector in cedis, the IMF line 32; mm is a constant money multiplier; P^f is the CPI of the U.S., the reserve currency; Y is real gross domestic product (GDP); XR is the nominal exchange rate defined as the value of US dollar in cedis; and v is an error term.

The relative PPP which 'translates the absolute PPP from a statement about price and exchange rate levels into price and exchange rate changes'[5] holds as the first differenced form of the real exchange rate which is defined as the relative PPP is stationary or covariance-stationary and is significant at 0.05 levels over the periods 1963.4 to 1983.1, 1983.2 to 2001.4 and 1963.4 to 2001.4 using 1983.2 as the shift period. See Table 1 and R. Garcia and P. Perron (1996).

Equation (2) is an identity which implies that changes in the money stock are due to a change in foreign reserves through the balance of payments (BOP) and/or a change in domestic credit extended by the consolidated banking system.

The Marshallian or Cambridge form of equation 1 is log-linearized, and the variables which are included in equations 2 and 3 are expressed in logarithmic form. We then differentiate the result and express the variables in terms of percentage changes by re-writing the EMP model in general form as follows[6]:

(4) $\Delta nfa_t - \Delta xr_t = \beta_1 \Delta dc_t + \beta_2 \Delta p_t + \beta_3 \Delta y_t + \beta_4 \Delta p^f_t + v_t$

where, β_1 and $\beta_2 < 0$; $\beta_3 > 0$ or < 0; $\beta_4 > 0$; $\Delta nfa_t = \Delta NFA/(NFA + DC)$ since data for NFA are negative from 1965.4 to the end of the series in 2001.4; 1982.1 to 1993.4 reported most of the negative NFA data; Δxr_t is the exchange rate appreciation; Δp_t is the rate of domestic inflation; Δp^f_t is the rate of foreign inflation; Δy_t is the growth rate of income; Δnfa_t is the change in net foreign assets as fraction of the money supply and Δdc_t is the rate of domestic credit; and subscript t denotes time. Equation (4) shows that for a given Δp_t, Δy_t, and Δp^f_t, an increase in Δdc_t will result in a one-to-one increase in Δxr_t and equiproportional decrease in Δnfa_t. The offset coefficient of domestic credit, β_1, is the principal mechanism discussed in such EMP studies. See the EMP studies cited above.

Equation 4 indicates that an increase in domestic credit and prices (foreign prices), *all other things being equal*, will lead to either an outflow (inflow) of net foreign reserves and/or depreciation (appreciation) of the cedi. Following R.A. Mundell’s (1962) and J. M. Fleming’s (1962) traditions, an increase in real income is likely to lead to an increase in demand for money. Interest rates then rise causing an inflow of net foreign assets and appreciation of the cedi, if capital is (perfectly) mobile. See also Obstfeld (2001). However, because of liberalization and psychology of long-term double digit inflationary experiences in the country, the imperfect mobility of capital and limited alternatives to savings/investments substitutes, when the real income increases, it leads to an expansion in the demand for foreign currencies and imported goods and services which serve as inflation-hedged investment alternatives. These imports, whether they are inputs or to be retailed in the country, to the extent that they are marked up over their initial costs and are adjusted for current and expected depreciation, exacerbate inflation which further causes depreciation of the cedi and outflow of net foreign reserves. Note that because the capital market is shallow, most of the adjustment resulting from an increase in real income occurs in the goods market. Additionally, an increase in real wealth or income is mainly invested in foreign currencies, which are sure and readily accessible alternatives to inflation-hedged investments in the country. As a result, the demand for foreign currencies increases causing the cedi to depreciate even further.

The sensitivity of EMP is tested by adding the exchange rate-net foreign assets ratios (Z) to equation 4 to obtain equation 5 as follows:

(5) $$\Delta nfa_t - \Delta xr_t = \beta_1\Delta dc_t + \beta_2\Delta p_t + \beta_3\Delta y_t + \beta_4\Delta p^f_t + \beta_5 Z_t + v'_t$$

where v'_t is an error term and all notations maintain their definitions. Connolly and da Silveira's (1979) variant of Z = (xr - 1)/(nfa – 1) which was employed for Brazil in the late 1970s is used because of discontinuities in xr/nfa ratios. Girton and Roper (1977) and Ghartey (2002) used xr/nfa ratios because there were no discontinuities in them.

If estimates of equation 5 show that the coefficient of Z is insignificant, whereas estimates of the rest of the independent variables remain unchanged from results obtained from equation 4, then the country does not discriminate in absorbing exchange pressures. The MA can therefore employ both net foreign assets or reserves and depreciation (nfa - xr) to determine the volume of intervention required to achieve a desired exchange rate target.

If the coefficient of Z is significant and positive, then the exchange pressure is absorbed by only depreciation of the cedi, while if Z is significant and negative, then it is absorbed by only loss of net foreign assets or reserves, *all other things being equal*. Note that under perfectly flexible exchange rate regimes, an external imbalance which leads to exchange pressure is absorbed by changes in exchange rates (depreciation), whereas under fixed exchange rate regimes, similar exchange pressure is absorbed by loss of net international assets (or reserves). Thus the exchange rate regime closer to what the monetary authorities practice can be determined from the estimated coefficient of Z in equation 5.[7]

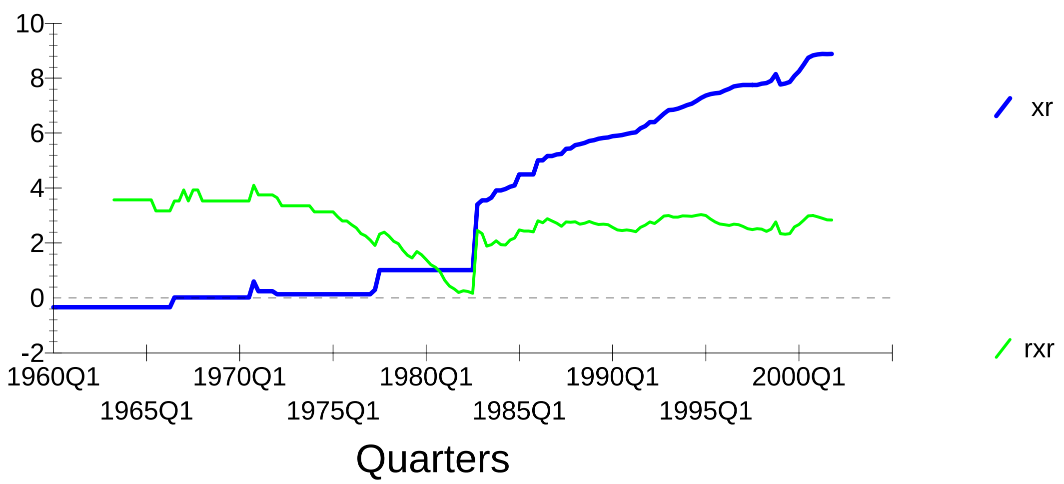
Sterilized intervention is the method by which the BOG prevents BOP surpluses or

Table 1: Unit root tests for the included variables in the model with an intercept.

	1961.2-2001.4, ADF(4)				
Level	Without a trend	With a trend	First Difference	Without a trend	With trend
Xr	0.639	-2.058	Δxr	-5.547	-5.657
Rxr	-1.971	-1.851	Δrxr	-5.579	-5.612
NFA	-1.084	-1.623	Δnfa	-4.313	-4.293
Dc	0.774	-1.660	Δdc	-4.423	-4.495
Y	1.593	-2.629	Δy	-3.771	-4.013
P	0.196	-1.970	Δp	-4.565	-4.566
Pf	-1.593	-1.124	Δpf[a]	-3.648	-3.871
	1961.2-1983.1, ADF(4)				
Xr	1.277	-2.413	Δxr	-3.372	-3.571
Rxr	-1.773	-2.413	Δrxr[a]	-3.873	-3.701
	1983.2-2001.4, ADF(4)				
Xr	-1.126	-2.468	Δxr	-7.334	-7.223
Rxr	-2.093	-2.012	Δrxr	-6.759	-6.744

Notes: NFA denotes actual level form data; Most NFA data from 1965.4 onwards are negative so we have used $\Delta nfa_t = \Delta NFA/(NFA + DC)$.to define the rate of change in net foreign assets; for the rest of the variables, lower case letters denote logarithmic form of respective variables. ** denotes 95% critical values of the augmented DF test statistics which are equal to -2.8825 and -2.9077 without a trend and with a trend, respectively. [a]ADF(1) results are reported for Δrxr over 1963.4 to 1983.1 and Δpf over 1961.2-2001.4.

Figure 1: Graph of nominal and real exchange rates in logarithmic forms.



Notes: xr is logarithmic form of nominal exchange rate; rxr is logarithmic form of real exchange rate.

deficits from affecting the domestic money supply. Sterilized intervention bias is the estimation of the extent the BOG engages in sterilized intervention activities to prevent the money supply from varying with changes in BOP surpluses or deficits. It measures the balancing effect of the offset coefficient. If the BOG engages in sterilized intervention policy, it makes domestic credit (Δdc) endogenous. The endogeneity of Δdc will require that the EMP be estimated by a 2SLS or multiple estimators, as the OLS will be biased by simultaneous equation problem. The extent of sterilized intervention bias is estimated formally by employing J.A. Hausman's (1978) method which requires that we add the residual values of domestic credit ($dc^{\dagger}$) to equation (4).[8] This ensures that when $dc^{\dagger}$ is included as an explanatory variable in equation (6), it does not introduce a simultaneous equation bias problem.

The dependent variable of the EMP model (Δnfa - Δxr) is used because the capital account surplus dependent variable yielded poor estimates. See Ghartey (2002, p.60) and Obstfeld (1982, p.48). The sterilized intervention bias in the study is therefore estimated from the following specification:

$$(6) \qquad \Delta nfa - \Delta xr = \beta_1 \Delta dc_t + \beta_2 \Delta p_t + \beta_3 \Delta y_t + \beta_4 \Delta p^f_t + \beta_5 \Delta dc^{\dagger}_t + \in_t$$

where $\beta_5 \geq 0$, $\in_t$ is an error term and the rest of the parameters maintain their signs. If the null hypothesis of $\beta_5 = 0$ is true, then it implies that domestic credit is exogenous so there is no sterilized intervention bias in the country, however, if $\beta_5 > 0$ and is significant, then there is a sterilization bias so domestic credit is not independent or exogenous in the country.

3.1 Data

The main sources of data are various issues of *International Financial Statistics'* (IFS) published by the IMF, Washington, DC and the Bank of Ghana. The U.S. dollar is used as a reserve currency for the study because according to the BOG's estimates, about 75% of foreign denominated transactions in the country are carried out in U.S. dollars. The GDP data are reported in annual form so we have used the interpolation technique discussed in the Appendix of M. Goldstein and M.S. Khan (1976) to convert it into quarterly series.

The terminal year for the study is 2001.4 and is chosen because we lost some end-points data due to leads employed in generating the quarterly GDP data through interpolation and the fully modified Phillip's and Hansen's estimator. Therefore the sample period covers 1963.1 to 2001.4.

The exchange rate of the country has undergone several policy and institutional changes. See Ghartey (1998) for some institutional details. Thus the floating exchange rates which actually started in April 1983 when the Provisional National Defense Council (PNDC) accepted the IMF's economic adjustment package which introduced Economic Recovery Program and wiped out black market activities, became officially institutionalized in 1988, and dwarfed the black market rates which had prevailed during the fixed exchange rates era prior to 1983. See Figure 1 where both logged form nominal and real exchange rates are plotted against time.

4: THE EMPIRICAL RESULTS

The first differenced forms of the variables in the model are stationary and are reported in Table 1. The jump in exchange rate in 1983.2 does not affect the unit root tests. Unit root tests of the exchange rate over the periods 1963.1 to 1983.1, 1983.2 to 2001.4 and 1963.1 to 2001.4 using Perron's (1990) test, G. Elliot, T.J. Rothenberg and J.H. Stock's (1996) test, and ADF unit root test yield results which indicate that the exchange rate is integrated at degree unity over the periods.[8] Empirical results were estimated by both single and multiple estimators. The multiple estimator is necessary because if indeed the MA sterilize both outflow of net foreign reserves/assets and depreciation by reducing domestic credit through open market operations, then there is a likelihood of simultaneous equation bias problem occurring.

Different estimators are therefore used to ensure that the estimated results reported are robust and are not affected by basic econometric problems such as autocorrelation, heteroscedasticity, stability and simultaneity problems. We have reported estimated results over the entire period of study using dynamic two-stage least-squares (D2SLS), dynamic least-squares (DLS), and fully modified Phillips and Hansen estimator (FMPHE) which is a multiple estimator that uses instrumental variables to correct for functional forms and simultaneous equation bias problems. Only estimates of the EMP model obtained from the FMPHE over the split periods,

Table 2: Estimates of the EMP model, 1963.4 - 2001.4

	1963.4-2001.4		1963.4-2001.4	1963.4-1983.1	1983.2-2001.4
Regressors	D2SLS	DLS	FMPHE	FMPHE	FMPHE
Δdc_t	-0.152	-0.152	-0.237	-0.719	-0.429
	[2.706]*	[2.705]*	[1.742]***	[8.836]*	[5.656]*
Δp^f_t	4.495	4.495	3.015	3.132	-2.163
	[4.313]*	[4.313]*	[1.576]	[3.160]*	[1.146]
Δp_t	-0.033	-0.33	-0.271	-0.211	-0.833
	[0.539]	[0.539]	[1.723]***	[2.964]*	[5.599]*
Δy_t	-1.455	-1.455	-0.943	-1.392	-2.129
	[5.240]*	[5.234]*	[2.934]*	[8.820]*	[8.409]*
C			-0.004	0.047	0.072
			[0.119]	[2.543]*	[3.247]*
D.W.	2.165	2.165			
F	6.491*	6.491*			
$\chi^2_{SC}(4)$	2.342	2.342			
$\chi^2_{FF}(1)$	6.684	6.684			
$\chi^2_{H}(1)$	13.059	13.059			
$\chi^2_{SG}(1)$	1.491				

Notes: The D2SLS results are estimated with Δdc, Δp^f_t, Δp_t, Δy_{t-1}, and Δy_t as instrumental variables. DLS is dynamic LS. Similarities in both DLS and D2SLS results show that there is no simultaneity problem. The absolute values of t-ratios are reported in the square brackets. Note that the Newey-West dynamic estimates which employ LS and 2SLS do not report any other diagnostic results. The DLS, D2SLS and FMPHE use Newey-West dynamic estimates. DLS and D2SLS use Parzen's weight whereas FMPHE use Bartlett weight with truncation lags of 50. Lagrange multiplier test of serial correlation is χ^2_{SC}, Ramsey's RESET test of functional form using the square of the fitted values is χ^2_{FF}, heteroscedasticity test based on regression of squared residuals on squared fitted values is χ^2_{H}, and Sargan's legitimate test of instrumental variables is χ^2_{SG}. Notations *, **, and *** represent 0.01, 0.05 and 0.10 significant levels, respectively.

Figure 2: Actual and Fitted values of the EMP model; Δnfa - Δxr is the dependent variable

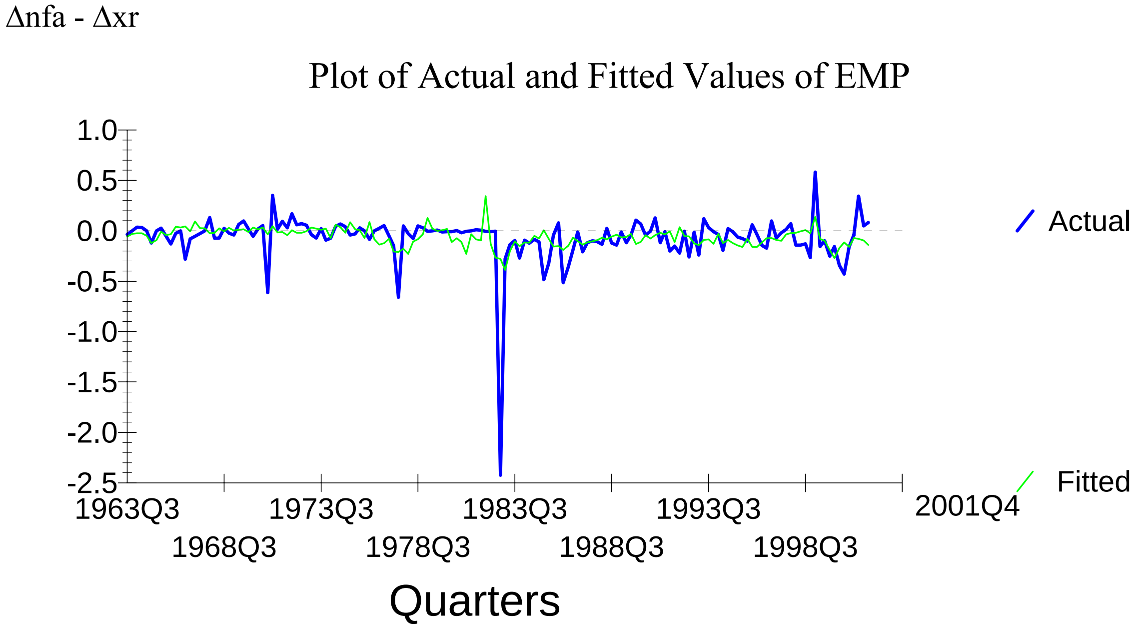


Table 3: Estimates of the EMP model including the Z composite variable

	1963.4-2001.4		1963.4 -2001.4	1963.4 – 1983.1	1983.2 – 2001.4
Regressors	D2SLS	DLS	FMPHE	FMPHE	FMPHE
Δdc_t	-0.175	-0.172	-0.257	-0.333	-0.536
	[3.030]*	[3.050]*	[2.054]**	[4.353]*	[7.771]*
Δp^f_t	4.646	4.646	3.578	3.756	-1.616
	[2.366]*	[4.376]*	[2.034]**	[3.951]*	[0.947]
Δp_t	-0.034	-0.035	-0.242	-1.332	1.101
	[0.567]	[0.587]	[1.684]***	[9.673]*	[8.222]*
Δy_t	-1.470	-1.470	-1.006	-1.059	-2.054
	[5.394]*	[5.397]*	[3.420]*	[7.107]*	[8.987]*
Z_t	0.001	0.001	0.001	0.582	0.001
	[1.558]	[1.555]	[2.078]**	[5.215]*	[5.885]*
C			0.009	-0.029	0.048
			[0.285]	[1.664]	[2.405]*
D.W.	2.188	2.187			
F	5.055*	5.142*			
$\chi^2_{SC}(4)$	2.931	2.966			
$\chi^2_{FF}(1)$	8.569	8.683			
$\chi^2_{H}(1)$	14.411	14.616			
$\chi^2_{SG}(1)$	4.050				

Notes: The D2SLS was estimated with Δdc_t, Δp^f_t, Δp_t, Δy_t, Δy_{t-1}, Δp_{t-2} and Z_t as instrumental variables. See also the notes in Table 2.

Table 4: Estimates with Δxr replacing the EMP (Δnfa - Δxr) as a dependent variable

	1963.4-2001.4		1963.4 – 2001.4	1963.4 – 1983.1	1983.2 – 2001.4
Regressors	D2SLS	DLS	FMPHE	FMPHE	FMPHE
Δdc_t	0.126	0.120	0.252	0.673	0.151
	[2.278]**	[2.145] **	[2.781]*	[8.850]*	[5.468]*
Δp^f_t	-4.115	-4.111	-2.872	-2.104	0.038
	[4.186]*	[4.190]*	[2.256]**	[2.272]*	[0.055]
Δp_t	-0.044	-0.042	0.326	0.244	-0.427
	[0.615]	[0.599]	[3.110]*	[3.677]*	[7.889]*
Δy_t	1.368	1.369	0.669	1.161	1.105
	[5.907]*	[5.915] *	[3.129]*	[7.870]*	[11.995]*
C			0.007	-0.049	0.002
			[0.327]	[2.866]*	[0.266]*
D.W.	2.346	2.345			
F	6.200*	6.310			
$\chi^2_{SC}(4)$	8.046	8.144			
$\chi^2_{FF}(1)$	7.007	7.101			
$\chi^2_{H}(1)$	13.903	14.070			
$\chi^2_{SG}(3)$	3.198				

Note: The instruments are Δdc_t, Δp^f_t, Δp_t, Δy_t, Δy_{t-1}, Δp_{t-2} and intercept term. See also Table 2.

1963.4 to 1983.1 and 1983.2 to 2001.4 are reported in the study to conserve space, as both D2SLS and DLS yield similar results. The leading estimates are obtained from FMPHE, DLS and D2SLS and are based on W.K. Newey and K.D. West's (1987) method of estimation which employs adjusted standard errors (S.E.) with Parzen weights and truncation lags of fifty to correct for heteroscedasticity and autocorrelation problems over the sample periods. See Tables 2 and 3.

These robust estimators yield results that are very similar in both magnitudes and significance with favorable diagnostic test results which indicate that there are no basic econometric problems. Note that Chow tests, predictive failure tests and recursive stability tests are not valid for the robust estimators employed in the study, although the corresponding ordinary least-squares (OLS) results which are not different from our robust reported results, have insignificant Chow test with $\chi^2(4)$ of 1.663 and a predictive failure test with $\chi^2(50)$ of 12.679. The recursive technique cannot be used to test the stability of Δxr since it is expressed as a dependent variable. Additionally, Ramsey's RESET tests of functional form using the square of fitted values (χ^2_{FF}) do not signal any specification bias problem. See Tables 2-4. All estimates are significant at 0.01 levels, and can be compared and contrasted to the results obtained in the EMP studies cited in the paper. For instance, the coefficient of domestic credit was -0.94 for Canada, -1.009 for Brazil, -0.152 for Jamaica, and ranges from -0.719 to -0.152 for Ghana.

Considering that Ghana had undergone several institutional and political changes in the past, we captured the periods of significant changes in the country by plotting the estimated actual and forecast data of the EMP or Δnfa - Δxr against time in Figure 2. It is clearer from the graphs that there was a single period of major spike in 1983 and three periods of minor spikes in 1972, 1977 and 1999. We attempted to capture all four periods of spikes by including a dummy variable which is defined to be unity for those four periods and zero elsewhere as regressors in equation (4). Unfortunately, the inclusion of this dummy variable did not improve the result, and although it was positive, it was not significant. We also considered two different dummy variables, namely: D1 which is defined to be unity from 1983.2 to 2001.4 and zero elsewhere;

and D2 which is defined as unity over the period 1999.1 to 2001.4 and zero elsewhere, independently and simultaneously. The best results are obtained from DLS and non trended FMPHE and are reported as follows[9]:

DLS: (7) $\Delta nfa_t - \Delta xr_t = - 0.155[2.968]^{*}\Delta dc_t + 4.646[4.361]^{*}\Delta p^f_t - 0.023[0.364]\Delta p_t$
$- 1.510[4.623]^{*}\Delta y_t - 0.007[0.377]D1 + 0.073[2.610]^{*}D2$

DW = 2.175, F = 4.072^{*}, $\chi^2_{SC} = 2.738$, $\chi^2_{FF} = 5.492$ and $\chi^2_{H} = 13.881$

FMPHE: (7') $\Delta nfa_t - \Delta xr_t = - 0.061[3.167] - 0.396[6.151]^{*}\Delta dc_t + 3.352[3.302]^{*}\Delta p^f_t$
$+ 0.357[4.811]^{*}\Delta p_t - 0.642[4.144]^{*}\Delta y_t + 0.007[0.400]D1$
$+ 0.066[2.207]^{**}D2$

The absolute t-ratios are reported in square brackets. Although the coefficients of D1 are not significant, the D2 are. Results of the DLS equation (7) are not different from those reported in Table 2, except that from equation (7), the D2 is significant.

The results show clearly that an increase in a domestic credit results in outflows of net foreign assets and depreciation of the cedi, *all other things being equal*, but the results are relatively weak as compared with some studies. An increase in foreign prices causes inflows of net foreign assets and appreciation of the cedi, *all other things being equal*. However, an increase in real income leads to an outflow of net international reserves and depreciation of the cedi in Ghana. Similar results are obtained by Ghartey (2002, p.56) for Jamaica, Obstfeld (1982, pp. 47) for West Germany over the 1960s and Bahmani-Oskooee and Bernstein (1999, pp. 586, 587) for Canada, France, Germany, Japan and UK. Note that the other studies cited did not explain why their real income coefficients were negative, although they all explained the offset coefficient, Δdc_t, because it is the main instrument used by central banks to influence exchange market pressures. We have explained the coefficient of the real income because it has peculiar implications to monetary policy in the Ghanaian economy.

We argue that the lack of readily available alternatives to inflation-hedged investments and the imperfect mobility of capital in the country, *supra* p.6, explain why an increase in real income results in outflow of foreign reserves and depreciation of the cedi. This means that an increase in real income is either spent on imports and foreign denominated assets which causes an outflow of net foreign assets and/or places additional pressure on demand for foreign currencies to cause the cedi to depreciate. Furthermore, Ghanaians know from experience that depreciation is inflationary, and foreign currencies are common inflation-hedged assets which are easily accessible to the public at a cheaper transaction cost than even Treasury bills. As a result, an increase in real income is spent on purchasing foreign currencies more so than interest-bearing securities, as the latter is relatively illiquid, but because foreign currencies are limited in supply, the pent up demand for them results in their prices rising, so the cedi depreciate.[10]

The question that begs for an answer is, how does the BOG absorb exchange market pressure? To answer this question, we have estimated an EMP equation by including Z. The results reported in Table 3 show that although the estimates remain the same as the EMP estimates in Table 2, the coefficient of Z is positive and near zero. Similar coefficient for Z was obtained for Jamaica by Ghartey (2002, p.57), Brazil by Connolly and da Silveira (1979, p.451), and Canada by Girton and Roper (1977, p.545).

Note that although from 1963.2 to 1983.1 estimates of Z from the FMPHE is 0.582, the 0.001 results from 1983.2 to 2001.4, and 1963.4 to 2001.4, are highly significant which indicate that depreciation is the principal means of absorption of exchange pressures in the country even though it is weak. However, this near zero coefficient of Z also suggests that the BOG uses both net foreign reserves and depreciation (nfa – xr) to absorb exchange pressure and determine the volume of interventions required to obtain different exchange rate targets.

To further buttress the findings, the EMP is decomposed into its constituents: exchange rate and net foreign assets, respectively, and each constituent is used as a regressand on the same regressors of the EMP equation to determine the 'true' endogenous variable. Problems of simultaneity, heteroscedasticity, autocorrelation and stability are anticipated and corrected by using FMPHE and D2SLS estimators. The results clearly show that the exchange rate bears the brunt of absorbing exchange pressure as its regressand yielded the best estimates which are reported in Table 4. This is in contrast to the results of Jamaica where changes in net foreign reserves are the principal means of absorbing exchange market pressure as they yielded the best results. See Ghartey (2002, p.58). The estimated coefficients in Table 4, except the results of Δp_t of D2SLS and DLS are significant at 0.01 levels. Thus an increase in domestic credit and real income, respectively, results in depreciation of the cedi, while an increase in foreign inflation results mainly in appreciation of the cedi, *all other things being equal*. The results of domestic inflation are inconclusive as they vary across periods and estimators. The main interpretation of these results is consistent with what is observed in Tables 2 and 3. They show that the primary source of absorbing exchange pressures in Ghana is by depreciation.

Thus, Ghana's exchange rate regime leans toward the flexible exchange rate end of the exchange rate regimes' continuum. According to J.B. Taylor (2001), whenever a fixed exchange rate regime is not optimal for a country, the only long-run monetary policy alternative it has is to adopt the 'trinity' of policy which consists of (i) flexible exchange rate, (ii) inflation target, and (iii) monetary policy rule; although he views monetary policy rule as another means of achieving the objectives of inflation targeting system.

Sterlization bias is tested formally by using Hausman's (1978) method which was applied to W. Germany by Obstfeld (1982, p.48) and Jamaica by Ghartey (2002, p.60). The Hausman test compares two sets of estimated coefficients. If Δdc is endogenous in the EMP model, then indeed there is a sterilization bias so the OLS estimator will yield bias results. To test this sterilization bias, Hausman proposes that one finds instrumental variables which are predetermined and correlated with the manipulated variable Δdc but not with the residuals of the EMP or Δnfa - Δxr in equation (4). Having obtained the estimates of Δdc by regressing it on the predetermined variables, the residuals denoted by $\Delta dc^{\dagger}$ are then added to the EMP model and re-estimated to obtain equation (8). If indeed Δdc is exogenous, the added residual $\Delta dc^{\dagger}$ to the EMP model will not be significant, but if it is endogenous then the added residual $\Delta dc^{\dagger}$ will be significant. See also Wu.

The result from D2SLS estimator which yielded very similar result as the other estimators is

(8) $\Delta nfa - \Delta xr = -1.156[1.842]^{***}\Delta dc_t + 6.659[3.113]^{*}\Delta p^f_t - 0.235[1.681]^{***}\Delta p_t$
$- 1.052[3.809]^{*}\Delta y_t + 1.029[1.676]^{***}\Delta dc^{\dagger}_t + 0.077[2.449]^{*}D2$

D.W. = 2.151, F = 4.379, $\chi^2_{SC} = 1.796$, $\chi^2_{FF} = 7.625$ and $\chi^2_H = 19.704$, $\chi^2_{SG} = 0.737$

In estimating the above equation, we have used the instrumental variables in Tables 2 in addition to D2, $\Delta dc^{\dagger}_{t-1}$ and $\Delta dc^{\dagger}_{t-2}$. The results indicate that the offset coefficient of Δdc and its residual $\Delta dc^{\dagger}$, are both significant at 0.10 levels with appropriate signs and diagnostic tests. The coefficients of Δdc and $\Delta dc^{\dagger}$, are -1 and 1, respectively. This means that Δdc in the EMP model is endogenous so there is indeed a weak form sterilization bias in the country. Additionally, the magnitude of both offset coefficients is unity which indicates that sterilized intervention bias is complete, and can be used to completely offset external fluctuations.

5: Conclusion and Policy Recommendation

The main empirical results are summarized as follows:

(i) Ghana engages in a weak form sterilized intervention to completely offset external fluctuations. Although exchange pressure is absorbed by both loss of net foreign assets or reserves and depreciation, the latter bears the brunt of the absorption from external pressures.

(ii) Decomposition of the EMP model shows that changes in exchange rates as a regressand on the EMP regressors, yielded the best results which are consistent with economic theory. Changes in domestic credit, prices and real income cause depreciation of the cedi, while foreign inflation causes the cedi to appreciate, although its effect and that of domestic inflation are not conclusive.

(iii) The country's mechanism for absorbing external imbalances places its exchange rate regime at the flexible end of the exchange rate regime's spectrum, as under perfectly flexible exchange rate regime external imbalances are absorbed by changes in the exchange rate.

The BOG must therefore embark on policies to arrest depreciation, introduce Deposit Insurance Corporation, phase out the cedi equivalent reserve requirements, and revamp some of the foreign currency account policies to boost up the public's confidence in the banking system, increase savings and promote the use of the banking system. These policies will also make it easier for financial institutions and the public to have easy access to external funds, strengthen the BOG's ability to use sterilized intervention to absorb exchange market pressures, and reduce their depreciating effects on the cedi.

Furthermore, a properly designed and credibly pursued inflation targeting policy which commits the government to abandon fiscal dominance, pursue and maintain fiscal discipline and responsibility, will re-direct the principal objectives of monetary policy to stable prices and low inflation, and reduce complexities associated with stabilizing the jittery exchange rate. Indeed the task ahead is arduous, but right steps in policy direction are certainly the means by which the destination of price and exchange rate stability, and their attending economic growth and prosperity, can be arrived at.

Appendix: Derivation of the EMP Model

Let TL = M + NML $\quad$ (1)

Where,

TL = Total liabilities of the consolidated banking system (both private and central banks are consolidated into a single banking system).

NML = Non-monetary liabilities of the consolidated banking system

M = Stock of money

TA = NFA + DA $\quad$ (2)

where,

TA = Total assets of the consolidated banking system

NFA = Net foreign assets of the consolidated banking system

DA = Domestic assets of the consolidated banking system

But according to Mundell (1971)

DC = DA – NML $\quad$ (3)

where,

DC = Domestic Credit

At equilibrium,

TA = TL

So by substituting (3) for DA

M + NML = NFA + DC + NML

$\Rightarrow$ M = NFA + DC $\quad$ (4)

Alternatively, we could simply define

M = mm(NFA + DC) $\quad$ (4')

where,

mm = Money multiplier

NFA + DC = Base Money

Note that (4) assumes that mm is unity in (4').

The absolute PPP is defined as

$XR = P/P^f$ (5)

where,

XR = Exchange rate

P^f = Foreign price level

P = Domestic price level

A simple classical demand for money is expressed as

$LP = k.P.Y$ (6a)

where,

LP = Liquidity preference or demand for money

k = constant of proportionality or Cambridge or Marshallian constant

Y = real GDP or GNP

By substituting for P into (6a) the demand for money can be re-written as

$LP = k.XR.P^f.Y$ (6b)

At the monetary equilibrium, the demand for money is equal to the supply of money

$M = LP \quad \Rightarrow \; M = k.XR.\,P^f.Y$ (7)

By substituting for M in (4 or 4'), we obtain

$NFA + DC = k.XR.\,P^f.Y$ or $mm(NFA + DC) = k.XR.\,P^f.Y$ (8)

Since mm (or unity in case of (4)) is a constant, we can express equation (4 or 4') in percentages by the following approximation:

$(\Delta M/M) = \Delta NFA/(NFA + DC) + \Delta DC/(NFA + DC)$

The right hand side of (8) can also be expressed in percentages as[11]

$(\Delta XR.k.P^f.Y)/(k.XR.P^f.Y) + (\Delta P^f.k.XR.Y)/(k.XR.P^f.Y) + (\Delta Y.k.XR.P^f)/(k.XR.P^f.Y)$

$= (\Delta XR)/(XR) + (\Delta P^f)/(P^f) + (\Delta Y)/(Y)$

But the rate of change or percentage changes expressed above can also be expressed as

$\Delta lnXR = (\Delta XR)/(XR)$; $\Delta lnP^f = (\Delta P^f)/(P^f)$; $\Delta lnY = (\Delta Y)/(Y)$ (9)

Again, following Girton and Roper (1977), Connolly and da Silveira (1979), Bahmani-Oskoee and Bernstein (1999) and Ghartey (2002), it is safe to assume that the percentage changes of net foreign assets in (4 or 4') can be approximated as $\Delta NFA/(NFA + DC) = \Delta nfa$ since most of NFA data are negative from 1965.4 onwards; $\Delta lnDC$ which is the rate of change in domestic credit is substituted for $\Delta DC/(NFA + DC)$ because DC data are positive throughout the study.

Equation (8) is therefore expressed in terms of percentage changes as follows:

$$\Delta NFA/(NFA + DC) + \Delta lnDC = \Delta lnXR + \Delta lnP^f + \Delta lnY \quad (11)$$

It is further expressed as an exchange market pressure (EMP) model as follows:

$$\Delta NFA/(NFA + DC) - \Delta lnXR = - \Delta lnDC + \Delta lnP^f + \Delta lnY \quad (12a)$$

where,

$EMP = \Delta NFA/(NFA + DC) - \Delta lnXR$

But

$Y = y – P$

where, y = nominal GDP or GNP

Thus (12a) can be expressed as

$$\Delta NFA/(NFA + DC) - \Delta lnXR = - \Delta lnDC + \Delta lnP^f + \Delta lny - \Delta lnP \quad (12b)$$

Since (12b) is an identity, we have expressed it in a general form as follows:

$$\Delta NFA/(NFA + DC) - \Delta lnXR = - \beta_1\Delta lnDC + \beta_2\Delta lnP^f + \beta_3\Delta lny - \beta_4\Delta lnP + \nu \quad (13)$$

where all the parameters are non-negative. Equations (13) and (4) in p.6 are equal except that we have expressed the logarithmic forms of (13) by small case letters in (4), and defined the former equation's parameters in a more general form. Note that the right hand side variables ($\Delta NFA/(NFA + DC) - \Delta lnXR$) constitute the EMP and because the EMP is the dependent variable of (13), its coefficients are constrained. This means that an increase in domestic credit which is the offset coefficient variable will result in either an outflow of net foreign assets or depreciation or both. In Ghana's empirical work, because most of NFA data from 1965.4 onwards are negative, we have approximated the rate of change in net foreign assets with the change in net foreign assets as a fraction of the money supply by $\Delta NFA/(NFA + DC)$.

Endnotes

1. Foreign currency accounts comprise of foreign accounts and foreign exchange accounts. Foreign accounts are foreign currency accounts opened and held by nonresidents of Ghana, and foreign exchange accounts are foreign currency accounts opened and held by residents of Ghana. Clearance of foreign denominated checks received in the country from abroad attracts a fee whereas similar foreign denominated checks issued in the country do not attract any fee.

2. Inflation targeting as a monetary policy was originally developed for developed countries by B. Bernanke et al. (2000) and L.E.O. Svensson (2000). However, F.S. Mishkin (2000) extends the policy to developing countries, with a caveat that in the long-run, large devaluation and monetization of debt due to fiscal indiscipline and dominance, render inflation targeting system ineffective.

3. These are the primary building blocks of monetary approach to balance of payments and exchange rate determination. See H.G. Johnson (1977, 1972) and Girton and Roper (1977).

4. The first differenced form of the exchange rate is stationary, which indicates that the foreign exchange market is weak form efficient. See Ghartey (2004) and Table 1. The non trended cointegration results of the PPP obtained from Johansen (1991) and Johansen and Juselius (1990) methods indicate that both the trace and λ-max tests yielded a likelihood ratio of 28.5 and 41.9, respectively. The null hypothesis of no cointegration is rejected in favour of at least one cointegration among spot exchange rates, foreign and domestic prices at 0.01 significance levels. Additionally, both Dickey-Fuller (DF) and augmented DF (ADF) unit root tests of the first differenced form of real and nominal exchange rates are significant at 0.05 levels as reported in Table 1.

5. See P. Krugman and Obstfeld (2000, p.397).

6. See the Appendix for the derivation of the complete EMP model.

7. Weymark (1995, 1997), Bahmani-Oskooee and Bernstein (1999) and some studies also use the term optimal to mean closer to the exchange rate regime in practice.

8. $\Delta dc^{\dagger}$ is residuals obtained when dc is regressed on instrumental variables used in 2SLS estimation of the EMP model.

8. We have reported only the ADF unit root tests in the paper for consistency and to conserve space because the rest of the unit root tests are routine and do not contradict any of the reported ADF results.

9. We have not reported results of periods 1963.4 to 1983.1 and 1983.2 to 2001.4 because the estimates of the explanatory variables are insignificant over those periods.

10. A referee has pointed out that demand for both interest-bearing assets and foreign currencies leads to depreciation of the cedi.

11. The rate of growth in y is obtained from the expression $(\partial y/\partial t)/y$ or $(\Delta Y/Y)$, where the former is for continuous y variables and the latter is for discrete Y variables.

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