A SMALL MACROECONMETRIC MODEL OF TRADE AND INFLATION IN GHANA

Samuel Donyina Ameyaw

No 696

WARWICK ECONOMIC RESEARCH PAPERS

DEPARTMENT OF ECONOMICS

THE UNIVERSITY OF WARWICK

A Small Macroeconometric Model of Trade and Inflation in Ghana

Samuel Donyina Ameyaw[1]

University of Warwick

Coventry

UK

Abstract

This paper contains an empirical investigation of the effects of trade and inflation on a conventional macroeconometric model for Ghana. First, the results corroborate the findings of the Fund that both devaluation and credit restraint are effective in addressing the balance of payment issues facing Ghana. Second, the direction and time pattern of the effects of these two policy experiments are different. Third, further depreciation of the domestic currency is unfavourable to the cause of curbing inflation in Ghana. It rather leads to price increases and is a source of fueling inflation, and could lead to a spiral of inflation through the agitation for higher wages by employees.

[1]I would like to thank Jeremy Smith for helpful comments and discussions. I have also benefitted from comments by participants in Oswald-Myrna's seminars at the University of Warwick, Economics Department. Financial support from the Bank of Ghana is gratefully acknowledged.

1.0 Introduction

The study contains an aggregate structural macroeconometric model that examines the determinants of the adverse Balance of Payments (BOP) position and the general price level in Ghana. Historically, Ghana's BOP has been in severe difficulties due to inappropriate trade, fiscal and monetary policies. This resulted in almost negligible capital inflows throughout the 1970s and early 1980s. In the process, successive governments lost control of the economy as more and more economic transactions became diverted to the parallel market. Prominent among the activities on the parallel markets were smuggling of imports and exports as well as the trafficking of currencies in the black markets. Consequently the objective of the stabilisation program initiated by the government in 1983, among others was to achieve a positive overall BOP position and to get inflation down to tolerable levels. To be able to achieve this objective the stabilisation program took Ghana through several episodes of devaluation, as well as the implementation of stringent policies to reduce the fiscal and current account deficits. These notwithstanding the macroeconomic problems confronting Ghana have worsened due in part to the general global instability, such as, the substantial fluctuations in the price of commodities in the world market accompanied by sharp increases in the real prices of energy and energy products and some essential raw materials. Hence we develop a small macroeconometric model to analyse the inflationary and BOP issues confronting the country. Specifically, the model is used to compare the dynamic responses to devaluation with the responses to tight credit policy. In particular, we determine whether devaluation/rapid depreciation of the domestic currency is really a cure for BOP problems, considering the appropriate cure for any disequilibrium depends on whether the origin of the disequilibrium is exogenous or endogenous to the domestic economy. The period of analysis in our study is 1970-2000 for which various institutions including the Bank of Ghana and the Statistical Service of Ghana have published a set of tables with data for a relatively large number of economic activities.

The study assumes that the exchange rate system consists of a dual rate regime in which an official floating nominal exchange rate co-exists with a quasi-illegal parallel market for foreign exchange. Also commercial transactions are settled partly in the official market at the exchange rate, which is set at the interbank market, and partly at the black market exchange rate. The trade equations (the exports and imports of goods and services) of the model have been

formulated in such that they underscore the fact Ghana is a small open economy and therefore a price taker in the world commodity market. Even though Ghana is the world's second largest producer of cocoa, it has no influence in deciding on cocoa prices at the world market. The trade equations therefore depend on relative prices as well as foreign demand. The desired holdings of domestic and foreign currencies is assumed to depend on both transactions motives and portfolio considerations, and that markets for government securities exists, so the public budget deficits are financed by borrowing abroad or by the Central Bank, as well as the domestic banking system. The money demand functions are formulated based on the assumption that the financial sector of the Ghanaian economy is not well developed. Thus as the main explanatory variables, we include real GDP as the scale variable and the 3-month treasury bill rate as the opportunity cost of holding money and also to take into account the speculative motives of money demand. In addition we have introduced the expected rate of inflation, which is believed to affect the short run behaviour of money demand and the depreciation of the cedi at the parallel market to represent currency substitution. In the money supply, we have net credit to commercial banks, net claims on government, its net foreign assets, and its other assets. We treated these as identities, and allowed the money multiplier to be determined by the relationship between the supply of money and the demand for money (M2). By this the supply of money and the demand for money are equiliberated. The derivation of the price equation also takes into account both tradable and non-tradable factors. The trade equations, the money demand equation and the various definitional identities make up a complete model explaining the markets for the three goods (exportables, importables, and non-traded goods), and one asset (money). The model simultaneously determines prices, balance of payments, and money supply, but assumes that output is exogenously determined.

The major empirical findings are that: inflation in Ghana is partly internationally transmitted. On the domestic front, the results show that inflation is partly due to monetary phenomenon while structural factors are also a contributory factor. Since most importers obtain their foreign exchange at the black market rate, any depreciation in that rate has a quick pass on effect on to domestic prices. According to the simulation results, a devaluation leads to higher inflation and thus reduces the demand for real cash balances. This eventually leads to a reduction in demand as a result of the higher opportunity cost. However, the trade balance

improves possibly because the positive relative price effect is smaller than the negative liquidity effects. A percentage reduction in domestic credit is able to produce an improvement in the trade balance larger in magnitude than that resulting from a 10% devaluation of the cedi. Also, the medium term effects are mild for the credit reduction experiment than that of the devaluation. Overall, the results support the view that tight credit policy should be preferable to devaluation since the latter leads to weaken economies that are already fragile.

The remainder of the paper is organised as follows. Section 2.0 introduces inflation in Ghana, and we formulate the general price equation in Section 3.0. We discuss and formulate our equations for the financial sector, exports, imports, unit price of exports and unit price of imports in Sections 4.0 to 7.0. Results of estimation of the various equations are discussed in Sections 8.0 to 8.4. Section 9.0 analyzes the simulation results based on alternative policy scenarios. Section 10.0 offers some concluding remarks and draws policy implications for macroeconomic management in a developing country with a parallel foreign exchange market.

2.0 Inflation in Ghana

Most economists oppose high inflation. However there is less agreement on what constitutes an optimal rate of inflation apart from stating that it should be a low rate of inflation. Some economists believe that inflation is a major evil, and argue that monetary policy (or monetary reform) should be geared towards its outright elemination (see Gavin, 1990; Gavin and Stockman, 1988; Hoskins, 1990, 1992; Howitt, 1990a; Selody, 1990a, b). Many others argue that eliminating inflation would reduce output and employment, and the cost of the lost output and employment would more than offset the gains from establishing price stability (see, eg Fortin, 1990; Lucas, 1990; Peters, 1990; and Scarth, 1990).

In the economics literature, inflation has been categorised as hyperinflation and/or chronic inflation if the monthly inflation rate exceeds 40% (by Cagan's criterion). Végh (1992) categorised the origins of hyperinflation into three features (1) where the origin is from large fiscal imbalances, (2) where there are disappearances of nominal inertia meaning situations where contracts gradually disappear in the face of extreme rates of inflation because most wages and prices become indexed to a foreign currency, resulting in many transactions being conducted in a foreign currency, and (3) where there are inextricable social and economic environments such that the public becomes convinced the situation can no longer be contained. Various

studies have demonstrated that in developing countries where the tax revenue system, capital markets, and regulatory institutions are underdeveloped, fiscal imbalances are often the root cause of hyperinflation and chronic inflation, as governments often have no alternative but to monetize their budget deficits (see Bruno and Fischer (1990)). Agenor and Montiel (1999) have argued that wage indexation on past inflation rates can also play an important role in inflation persistence, both directly and indirectly, by transmitting exchange rate movements to domestic prices. In addition, they have observed in some countries that the frequency at which nominal wages are adjusted tends to increase with the inflationary pressures generated by exchange rate movements, thereby raising inflation.

In their analysis of inflationary episodes in Bolivia, Israel, Argentina, and Brazil, Dornbusch et al (1990) suggested there was an increased compatibility between domestic prices and the nominal exchange rate as inflation rises. Furthermore, the shortening of price adjustment intervals may become another source of inflationary pressure if the stance of monetary policy remains accommodative. This can also be reflected in domestic food prices. In many developing countries (particularly in Sub-Sahara Africa), food items comprise the bulk of the goods included in the consumer price indices. The literature on price determination is therefore very large. To be able to analyse Ghana's case we try to classify the general price determination into two main units (1) the monetarists and (2) the structuralists views. According to the monetarists view, the main cause of inflation is excess demand for goods and services caused by an extensive expansion of money supply in the economy. This view has its roots from Irving Fisher's theory. However, according to the structuralists view, structural rigidities in the economy are the root causes of inflation. In other words, the price system is unable to adjust quickly to changes in aggregate demand due to distortions in the price control mechanisms and credit misallocations. A few models have been developed recently with different and often conflicting assumptions about the causes of inflation in Ghana. For instance, Ahmad (1970) suggested that Ghana's inflation emanates from excess demand caused by expansionary fiscal and monetary policies. However, Chibber and Shaffik (1990), and Youngblood et al (1992) associated the problem with purely monetary factors. Chibber and Shaffik tried to find supporting evidence that the rate of depreciation of the domestic currency had a significant impact on domestic inflation although the results were not supportive of this assertion. Other studies, including Sowa and

Kwakye (1993), suggested that inflation in Ghana is due to real factors. In this study, we have assessed the major causes of inflation in a general sense, and then tried to explain the factors responsible for inflation in Ghana. The methodology adopted in the study draws extensively on the approach used by Agenor and Montiel (1990) for some developing countries, and Moser (1997) for price determination in Nigeria.

3.0 Derivation of the Price Equation

First of all, we assume that the price system (P_t) consists of a geometric average of the price of tradable goods $\left(P_t^T\right)$ and nontradable goods $\left(P_t^N\right)$ and can be expressed as:

$$P_t = \left(P_t^T\right)^{\lambda} \left(P_t^N\right)^{1-\lambda} \tag{1}$$

where λ measures the share of tradable goods in total expenditure. In log linear form, equation (1) can be expressed as:

$$\ln P_t = \lambda \ln P_t^T + (1-\lambda) \ln P_t^N \tag{2}$$

where λ represents the share of tradable goods in the total expenditure.

In domestic currency terms, the tradable goods portion can be represented as:

$$\ln P_t^T = \beta \ln E_t + (1-\beta) \ln BEX_t + \ln PW_t \tag{3}$$

where PW_t is the world price of tradable goods, BEX_t is the parallel market rate, E_t is the official exchange rate, and β denotes the proportion of trade carried through official channels. This demonstrates that an increase in the exchange rate (official (E_t) or black market (BEX_t)) and foreign prices will lead to an increase in the overall price level. The official exchange rate and the black market rate have been included because trade in Ghana takes place at both levels. Indeed, it is expected that the rate prevailing in the black market would explain the price equation better than the official rate, since a substantial amount of foreign exchange rationing take places at official levels, whereas a large volume of commercial transactions and most capital inflows are settled in the parallel market at the free exchange rate (BEX_t)

It is assumed the price of nontradable goods $\left(P_t^N\right)$ is set in the money market where demand for nontradable goods is assumed to move in line with demand in the economy. Consequently,

the price of nontradable goods is determined by the money market equilibrium condition, real money supply (M^s/P) equals real money demand $\left(M^d/P\right)$. This yields the following equation for nontradable goods prices

$$\ln P_t^N = \phi(\ln M_t^s - \ln M_t^d) \tag{4}$$

where M^s represents the nominal stock of money, M_t^d is the demand for nominal money balances, and ϕ is a scale factor representing the relationship between economy-wide demand and demand for nontradable goods. The demand for real money balances $\left(M^d/P\right)$ is assumed a function of real income (Y_t), inflationary expectations (π_t^e), and the rate of depreciation of the domestic currency in the parallel market (BEX_t);

$$M^d = f(\underset{+}{Y_t}, \underset{-}{\pi_t^e}, \underset{+}{BEX_t}) \tag{5}$$

anticipate signs are denoted below the explanatory variables.

The expected rate of inflation is assumed, based on adaptive expectations, and equal to:

$$\pi_t^e = \Delta \ln(P_{t-1}) \tag{6}$$

This backward looking expectational assumption is based on the fact that though the stabilisation program of the government has been ongoing for over two decades, any announced policy of reduction in the rate of growth of money stock is not viewed as credible by Ghanaians due to previous policy inconsistencies. Consequently, inflation rates have persistently been high in the country.

In log-linear form, the money demand function is:

$$\ln(M^d) = \psi_1 \ln(Y_t) - \psi_2 \Delta \ln(P_{t-1}) - \psi_3 \ln(BEX)_t \tag{7}$$

where Y_t = real income.

Thus, the nontradable equation (4) becomes:

$$\ln P_t^N = \phi(\ln M_t^s - [\psi_1 \ln(Y_t) - \psi_2 \Delta \ln(P_{t-1}) - \psi_3 BEX_t]) \tag{8}$$

and combining equations (3) and (8), using (2) gives an overall price equation:

$$\ln P_t = \lambda \left[\beta \ln E_t + (1-\beta) \ln BEX_t + \ln PW_t\right] +$$

$$(1-\lambda)\left[\phi(\ln M_t^s - [\psi_1 \ln(Y_t) - \psi_2 \Delta \ln(P_{t-1}) - \psi_3 BEX_t])\right] \tag{9}$$

The final form of the price equation was formulated as:

$$P_t = F_1(\underset{+}{M_t{}^s}, \underset{ambiguous}{\underset{+}{BEX_t}}, \underset{+}{E_t}, \underset{+}{\Delta P_{t-1}}, \underset{+}{PW_t}, \underset{-}{Y_t}) \tag{10}$$

The Δ sign denotes the first difference operator.

4.0 Financial Sector

The financial system in Ghana may be categorized into three main features (i) organised sector that comprises the Central bank and the commercial banks, (ii) traditional sector that embodies the traditional market where informal credit creation is the main function, and (iii) capital market consisting of the Stock Exchange and the National Trust Holding Company. The objective for including the formal monetary system into the model, is because money plays a pivotal role in a developing economy through the above mentioned financial intermediaries. The contributions which these intermediaries can make towards raising the rate of savings and the transformation of the savings into productive investment projects and generally provide the amount of liquidity needed for economic development need to be stressed. Apart from the traditional role of a central bank the Central Bank of Ghana (BOG) is also expected to play a more responsible role by responding to developmental needs. In Ghana, for instance, this has taken the form of recommending and financing the establishment of special financial institutions such as the agricultural and industrial banks, rural banks, foreign exchange bureax and non-financial institutions. These institutions help to provide unlimited credit to government and also offer economic and advisory services to the government. The issues pertaining to informal credits have been well documented by Dordunoo (1996). He argued that a special loan scheme exists in rural Ghana, especially the cocoa growing areas. The need for the credit arises because cocoa growing is a perennial activity and hence the cocoa trees are acceptable forms of collateral by these lenders. Hence in most instances, cocoa farms are pledged as collaterals for loans to

be repaid over a period of time horizon since repayments could be extended several times. In such instances, the distinction between short and long term loans are not immediately clear. Interest charged on such loans vary from place to place and by the type of borrower. Sometimes these rates can be as high as 100 percent or more. Becauses of the tendency for renegotiation, the actual interest paid on loans depend on the size of borrowing and the length of the loan. For instance a farmer may borrow an amount of US$200 and agree to pay US$500 made up of principal plus interest. Hence since the interest rate is fixed over the entire period of the loan, the longer the person takes to hold onto the funds the lower is the rate of interest (see Killick, 1996).

In the formal sector, for a large part of the sample period interest rates were controlled by the central bank, and were institutionally determined. The Bank of Ghana fixed interest rates and then asked the banks to adjust both their lending and deposit rates in accordance with a given band within which the commercial banks could operate. Consequently, the interest rate can be treated as exogenous in the model.

The money demand equation is split into two equations: the demand for narrow money $\left(\frac{M1}{P}\right)_t$ and the time and savings deposits $\left(\frac{TSD}{P}\right)_t$.

We can formulate the demand for narrow money to be a function of real income (Y_t), (see Adam, (1991); Kole and Meade (1995)), inflation rate (ΔP_t), and also on the black market exchange rate (BEX_t) to represent currency substitution in the country (see for instance, Bahmani-Oskooee (1991); Adam (1992); Arize (1994); Dekle and Pradhan (1997)). The estimated equations are formulated as:

$$\left(\frac{M1}{P}\right)_t = F_2 \left(\underset{+}{Y_t}, \underset{-}{\Delta P_t}, \underset{+}{BEX_t}, \right) \tag{11}$$

The money demand equation for the time and savings deposits is assumed to be a function of real GDP (Y_t), interest rate (IR_t), and the rate of inflation (ΔP_t). This is expressed as:

$$\left(\frac{TSD}{P}\right)_t = F_3 \left(\underset{+}{Y_t}, \underset{-}{IR_t}, \underset{-}{\Delta P_t} \right) \tag{12}$$

The sum of the two provides the broad money demand $(M2_t)$ which is given by:

$$M2_t = TSD_t + M1_t \tag{13}$$

5.0 The Export Equation

Ghana is a small open economy. Consequently, any major development or problem in the world economy has a significant impact on its domestic economy, such as declining levels of commodity prices and rising crude oil prices. Ghana exports cocoa, timber, gold, manganese, and diamonds, with cocoa as the principal export commodity. However, it is a price taker and thus has no influence in determining the world price. It is assumed that the volume of exports from Ghana depends on the relative price of exports and foreign demand. The export equation thus, includes real world income and the ratio of export price to the price of foreign substitutes. It also incorporates the price of foreign exchange in the unofficial or black market. A dummy variable for 1994 takes account of a major structural change when Ghana changed over from military admistration to a civilian regime. However, due to the long gestation periods associated with production of its principal exports, it has a slow response to any changes in demand. Besides, most of the primary exports are exhaustible resources such as the minerals, and where they can be grown like cocoa, the resources needed to produce and expand production cannot be easily expanded in the face of their competing uses. All these put together shows that the response of exports to demand is likely to be very small. Consequently, in line with Khan et al (1990), Ghartey and Rao (1990), Agenor and Montiel (1999), Guarda and Pieretti (2000), and Musila (2002), we formulate the export function as follows:

$$\left(\frac{VX_t}{PX_t}\right) = F_4\left(\underset{-}{\left(\frac{PX_t}{PW_t}\right)}, \underset{+}{BEX_t}, \underset{+}{\left(\frac{YW_t}{PW_t}\right)}\right) \tag{14}$$

where VX_t is the nominal value of exports of goods and services, PX_t is the unit export price index, BEX_t is as defined before, YW_t is world nominal income, PW_t is the world unit price of tradable goods.

5.0 Imports Equation

Conventionally, the import equation is formulated as a function of real domestic income and relative price of imports. We have made a slight modification in this study by the inclusion of capital availability variable (a proxy for FDI or foreign capital inflows) and essential imports

variable. The reason is that the importation of essentials like food and drinks, medicine, and crude oil are made possible only when there is sufficient foreign exchange inflows into the country.

$$\left(\frac{VM_t}{PI_t}\right) = F_5 \left[\underset{+}{Y_t}, \left(\underset{+}{\frac{KI_t}{PI_t}}\right), \left(\underset{-}{\frac{PI_t * BEX_t}{P_t}}\right), \underset{+}{EI_t}\right] \tag{15}$$

where VM_t is the nominal value of imports of goods and services, PI_t is the unit price of imports, KI_t is the proxy for foreign capital inflows, and EI_t is essential imports such as food, medicine and crude oil. Other variables are as defined previously.

From standard demand theory, the partial derivative of the demand for imports with respect to the price of imports would be negative. In other words, a rise in import prices would result in a decrease in demand as imports become more expensive. The effect on the demand for imports of real income is expected to be positive. Indeed, real imports would be expected to increase with real income for two reasons. First, if an increase in real income leads to an increase in real consumption, with an unchanged distribution of income, more foreign goods will be purchased. Second, if an increase in income also leads to an increase in real investment, then investment goods not produced domestically must be imported. This formulation draws on Sundararajan (1996) for India.

6.0 Unit price of exports and imports

The export and import indices are assumed to be determined on the world market and by changes in the domestic currency exchange rate. This assumption is consistent with the fact Ghana is a small open economy and thus, a price taker on the international market.

The model is closed by the following identities:

Balance of Payment identity

$$R_t = R_{t-1} + TB_t + KI_t * BEX_t \tag{16}$$

where R_t is net foreign assets , and TB_t is the trade balance .

Money Supply identity

$$M_t^s = K_t * (R_t + NDA_t) \tag{17}$$

where K_t is money multiplier, NDA_t is net domestic assets, and equation (17) illustrates the main sources of broad money stock, where

$$NDA_t = CGT_t + COC_t + CRE_t + ONA_t \tag{18}$$

Here, CGT_t = total credit to government; COC_t= cocoa financing (nominal terms); CRE_t= credit to the rest of economy; ONA_t= other net assets. Equation (18) shows that net domestic assets is defined as the sum of total credit to government (CGT_t), cocoa financing (COC_t), credit to the rest of the economy (CRE_t), plus/minus other net assets (ONA_t).

Trade balance definition

$$TB_t = VX_t * PX_t * BEX_t - VM_t * PI_t * BEX_t \tag{19}$$

All other variables are as defined before.

7.0 Results of Estimation

The methodology used involves the use of error-correction and cointegration techniques. By this approach the entire model is estimated after taking into account the time series properties of the variables at hand. Time series analysis shows that most macroeconomic series are non-stationarity of order one, i.e. their first differences are stationary. In this case, estimating equations in levels produces misleading test statistic values when, in fact, the series are totally unrelated, since estimation in levels is meaningful only when the series are cointegrated (see Banerjee et al, 1993). Accordingly, the series in this model are first tested for stationarity (see Appendix 5) and if the null hypothesis of non-stationarity is not rejected, the variables are tested for cointegration using the Johansen methodology. The cointegration results are indicated beneath each long run equation. Upon the acceptance of the cointegration hypothesis, the equation is estimated in levels (long-run equation) and the lagged residuals are used as an explanatory variable (error correction term) in the first-difference (ECM) equation. On the other hand, if the cointegration hypothesis is not accepted, the equation is estimated in first difference logarithms without error correction term. This procedure ensures that all the parameters are consistently estimated and that reported standard errors can be used for hypothesis testing. The estimates are accompanied by a battery of misspecification tests for autocorrelation, het-

eroscedasticity, normality, and reset tests of the residuals. Despite the moderate sample size (31 annual observations, (1970-2000)), these tests provide a reliable measure for likely problems in the specification of the equations. Indeed, a period of thirty-one years should be adequate to reveal the links among the variables under consideration. Stability of the equations are confirmed by the various Chow break-point tests.

7.1 Prices

The long run price equation, $(A2.1a)$ shows that the general price index is a decreasing function of real GDP but an increasing function of money, past inflation rates, the exchange rate in the parallel market, and the foreign prices. The official exchange rate variable was dropped because it possessed the wrong sign neither was it significant. All the variables have satisfied the theoretical, statistical and econometric conditions. The explanatory variables together explain about 87 percent of the variation in the dependent variable. Real GDP variable was found to exert large and significant negative influence on domestic prices. The results show that a percentage increase in real GDP would lead to a 0.86% decrease in the price level in the long run. Here, the results support the assertion by some researchers that structural factors have a sharp adverse effects on inflation in Ghana (see Sowah and Kwakye, 1993). However, in the short-run equation $(A2.1b)$, a percentage change in Y would lead to 0.17% decline in inflation. The results also show that the depreciation of the exchange rate in the black market (BEX_t) has a positive and significant impact on the general price level in the Ghanaian economy, thus confirming the result by Roberts (1989) and Dordunoo (1996) that inflation in Ghana is also influenced by cost-push forces. Consequently, to the extent that parallel exchange rates in Ghana, being very sensitive to actual and anticipated changes in economic conditions, are more volatile than official exchange rates, domestic prices are more likely to display a significant degree of instability, which may adversely affect economic decision making (Agenor and Montiel, 1999). A percentage increase in the black market rate would lead to 0.63% increase in domestic prices in the long-run. In the short-run, a percentage change in the depreciation of the cedi in the black market would lead to an increase in inflation by 0.52%. This points to the fact that the continuous depreciation of the exchange rate might have led to the huge revaluation losses all of which has to be borne by the government account, thereby leading to huge growth in money supply. The results show that the official exchange rate variable is insignificant so we

conclude that it is the depreciation of the black market exchange rate that influences domestic prices in the country. We also found the foreign price of tradable goods variable to be significant supporting the view that inflation in Ghana is at least partly internationally transmitted. The coefficient of equilibrating variable in equation ($A2.1b$) is negative and significant. It shows that the speed of adjustment to disequilibrium in prices is 45% per annum. There was the general idea that improved rainfall significantly reduces inflation (see Sarpong, 1995). However in our study, this variable was not significant. Our results confirm that inflation in Ghana may be associated with both foreign and domestic factors as argued by Agenor and Montiel (1999), and also by monetary factors in accordance with the arguments by Chibber and Shaffik (1990), and Youngblood et al (1992).

7.2 The Demand for Money

The estimated equations of both the demand for real narrow money and the real time and savings deposits equations ($A2.2a$) to ($A2.3b$) performed quite satisfactorily. All the explanatory variables have expected signs and are significant at the 5 percent level or better. The adjusted R^2 value for the long run equation is 0.76. Equation ($A2.2a$) shows that the demand for currency (ie real narrow money) depends positively on real income and the depreciation of the domestic currency in the black market, but negatively on interest rates and changes in domestic prices (inflation). From the results, we notice that a percentage increase in real income results in an increase of 0.66% in the demand for real narrow money. The income elasticity of 0.66 is consistent with the results of our recent MSc study for Ghana in which the income elasticity was estimated at 0.52 for the period 1970-1997. Tseng and Coker (1991) report income elasticity for the demand for narrow money of 0.79 for Indonesia, 1.11 for Korea, 0.67 for Phillipines, 0.86 for Singapore, 0.85 for Thailand, and 0.89-1.8 for Kenya. In addition, a unit change in inflation (a unit increase in inflation) generates a 0.07% increase in the demand for narrow money. Thus, a 100 percent point increase in inflation would be accompanied by 7% increase in the demand for real currency by the Ghanaian public. This is consistent with human behaviour because as prices rise, agents tend to hold more real currency to spend now in order not to suffer any losses on their holdings. The rate of interest has a negative influence on the demand for real narrow money. Furthermore, the rate of currency substitution, which is proxied by the inclusion of the parallel market rate (BEX_t), is positively signed and significant. It has a partial elasticity of

0.05. In the short run equation ($A2.2b$), our results show that a 1 percentage point change in the depreciation of the domestic currency in the black market after a year leads to a growth in the demand for narrow money by 0.09%.

We notice from equation ($A2.3b$) that the demand for real time and savings deposits (quasi money held by the public in commercial banks) in the long run is influenced by real income domestic interest rate and inflation rates. All the estimated coefficients are significant and have the a priori signs. The long run income elasticity for real quasi money is estimated at 0.99 while the short run value is 1.04. Sowah (1993) had long run income elasticity of 0.72 for Ghana in respect of the demand for broad money, and 1.16 for the short run equation. Sarpong (1995) estimate a short run income elasticity of 1.97 over the period 1970-1987 for Ghana while Gockel (1983) find a short run income elasticity of 1.55 for Ghana[2]. In their study on Kenya, Elliot et al (1986) estimate long run income elasiticity of 1.1 and 1.2 for the short run, while Lipumba et al (1988) had 1.4 for the short run and 2.2 for their aggregate long run money demand function. The disequilibrium variable is correctly signed and significant. It shows that each year the speed of adjustment to disequilibrium is 9.7%. The inflation variable is negatively signed indicating that inflation in Ghana should be reduced in order for the monetary authorities to be able to attract and increase bank savings and time deposits.

7.3 Exports of goods and services

Equation ($A2.4a$) shows that the long run demand for exports is determined by the ratio of domestic export price to the price of foreign substitutes, real world income, and the exchange rate in the parallel market, as well as a dummy variable for 1994. The adjusted coefficient of determination is 0.94 for the long run equation and 0.81 for the short run. The equations reveal that the price elasticity of export demand is negative and highly significant in both the long-run and short-run. The coefficient of the exchange rate variable possessed the right sign. The key variables that explain export demand are relative prices of exports, world real income, and the exchange rate. The demand for Ghanaian exports is strongly influenced by world economic activities. All the variables are significant at the 5% signiicant level. The results show that the long run price elasticity is -0.17 and 0.40 for the real world income elasticity. in other words, an increase in world real income by 1 percent leads to a 0.40 percent increase in export demand

[2]cited in Sarpong 1997

in the long-run. As relative price level increases by one percent, export demand decreases by 0.17 percent in the long-run. The 1994 dummy accounts for the possible structural shift due to the regime change in Ghana from over 20 years of military rule to a democratic multiparty rule. The estimated short run income elasticity in our model equation ($A2.4b$) is 0.66 and the relative price elasticity is -0.46. These compare favourably with those of Musila and Rao (2002) for Kenya and Musila (2003) for Malawi. The disequilibrium variable is correctly signed and significant. It shows that each year the speed of adjustment to disequilibrium is 40%. A dummy variable for 1978 had a negative influence on the country's export possibly due to the currency exchange that prevailed at the time. A new currency was introduced to replace the existing ones. Again, in regards to the export equation for the industrialised countries, Houthakker and Magee (1969) obtained income elasticities ranging from 0.99 to 3.55, and negative 0.03 to negative 2.47 for the price elasticities. The income elasticities of the export equations for the eleven developing countries ranged from 0.34 to 4.00, while the price elasticities were - 0.07 to - 1.3.

7.4 Imports Equation

Equations ($A2.5a$) and ($A2.5b$) summarize the import relations. The adjusted coefficient of determination are 0.74 and 0.70 for the long run and short run, respectively.

The estimated equation ($A2.5a$) shows that the major determinants of imports in Ghana in the long-run are national income, capital availability (foreign exchange inflows), and relative price of imports. In the long-run, the effect of income is highly significant and correctly signed. Real imports increase with income because if an increase in real income leads to an increase in real consumption, then with an unchanged distribution of income more foreign goods would be purchased. In addition, if an increase in income leads to an increase in real investment, then investment goods that are not domestically produced must be bought from overseas. The regression results show that a percentage increase in income would lead to 0.43% increase in imports in the long-run. The capital inflow variable is also highly significant and correctly signed. A percentage increase in the relative price of imports variable reduces imports marginally by approximately 0.88 percent annually, this effect is comparable with that estimated in Sundararajan's (1986) model.

In the short-run equation ($A2.5b$), the speed of adjustment to disequilibrium is about 34%

per annum. The relative price elasticity of Ghana's imports was estimated at -0.17. This result is quite low, indicating that relative prices do not have significant impact on the imports of a developing country such as Ghana. Since the estimated price elasticity is significantly less than unity, it confirms the commonly expressed view that developing countries have a price inelastic demand for imported goods. This also implies that, in Ghana, changes in the poeple's income hardly affect their decision to import.

In general, the results have been positive in the sense that they compare favourably with other studies. Indeed, they are plausible compared with the estimated results of the imports equation by Houthakker and Magee (1969) for fifteen industrial countries and eleven developing countries. The regression coefficients of their study has shown that the income elasticities are between 1 and 2, for the developed countries and 0.5 to 1.5 for the developing countries. The price elasticities ranged from -0.13 to -1.46 for the industrial countries, while those of the developing countries were estimated at -0.07 to -1.03.

It must also be emphasised here that by manipulating the results we obtain a value for both the exchange rate elasticity of export and import which is lower than unity. This indicates that the Marshall-Lerna condition is not fullfilled in the country, implying that continous devaluation of the domestic currency may not necessarily improve the trade balance. Additionally, the import substitution nature of the industrial sector of Ghana coupled with the volume of capital inflows in recent times calls for large volumes of imports of finished unfinished products and raw materials to feed the domestic industries since there are no domestic substitutes.

8.0 Model Simulation

In this section, dynamic simulation techniques are used to evaluate the performance of the overall model. The simulation results show that the goodness of fit of the whole model is excellent, and that the model is stable and robust. As in the case of Agenor and Montiel (1990), a baseline case is first obtained, and deviations of the path of the economy from it in response to changes in policy variables are analyzed. All shocks are assumed to be fully anticipated. The policy simulations focus mainly on the dynamic effects of devaluation and how they contrast with the effects of tight credit policy. This is interesting because the IMF has almost always insisted on devaluation as a condition for extending loans to deficit developing countries. Ghana has, during the course of introducing the ERP, devalued its currency massively i.e since 1983.

One would like to know if this policy path taken is the most effective one compared to other policies, such as credit contraction.

8.1 Effect of 10% Devaluation in cedi

We consider an impact of a 10 percent one-shot devaluation of the parallel market exchange rate, shown in Figure 1.1. The immediate impact of this shock on the general price level is a rise of 5.8 percentage points above baseline, see figure 1.1 (i), indicating that the devaluation has a positive effect on prices in the short-run as the cost of imported raw materials have risen. In the medium-run, the general price level decelerates to baseline over a period of about five years. This result is consistent with other similar studies. For instance, Connolly and Taylor (1979) presented empirical evidence showing that devaluation changes the domestic price level through the prices of traded goods. Also, Agenor and Montiel (1990) observe that a once-for-all fully anticipated 10 percent devaluation leads to a rise of 1.2 percent in the domestic price level. They, however, emphasise that the magnitude of this price increase depends very much on the country and the nature of data at hand. Another study by Sundararajan (1986) on India shows a similar impact effect. His study shows that a percentate devaluation of the Indian rupee, leads to a rise in the price level by about 0.6 percentage points in the immediate period, and by 0.8 percent in the medium term.

As illustrated in figure 1.1 (ii) and (iii), the devaluation results in an immediate fall in both imports (figure 1.1 (ii)) and exports, (figure 1.1 (iii)) respectively; but the fall in imports is substantial. The trade balance, figure 1.1 (iv), improves in the immediate period, but deteriorates subsequently before improving again, a classic J-curve effect. These responses are the consequence of the interaction between relative price effect of Ghana's traded goods and the liquidity effect of devaluation. In the medium term, exports increase by about 1.2 percentage points, as shown in figure 1.1 (iii). This automatically translates into increasing the level of reserves, figure 1.1 (v). Figure 1.1 (vi) also shows that the devaluation raises the money stock by 1.2 percentage points in the immediate period. However, there is a sharp fall in this variable to about 0.2 percentage points in the second year, followed by a small oscillatory response to baseline level. The features exhibited by this model are consistent with expectation. For example, Sundararajan (1986) argue that the oscillatory response of the trade balance is due to interaction between relative price effect and the liquidity effect of devaluation. We infer that as

relative prices of tradable goods vis-a-vis non-tradable goods improve, the trade balance also improves, and vice-versa.

The trade balance is also affected by the liquidity effect following devaluation. The reason being that, devaluation causes the demand for real balances to decline (due to the strong sensitivity of money demand to inflation), and thus lead to a reduction in absorption (see Khan and Knight, 1982), but with an improvement in the trade balance in the year of the devaluation. In other words, devaluation causes a decline in the demand for real balances because the rate of change in prices, which is also a proxy for the opportunity cost of holding money in a high inflation developing country (see Adam, 1991, 1992), has risen. In the subsequent years, however, as relative prices weakens, the negative liquidity effects become magnified resulting in a deterioration in the trade balance. Thereafter, as the liquidity effects turn positive and more than offsets the weakening prices, the trade balance turns positive. Ahluwalia and Lysy (1981), have contended that "exports for example may not respond sufficiently enough to devaluation because in many developing economies exports are primary commodities whose supply is rigidly limited in the short run".

Agenor and Montiel have argued that, so far as the stylized facts are concerned, empirical evidence on the way in which dual markets, with legal and illegal foreign exchange rates, react to policy shocks is very scanty. Among the few studies available are Edwards's (1989) analysis of 18 devaluation experiences in Latin America, Kamin's (1988) study of the behaviour of parallel exchange rates across 40 devaluation episodes in a larger group of developing countries; and Sundararajan's (1986) study on India. Results of the simulations conducted in this section are consistent with these studies and provide evidence of the crucial role devaluation plays as a monetary transmission mechanism and the behaviour of macroeconomic variables (see also Dornbusch, 1980). On the Ghanaian economy Amoako (1980) finds a deterioration in the trade balance as a result of devaluation. Ghartey (1987) confirmed that devaluation is an effective tool for correcting the persistent balance of payments problems facing Ghana. However, in another study Ghartey and Rao (1987) find a contradictory result to their earlier study and argue that devaluation in Ghana connot be relied upon to redress the balance of payments problems of Ghana.

8.2 Dynamics of Credit Contraction

Figure 1.2 depicts the time paths of the major variables following the contraction in money supply. The effects of the credit policies are examined to see how adequately they can substitute for devaluation as well as help to ease inflationary pressures in Ghana. The results show that a percentage point contraction in domestic credit can produce a marked initial improvement in both the trade balance and the domestic price level. The effect of this shock is analogous to a monetary tightening policy by the authorities. Figure 1.2 (i), shows that in the immediate period when the credit policy is being tightened, a one-percentage point reduction in credit leads to a reduction of 0.36 percent in the price level. This is due to the fall in money supply by almost 0.8 percent. Sundararajan's (1986) study on India finds similar impact effects, (see also Mohsin and Knight (1982)). Sundararajan's study shows that a percentage reduction in credit leads to a reduction of 0.6 in money stock, and a fall of about 2 percentage points in the price level. Mohsin and Knight (1982) assert that following credit contraction, domestic prices decline before rising back to its long-run equilibrium level but the moderation in prices persist for several years. Our analysis show that the reduction in the price level raises demand for real money balances which also has effect on relative export and import prices. This is because the reduction in inflation leads to an increase in demand for real balances by more than the increase in the supply of real credit (although nominal credit shrinks, real credit expands due to the sharp reduction in the price level). We, thus, notice a rise in exports as shown in figure 1.2 (ii), accompanied by a fall in imports, figure 1.2 (iii), but the rise in exports is relatively stronger than the fall in imports. As a consequence of these relative price effect and the negative liquidity effect, the trade balance improves strongly, in the short run, figure 1.2 (iv). Subsequently, all variables, especially, the price level as well as the trade balance adjust gradually to their baseline levels. Generally, the price effect associated with a reduction in money supply lasts longer than the shock due to devaluation. Figure 1.2 (v) shows also, that the BOP, rises instantaneously following this shock.

From the ongoing analysis, we realise that the transmission of monetary policy resulting from the shocks considered in this model are consistent with existing literature, more especially those that pertain to developing countries (see on India, Sundararajan, (1986); on Turkey, Olgun (1984); Khan and Knight (1981) on some developing countries, Lizondo and Montiel (1989),

Edwards (1989) on 18 developing countries, and Agenor and Montiel (1990) on 8 developing countries).

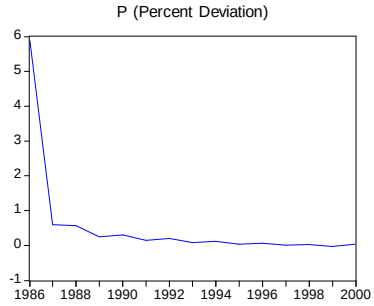
9.0 Conclusion

In this paper we have used annual data on Ghana (1970-2000) to construct a small macro-econometric model to explain trade and the rate of change of domestic prices in Ghana. During this period, the economy of Ghana witnessed growing levels of credit to finance government deficits; hence, there were large fiscal imbalances. Consequently, inflation spiralled to very high levels, averaging about 45 percent per annum. We noted from our study that the domestic price level in Ghana is highly dependent on both domestic and foreign factors (such as overseas commodity prices). The view that inflation in Ghana is partly internationally transmitted is thus, confirmed by our study. On the domestic front, the results show that inflation is partly due to monetary phenomenon, while structural factors are a contributory factor. Since importers obtain their foreign exchange mostly from the black market prevailing in the country any depreciation in the black market rate has a quick pass through effect on domestic prices.

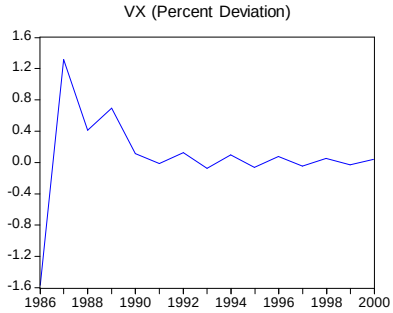
We also noted that world real GDP and relative prices are the most important determinants of demand for Ghana's exports, while Ghana's real GDP and relative prices are the main determinants of her imports. The long run price elasticity of the exports is smaller than unity, confirming the assertion that Ghana's exports are price inelastic. It also implies that price variations in the world market have only small effects on the quantity demanded of Ghana's exports. Secondly, the income elasticity of exports is less than unity. Since the estimated price elasticity of Ghana's imports is significantly less than unity, it confirms the commonly expressed view that Ghana has a price inelastic demand for imported goods. The short run income elasticity is far less than unity, implying that, in Ghana, changes in the poeple's income hardly affects their decision to import. As regards the monetary sector, our estimates show that the main determinants of real narrow money balances and quasi money are real GDP, depreciation of the cedi in the parallel market, inflation and nominal interest rate.

Through simulations we were able to find out that both devaluation and credit restraint are effective in addressing the balance of payment issues facing Ghana. However, the analysis shows that the direction and time pattern of the effects of these two policy experiments are different. It is therefore incumbent on policy authorities to find a combination of policy measures that would allow their economic recovery programes to achieve major objectives at smaller cost. The study has shown that further depreciation of the domestic currency is unfavourable to the

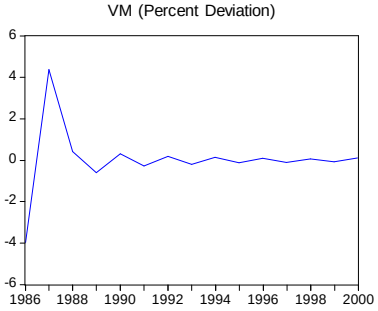
cause of curbing inflation in the domestic economy. It rather leads to price increases and is a source of fueling inflation, and could lead to a spiral of inflation through the agitation for higher wages by firms. On the whole the results have also confirmed that if the objective of the authorities is to improve the trade balance in the short-run, then tight domestic credit policy would be a better approach than the continuous depreciation of the currency.



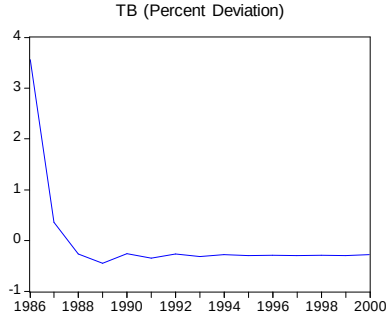
(i)



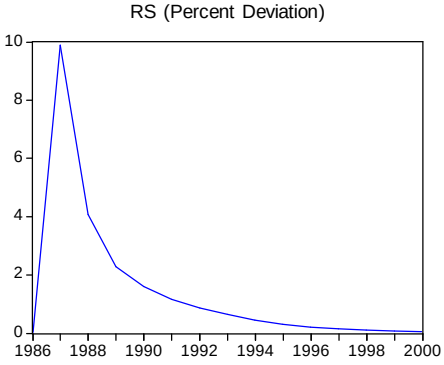
(ii)



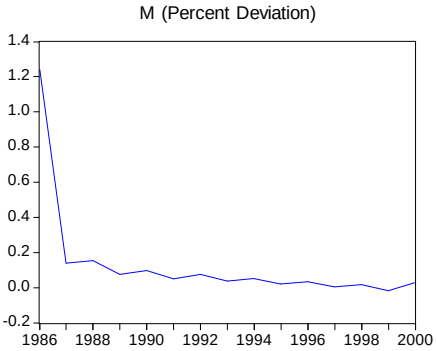
(iii)



(iv)



(v)



(vi)

Figure 1.1: Effect of 10 Percent Temporary Devaluation

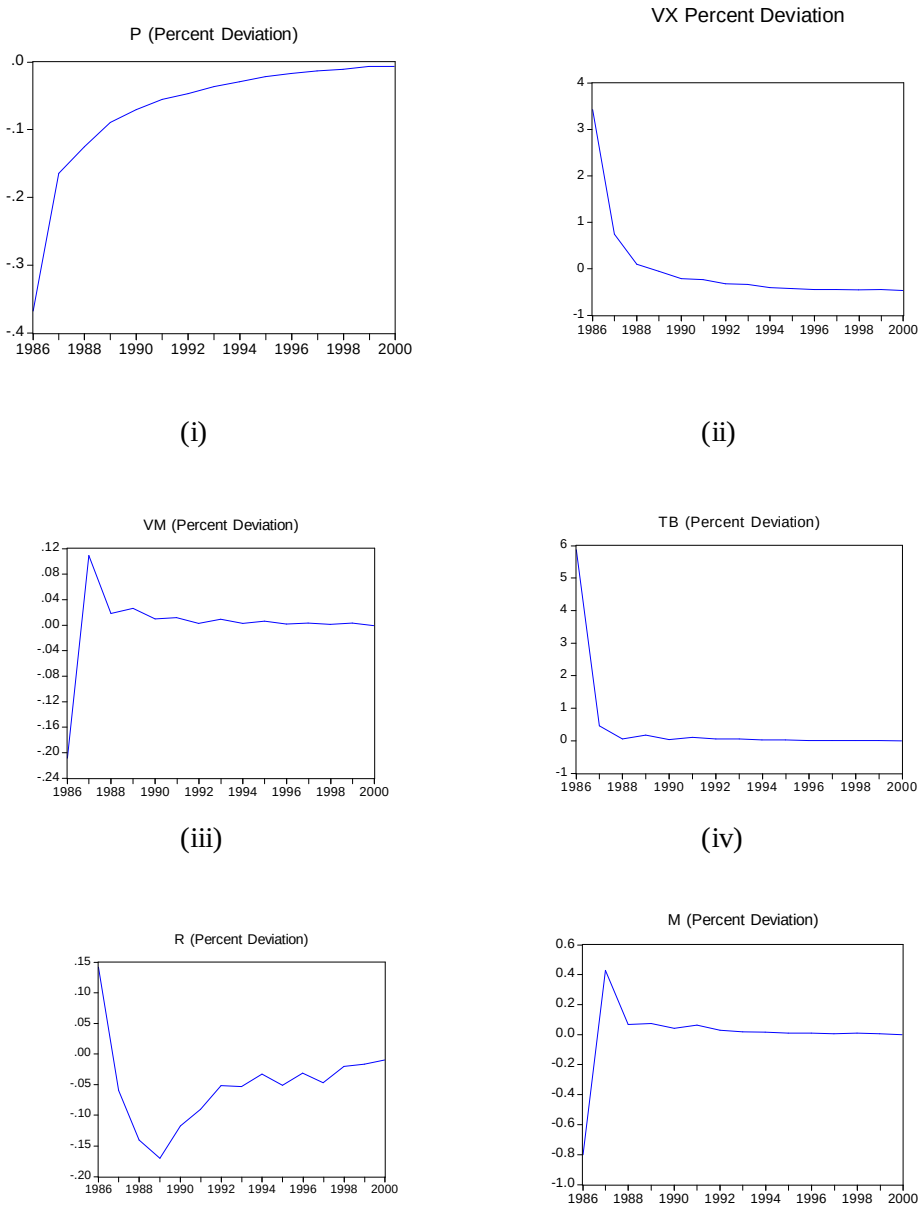


Figure 1.2: Effect a a one-shot reduction in domestic credit by a percentage point.

APPENDIX A

A.2.0 Regression Results

In the next section we present the detailed results of the estimated equations using annual data covering the period 1970 to 2000. The t-raios of the estimated coefficients are given in parentheses. The Durbin-Watson statistic (DW) and the adjusted coefficient of determination $\left(\bar{R}^2\right)$ are listed below each estimated equation. The likelihood ratio (LR) test statistic for the Johansen procedure is reported below each estimated long run equation. A LR test statistic greater than the critical value (also indicated in the square brackets) indicates that the series are cointegrated. In addition to the $\left(\bar{R}^2\right)$, DW, four other diagnostic tests used for the short run are reported below each short run equation. They include the Breusch-Godfrey serial correlation Lagrange multiplier (LM) test, Arch LM test, White heteroscedasticity (cross terms) test, and Jarque-Bera normality test and Chow (break point) test.

A.2.1 Prices

Long run:

$$\ln\left(\hat{P}\right) = \underset{(-3.48)}{-3.3453} - \underset{(-2.35)}{0.8627}\ln(Y) + \underset{(2.48)}{0.0627}\Delta\ln(P) + \underset{(4.47)}{0.3038}\ln(M2)$$

$$+\underset{(2.13)}{0.6301}\ln(BEX) + \underset{(3.31)}{0.161}\ln(PW) \qquad \text{(A2.1a)}$$

$\bar{R}^2 = 0.86, \qquad DW = 2.87, \qquad [t - ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test : LR = 68.66(5\%\ critical\ value = 68.52)]$

Short run:

$$\Delta\ln(P) = \underset{(-2.92)}{-0.2142} + \underset{(2.92)}{0.1368}\Delta\Delta\ln(P)_{-1} + \underset{(7.52)}{0.4629}\Delta\ln(M2) + \underset{(5.88)}{0.5218}\Delta\ln(BEX)$$

$$\underset{(-2.18)}{-0.1658}\Delta\ln(Y) + \underset{(2.04)}{0.0027}\Delta\ln(PW)_{-1} - \underset{(7.20)}{0.4470}\left[\ln(P) - \ln\left(\hat{P}\right)\right]_{-1} \qquad \text{(A2.1b)}$$

$\bar{R}^2 = 0.87, \qquad DW = 2.34, \qquad \sigma = 0.068821 \qquad [t - ratios\ in\ parentheses]$

Breusch-Godfrey LM test (1)	Obs*R^2 = 2.7277	p=0.2567
Arch LM test (1)	Obs*R^2 = 0.4901	p=0.4838
White Hetroskedasticity test	Obs* R^2 = 9.7425	p=0.7148
Normality test	Jarque-Bera = 0.9412	p=0.6246
Chow (break point) test: 1994	F(7, 14) = 0.1926	p=0.9404

A.2.2 The Demand for Money

Long run:

$$\ln\left(\frac{\hat{M1}}{P}\right) = \underset{(2.19)}{0.7664} + \underset{(4.21)}{0.6607}\ln\left(\frac{GDP}{P}\right) - \underset{(-2.30)}{0.0860}IR - \underset{(-2.40)}{0.0717}INF$$

$$+\underset{(2.53)}{0.057}\ln(BEX) \qquad \text{(A2.2a)}$$

$\bar{R}^2 = 0.76, \qquad DW = 1.97, \qquad [t-ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test: LR = 68.86(5\%\ critical\ value = 68.52)]$

Short run:

$$\Delta\ln\left(\frac{M1}{P}\right) = \underset{(2.72)}{0.3196} + \underset{(5.32)}{0.8110}\Delta\ln\left(\frac{GDP}{P}\right) + \underset{(-2.10)}{0.0910}\Delta\ln(BEX)_{-1}$$

$$+\underset{(-2.29))}{0.3385}\ln\left(\frac{M1}{P}\right)_{-1} - \underset{(-3.11)}{0.0970}\left[\ln\left(\frac{M1}{P}\right) - \ln\left(\frac{\hat{M1}}{P}\right)\right]_{-1} - \underset{(-2.27)}{0.3196}DUM99 \qquad \text{(A2.2b)}$$

$\bar{R}^2 = 0.64, \qquad DW = 2.11, \qquad \sigma = 0.118556 \qquad [t-ratios\ in\ parentheses]$

Breusch-Godfrey LM test (1)	Obs*R^2 = 1.1389	p=0.5661
Arch LM test (1)	Obs*R^2 =0.21197	p=0.6452
White Hetroskedasticity test	Obs* R^2 = 11.7036	p=0.2314
Normality test	Jarque-Bera =0.2589	p=0.8782
Chow (break point) test: 1994	F(6, 13) =1.4875	p=0.2602

A.2.3 Demand for time and savings deposits

Long run:

$$\ln\left(\frac{\hat{TSD}}{P}\right) = \underset{(2.81)}{10.5123} + \underset{(8.66)}{0.9892}\ln\left(\frac{GDP}{P}\right) - \underset{(-2.62)}{0.0312}IR - \underset{(-4.61)}{0.1195}INF \qquad \text{(A2.3a)}$$

$\bar{R}^2 = 0.96, \qquad DW = 2.24, \qquad [t - ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test : LR = 52.98(5\%\ critical\ value = 47.21)]$

Short run:

$$\Delta\ln\left(\frac{TSD}{P}\right) = \underset{(3.39)}{0.0110} + \underset{(6.27)}{1.0425}\Delta\ln\left(\frac{GDP}{P}\right) - \underset{(-1.96)}{0.2370}\Delta IR$$

$$- \underset{(-2.83)}{0.379}\left[\ln\left(\frac{TSD}{P}\right) - \ln\left(\frac{\hat{TSD}}{P}\right)\right]_{-1} \qquad \text{(A2.3b)}$$

$\bar{R}^2 = 0.79, \qquad DW = 1.79, \qquad \sigma = 0.123365 \qquad [t - ratios\ in\ parentheses]$

Breusch-Godfrey LM test (1)	Obs*R^2 = 1.5803	p=0.4542
Arch LM test (1)	Obs*R^2 =0.9222	p=0.6312
White Hetroskedasticity test	Obs* R^2 = 12.9197	p=0.3526
Normality test	Jarque-Bera =0.4703	p=0.7940
Chow (break point) test: 1994	F(4, 22) =0.35363	p=0.7064

A.2.4 Export Equation

Long run

$$\ln\left(\frac{\hat{VX}}{PX}\right) = \underset{(3.74)}{4.8771} - \underset{(-3.98)}{0.1702}\ln\left(\frac{PX}{PW}\right) + \underset{(2.47)}{0.4093}\ln\left(\frac{YW}{PW}\right)$$

$$+\underset{(12.45)}{0.1851}\ln(BEX) + \underset{(4.71)}{0.025}DUM94 \qquad \text{(A2.4a)}$$

$\bar{R}^2 = 0.94, \qquad DW = 2.37, \qquad [t - ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test : LR = 53.23(5\%\ critical\ value = 47.21)]$

Short run:

$$\Delta\ln\left(\frac{VX}{PX}\right) = \underset{(2.39)}{0.2315} + \underset{(3.10)}{0.6636}\Delta\ln\left(\frac{YW}{PW}\right)_{-1} - \underset{(-4.91)}{0.4647}\Delta\ln\left(\frac{PX}{PW}\right) - \underset{(-2.58)}{0.2405}DUM78$$

$$+\underset{(4.18)}{0.3154}\Delta\ln\left(\frac{VX}{PX}\right)_{-1} - \underset{(-2.82)}{0.4051}\left[\ln\left(\frac{VX}{PX}\right) - \ln\left(\frac{\hat{VX}}{PX}\right)\right]_{-1} \qquad \text{(A2.4b)}$$

$\bar{R}^2 = 0.81, \qquad DW = 3.49, \qquad \sigma = 0.083852 \qquad [t - ratios\ in\ parentheses]$

Breusch-Godfrey LM test (1)	Obs*R^2 = 1.7299	p=0.4210
Arch LM test (1)	Obs*R^2 = 1.1623	p=0.2813
White Hetroskedasticity test	Obs* R^2 = 16.608	p=0.2188
Normality test	Jarque-Bera =1.0386	p=0.5051
Chow (break point) test: 1994	F(6, 18) =0.1923	p=0.9446

A.2.5 Import Equation

Long run:

$$\ln\left(\frac{VM}{PI}\right) = \underset{(-4.86)}{-2.1311} + \underset{(11.21)}{0.4346}\ln(Y) - \underset{(-2.86)}{0.8851}\ln\left(\frac{PI*BEX}{P}\right)$$

$$+\underset{(6.80)}{0.3417}\ln\left(\frac{KI}{PI}\right) \tag{A2.5a}$$

$\bar{R}^2 = 0.74, \qquad DW = 3.03, \qquad [t-ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test: LR = 47.32(5\%\ critical\ value = 47.21)]$

Short run:

$$\Delta\ln\left(\frac{VM}{PI}\right) = \underset{(2.06)}{0.0423} + \underset{(2.82)}{0.8524}\Delta\ln(Y) - \underset{(-5.21)}{0.1685}\ln\left(\frac{PI*BEX}{P}\right)$$

$$+\underset{(5.20)}{0.5104}\Delta\ln\left(\frac{KI}{PI}\right) - \underset{(-4.76)}{0.3494}\left[\ln\left(\frac{VM}{PI}\right) - \ln\left(\frac{\hat{VM}}{PI}\right)\right]_{-1} \tag{A2.5b}$$

$\bar{R}^2 = 0.70, \qquad DW = 2.27, \qquad \sigma = 0.069122 \quad [t-ratios\ in\ parentheses]$

Breusch-Godfrey LM test (1)	Obs*R^2 = 2.8340	p=0.2421
Arch LM test (1)	Obs*R^2 = 0.3327	p=0.5644
White Hetroskedasticity test	Obs* R^2 = 12.809	p=0.5421
Normality test	Jarque-Bera =1.565	p=0.4571
Chow (break point) test: 1994	F(5, 20) =0.2915	p=0.8854

Bibliography

[1] Adam, Christopher S. (1991), " Financial Innovation and the Demand for £M3 in the UK 1975-86" *Oxford Bulletin of Economics and Statistics,* Vol. 53, No 4 (November 1991), pp 401-24.

[2] _____ (1992), "On the Dynamic Specification of Money Demand in Kenya", *Journal of African Economies,* vol 1, No2 (August, 1992), pp233-270.

[3] Agenor, P. and Montiel, P (1999) *Development Macroeconomics*, Princeton, NJ: Princeton University Press.

[4] Agenor, Pieere-Richard, (1990); "Stabilisation Policies in Developing Countires with a parallel Market for Foreign Exchange; A Formal Framework", *IMF Staff papers* Vol. 37. No 3, September.

[5] Amoako, K. Y. (1980), *Balance of Payments and Exchange Rate Policy: The Ghanaian Experience,* Garland: New York

[6] Arize, Augustine C. (1994), "A Re-Examination of the Demand for Money in Small Developing Economies", *Applied Economics,* Vol. 26, No. 3 (March 1994), pp 217-28

[7] Bahmani-Oskooee, Mohsen, (1991), "The Demand for Money in an Open Economy: The United Kingdom", *Applied Economics,* Vol 23, No. 6 (June 1991), pp 1037-42.

[8] Baumol, W. J (1952), "The transactions Demand for Cash: An inventory Theoretic Approach", *Quarterly Journal of Economics,* Vol 66, pp 545-56.

[9] Behrman, J.R and Hanson, J.A (1979), "The Use of Econometric Models in Developing Countries", in Behrman J.R., *National Bureau of Economic Research.*

[10] Buffie, E. (1999) "Public Sector Wage-Cycles and the Co-Movement of the Fiscal Deficit and Inflation in Less-Developed Countries", *Journal of Money, Credit and Banking* 31 (4): 785-810.

[11] Cagan, P. (1956) "The Monetary Dynamics of Hyperingflation", in M. Friedman (ed), The Qyantity Theory of Money and Other Essays, Chicago, IL: University of Chicago Press.

[12] Calvo, G., Leiderman, L. and Reinhart, C. (1996) "Inflows of Capital to Developing Countries", *Journal of Economic Perspectives* 10 (2): 123-40.

[13] Chibber, Ajay and N. Shaffik (1990), "Exchange Reform, Parallel Markets and Inflation in Africa: The Case of Ghana", World Bank Working Papers, No 427, May.

[14] Chibber, Ajay and Chad Leechor (1993), "Ghana: 2000 and Beyond", *Finance and Development*, World Bank, September.

[15] Connolly, Michael and Dean Taylor, (1979), "Exchange Rate Changes and neutralisation: A test of the Monetary Approach Applied to Developed and Developing Countries," "*Economica,"* 46, pp 281-294

[16] Cushman, D.O and Tao Zha, (1997), "Identifying monetary policy in a Small Open Economy under flexible exchange Rates". *Journal of Monetary Economics* 39, 433-448.

[17] Dekle, R. and M. Pradhan, (1997), "Financial Liberalisation and Money Demand in ASEAN Countries: Implications for Monetary Policy," IMF Working Paper No. WP/97/36 (Washington: International Monetary Fund, March 1997).

[18] Dickey, D.A, W. R. Bell and R.B.Miller (1986), "Unit Roots in Time Series Models: Tests and Implications", *The American Statistician*, Vol 40, pp 12-16.

[19] Dicky, D.A and W.A. Fuller (1979), "Distributions of the Estimators for Autoregressive Time Series with a Unit Root", *Journal of the American Statistical Association*, Vol 74, pp 427-31.

[20] Dordunoo, Cletus K. (1994), "The Structure and Policy Implication of a Macroeconomic Model of Ghana", *World Development,* Vol 22, No 8, pp 1243-1251.

[21] Engel R.F and C.W.J. Granger (1987), "Cointegration and Error Correction: representation, Estimation and Testing", *Econometrica,* Vol 55, pp 251-76.

[22] Fair, R.C (1984), Specification, Estimation, and Analysis of Macroeconometric Models, Havard University Press.

[23] Ghartey, E.E and Rao, U.C.L.G (1990), "A Short-run Forecasting Model of Ghana", *Economic Modelling, July.*

[24] Government Financial Statistics Yearbook, IMF, various issues.

[25] Gruen D.W.R and J. Dwyer (1995), "Are Terms of Trade Rises Inflationary?", Reserve Bank of Australia Research Discussion Paper No. 9508.

[26] Gylfason, T. and Schmid M. (1983), "Does Devaluation Cause Stagflation?", *Canadian Journal of Economics,* Vol XVI, No4, November.

[27] Harvey, A.C. (1980), "On Comparing Regression Models in Levels and First Differences", *International Economic Review,* 21, pp707-720

[28] Harvey, A.C., (1983), *The Econometric Analysis of Time Series,* Philip Allen.

[29] Hendry, D.H. (1993), *Lectures in Econometric Methodology,* Oxford University Press.

[30] Holly Sean and Martin Weale (2000), "*Econometric Modelling: Techniques and Applications*", Cambridge University Press.

[31] Huq, M.M. (1989), *The Economy of Ghana, The first 25 Years Since Independence*, Macmillan Press Ltd. London.

[32] Jorgenston, D.W. (1961), "The Development of a Dual Economy", *Economic Journal,* pp 71

[33] Khan, Moshin S, J Saul Lizondo, 1987, "Devaluation, Fiscal Deficits and the Real Exchange Rate", *The World Bank Economic Review,* Vol.1, No.2.

[34] Killick, Tony (1978), *Development Economics in Action: A Study of Economic Policies in Ghana,* Heinemann Educational Books: London.

[35] Klein, Lawrence (1965), "What Kind of Macroeconometric Model for Developing Economies", *Econometric Annal of the Indian Economic Journal,* Vol.13, No3.

[36] Klein, L.R. (1983), *The Economics of Supply and Demand,* Basil Blackwell: Oxford.

[37] Krugman, P. and Taylor, L. (1978), "Contractionary effects of Devaluation", *Journal of International Economics,* 8, August.

[38] Lipumba, N. B. Ndulu, S. Horton and A. Plourde (1988), "A Supply Constrained Macroeconometric Model of Tanzania", *Economic Modelling,* October.

[39] Marston, R.C., (1985), "Stabilisation Policies in Open Economies" in Jones, R. W. Kenen, P. B. (Eds) Handbook of International Economics. Vol II. Elsevier, Amsterdam, pp 859-916.

[40] Marwah, K. (1969), "An Econometric Model of Colombia: A Prototype Devaluation view", *Econometrica,* Vol. 37, No.2

[41] Moser, Gary G. (1995), "The Main Determinants of Inflation in Nigeria", *IMF Staff pepers* Vol 42. No 2, June.

[42] Mohsin, S. Khan, Peter Montiel, and Nadeem U. Haque, (1990), "Adjustment with Growth:-Relating the Analytical Approaches of the IMF and the World bank", *Journal of Development Economics* 32, 155-179, North Holland.

[43] Mohsin, S. Khan, and Malcom D. Knight (1982), "Some theoretical and Empirical Issues Relating to Economic Stabilisation in Developing Countries", *World Development,* Vol 10, No.9 pp 731-750.

[44] Musila, J. W (2002), "An econometric Modelling of the Malawian Economy", *Economic Modelling* Vol 19, 295-330

[45] Phillips, P. C and P. Perron (1988), "Testing for a Unit Root in Time Series Regression", *Biometrika*, vol 75, pp 335-46.

[46] Pinto, Brian, (1989), "Black Market Premia, Exchange Rate Unification, and Inflation in Sub-Saharan Africa", *World Bank Economic Review,* Vol 3. pp 321-38. September.

[47] Polak, Jacques J. 1957. "Monetary Analysis of Income Formation and Payments Problems" *IMF Staff Papers* 6 (November):1-50

[48] Pyndick, R.S. and D.L Rubinfeld (1991), *Econometric Models and Economic Forecasts,* Fourth Edition, McGraw-Hill International Editions.

[49] Quarterly Digest of Statistics, Republic of Ghana, various issues.

[50] Roe, Allan and Hartmut Schneider (1992), *Adjustment and Equity in Ghana,* Adjustment and Equity in Developing Countries, Development Center Studies, OECD.

[51] Sarpong, Daniel Bruce (1993), "A Growth Oriented Macroeconometric Model of Ghana" *The Economic Science,* Vol. 43, No 4, March., Nagoya University.

[52] Scarth, W. (1990), "Fighting Inflation: Are the Costs of Getting to Zero too High?", in R.C. York (ed) *Taking Aim: The Debate on Zero Inflation,* Cleveland, Ohio, Federal Reserve Bank of Cleveland, pp 81-103.

[53] Sowa, Nii Kwaku (1994), "Fiscal Deficits, Output Growth and Inflation Targets in Ghana", *World Development,* Vol. 22, No 8.

[54] Sundararajan, V (1986), "Exchange Rate Versus Credit Policy- Analysis with a Monetary Model of Trade and Inflation in India", *Journal of Development Economics* 20, 75-105. North Holland.

[55] UNCTAD (1968), *Trade Prospects and Capital Needs for Developing Countries,*U.N, New York.

[56] Van Wijnbergen, Sweder (1986) "Exchange rate Management and Stabilisation Policies in Developing Countries", in Edwards, S and Ahamed, L (eds) *Economic Adjustment and Exchange Rates in Developing Countries,* University of Chicago Press: Chicago.

[57] Van Wijnbergen, Sweder (1991), "Fiscal Deficits, Exchange Rate Crises, and Inflation", *Review of Economic Studies* 58 (1): 81-92.