# Contents

# Chapter 1

# A Small Macroeconometric Model of Trade and Inflation in Ghana

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**Abstract**

*This paper uses a conventional macroeconometric model to empirically investigate the effects of credit tightening and currency depreciation on trade and inflation in Ghana. Our main findings are as follows. First, the results corroborate the view of the International Monetary*

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*Fund that both depreciation and credit restraint are effective in addressing the balance of payments issues facing developing economies, such as Ghana. Second, depreciation of the domestic currency is unfavourable to the cause of curbing inflation in Ghana. It rather leads to price increases and could lead to spiraling inflation through the agitation of higher wages by employees. Third, depreciation of the domestic official exchange rate leads to a decline in the parallel market exchange rate premium, while increases in money supply causes the parallel market exchange rate premium to increase.*

## 1.1 Introduction

This paper presents an aggregate structural macroeconometric model to examine 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 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 the smuggling of imports and exports and the trafficking of currencies. A stabilisation program was initiated by the government in 1983 with the objective of achieving a positive overall BOP position and getting inflation under control. To achieve this objective the stabilization program took Ghana through several episodes of depreciation, as well as the implementation of stringent policies to reduce the fiscal and current account deficits. These notwithstanding the macroeconomic problems confronting Ghana worsened due in part to general global instability such as substantial fluctuations in commodities prices in the world market accompanied by sharp increases in the price of energy, energy products, and some essential raw materials.

Using data for Ghana over the period 1970-2000, we estimate a small macroeconometric model to analyze the inflationary and BOP issues confronting the country. Specifically, the model is used to compare the dynamic responses of trade and inflation to depreciation with the responses to tight monetary policy.

This chapter contributes to the literature on Ghana in at least three main respects. First, we present new results from estimating a macroeconometric model of trade and inflation for the pe-

riod 1970-2000, which has not been previously studied in the literature. Second, this is the first study to empirically investigate the dynamic effects of depreciation and credit restraint (tight monetary policy) as policy options used to address the BOP issues in the Ghanaian economy. Third, we have taken into account the fact 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. Commercial transactions are settled partly using the official market exchange rate and partly at the parallel market exchange rate. Consequently, the exchange rate premium between the parallel market exchange rate and the official market exchange rate has been endogenised to help identify the potfolio determinants that have important influence on the premium both in the short and longer run.

The trade equations of the model have been formulated to underscore the fact that Ghana is a small open economy and therefore a price taker in the world commodity markets. The export equations therefore depend solely on relative prices. The desired holdings of domestic and foreign currencies is assumed to depend on both transaction motives and portfolio considerations. 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: gross national income as the scale variable; the expected rate of inflation, which is believed to affect the short run behaviour of money demand; and changes in the cedi-US dollar exchange rate at the parallel market to represent currency substitution. In the money supply equation, we have net credit to commercial banks, net claims on the government, the government's net foreign assets and other assets. We treated these as identities, and allowed the money multiplier to be determined in equilibrium by the relationship between the supply of money and the demand for money (M2). The derivation of the price equation also takes into

account both foreign and domestic 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 two assets (money and foreign exchange). The model simultaneously determines prices, balance of payments, and money supply, but assumes that output is exogenously determined as was the case in the International Monetary Fund's (IMF) stabilization model for developing economies.

The major empirical findings are summarized as follows. Inflation in Ghana is partly internationally transmitted. Since most importers obtain their foreign exchange at the parallel market rate, any depreciation in that rate has an immediate effect on domestic prices. Our results show that domestic structural factors are a major contributing factor causing inflation in Ghana. However, it is also partly a monetary phenomenon.

According to the moel simulation results, a depreciation leads to higher inflation. This eventually leads to a reduction in the demand for real cash balances of agents as a result of the higher opportunity cost of holding money. The trade balance improves because the positive relative price effect is smaller than the negative liquidity effect. A percentage reduction in broad money (M2) is able to produce an improvement in the trade balance. Also, the medium term effects are mild for the broad money reduction experiment as compared to those resulting from the depreciation. Overall, the results suggest that a reduction in money supply should be preferable to depreciation of the domestic currency as a policy option to improve a worsening BOP position and to reduce higher inflation rates.

The remainder of the paper is organized as follows. Section 2.0 introduces inflation and looks at some existing work on inflation in Ghana. We formulate the general price equation in Section 3.0. We discuss and formulate our equations for the financial sector, parallel exchange

rate premium, exports, imports, unit price of exports and unit price of imports in Sections 3.1 to 3.4. The estimation results are discussed in Sections 4.3. Section 5.0 analyzes the simulation results based on alternative policy scenarios. Section 6.0 offers some concluding remarks and draws policy implications for macroeconomic management in a developing country with a parallel foreign exchange market.

## 1.2 Inflation in Ghana

There is little agreement on what constitutes an optimal rate of inflation apart from stating that it should be low. Gavin (1990) posits that inflation is a major evil, and argues that monetary policy (or monetary reform) should be geared towards its outright 'elimination'. Some other economists argue that reducing inflation would reduce output and employment and that this cost would more than offset any gains from establishing price stability ( e.g. Fortin, (1990) and Lucas (1990)).

In the economics literature, inflation may be grouped as hyperinflation or chronic inflation if the monthly inflation rate exceeds 40% (by Cagan's criterion). Végh (1992) argues that hyperinflation consists of 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 that 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 also plays an important role in inflation persistence, both directly and indirectly, by transmitting exchange rate movements to domestic prices. In addition, they have observed that in some countries, the frequency at which nominal wages adjust tends to increase with the inflationary pressures generated by exchange rate movements, thereby raising inflation.

Any shortening of price adjustment interval may become another source of inflationary pressure, if the stance of monetary policy remains accommodative. This can also be reflected in domestic food prices, notably, in developing countries (particularly in Sub-Sahara Africa) where food items comprise the bulk of the goods included in the consumer price indices.

Since the literature on price determination is very large, we focus our analysis on two main views of general price determination: the monetarists and 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 in 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 number of 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 (1990) could not find

empirical support for the assertion that the rate of depreciation of the domestic currency had a significant impact on domestic inflation. Other studies, including Sowa and Kwakye (1993), suggested that inflation in Ghana is due mostly to real factors. In this study, we have assessed the major causes of inflation in a general sense by using an empirical model which allows for both structural and monetary factors to influence inflation in Ghana. The methodology adopted in this study draws extensively on the approach used by Agenor and Montiel (1990) for some developing countries and Moser (1997) for price determination in Nigeria.

## 1.3 Derivation of the Price Equation

A closer look at the Ghanaian economy shows that Ghana enjoyed price stability during the early 1970s. Signs of inflationary pressures in the country started in 1975 when the consumer price index rose to an average of 50 percent per annum, reaching a peak of 123 percent in 1983. However, inflation reduced drastically following the introduction of the Economic Recovery Program (ERP). Recently, price pressures have built up again hovering around an average of 50 percent per annum over the past decade.

Regarding the causes of inflation in Ghana, it is noteworthy that excessive public sector spending which necessitated increases in money growth may have generated this inflationary pressure in the country. It is argued that increased government spending stimulated growth in aggregate demand which contributed to worsening supply shortages, and lead producers to raise prices, (see Sowa, 1994).

A critical analysis of Table 4.1 shows that the government budget has been in deficit throughout the 1970s as a result of increased government spending. The government, throughout this

period, relied heavily on domestic financing by borrowing from the Central Bank and the domestic non-banking sector. We can see from the last column in Table 4.1 that since the introduction of the ERP in 1983, financing of excessive government spending has been through domestic and foreign borrowing.

Table 4.2 shows the pattern of money supply and the corresponding sources of those changes. It is evidently clear from the data that between 1984 and 1994, growth in the broad money supply was moderated by the decrease in Net Foreign Assets (NFA), while credit to the government caused the money supply to grow annually. This is consistent with the notion that growth in the money supply, as a result of excessive government spending, may have led to the sharp increases in the rate of inflation in Ghana.

It is also noteworthy that a significant portion of the total supply of goods and services in Ghana is derived from imports. Import prices are, thus, expected to have a large influence on the domestic prices. Specifically, changes in import prices of raw materials and intermediate goods (due for instance to changes in the prices of crude oil) affect the prices of finished goods through their influence on costs, especially where the imported materials enter into the domestic production of these goods. In addition, changes in foreign prices may affect the prices of domestically produced goods through their effects on domestic industries. These links between import and domestic prices are expected to play an important role in the transmission of inflationary pressures from abroad into the Ghanaian economy.

Apart from the factors mentioned above, there is also the situation whereby wage earners adjust their inflationary expectations such that they exert important influence on the movement of consumer prices. Hence the frequency at which wages are adjusted could also be an influential factor. Following the discussion above, a number of alternative specifications for the general

price equation were explored. The final form of the price equation was formulated as:

$$APO_t = F_1 \left[ \underset{+}{AMEY_t},\ \underset{+}{APIM_t},\ \underset{-}{AYEMP_t} \right] \tag{1.1}$$

where $APO_t = Ln(P)_t$, and $P_t$ is the GDP deflator; $AMEY_t = Ln\left(\frac{M^s}{GDP}\right)_t$, $M_t^s$ is broad money supply, $GDP_t$ = gross domestic output; $APIM_t = Ln(PM_t * E_t)$, $PM_t$ is the import price index, and $E_t$ is the official market exchange rate; and $AYEMP_t = Ln\left(\frac{GDP_t}{EMP_t}\right)$ is output per employee, a proxy for productivity, $EMP_t$ is total number of persons employed.

## 1.4 Financial Sector

Before the 1970s financial factors did not play any major part in macroeconometric models. In the early models, which in the United States were very much in the Keynesian tradition, financial factors affected the real economy through the influence of interest rates on expenditures, with little attention being paid to the financial implications of credit flows in the economy. The transition from fixed to more freely floating exchange rates since the early 1970s and the widespread adoption of target-oriented monetary policies has placed increasing emphasis on the role of money in the determination of real output and prices. Hence macroeconometric modelling would now be considered seriously incomplete if it did not contain a domestic monetary sector.

Historically, the functioning of the financial system in Ghana has been heavily regulated. The general objectives of the regulatory policies remained until the early 1980s relatively unchanged, although the details of banking regulations have varied over time. Some of the regulations were designed to channel credit into uses which were deemed desirable from the point of view of the Government's specific social and economic objectives, while others were aimed at

meeting the requirements of fiscal policy. The government's financing needs continued to dominate the conduct of monetary policy in the 1990s. The instruments employed by the monetary authorities to pursue these goals comprised direct controls over credit aggregates and the allocation of credit, restrictions on the portfolio policies of commercial banks, and the regulation of interest rates which financial intermediaries were allowed to pay on deposits and to charge on the various types of loans.

During these last few years, a number of measures have been taken aimed at deregulating the credit and banking system, including the liberalisation of most interest rates, the lifting of a number of specialised credit rules and direct controls and the reduction of the administrative allocation of bank deposits. However, despite the increased degree of liberalisation, the Ghanaian banking system is still characterised by extensive controls of the costs, volume and direction of financial flows, as well as excessive concentration and direct government intervention.

The financial system in Ghana[3] may be categorized into three main sectors: (i) an organised sector that comprises the Central bank and the commercial banks, (ii) a traditional sector that embodies the traditional market where informal credit creation is the main function, and (iii) a capital market consisting of the Stock Exchange and the National Trust Holding Company. Including the financial sector in the model is important because money plays a pivotal role in a developing economy through the above mentioned financial intermediaries. It is important to

[3]One main feature of the Ghanaian financial system is that the banking system performs an important role in the process of financial intermediation. The dominance of the banking system reflects the underdeveloped nature of the capital market, the preference of the private sector for highly liquid or low risk assets, and the limited role of other financial intermediaries. While an organised capital market exists in Ghana, its scope is limited. Although a number of measures have been taken over the years to foster its development, the market remains narrow. In addition, no regular over-the counter market for securities operates for their capital requirements. Nor for that matter does an organised money market exists. Even short term financial instruments, such as negotiable bankers acceptances, certificates of deposit and directly placed commercial paper are of negligible amounts or do not exist. And until recently short term government securities were not sold at auction. At present the banking system comprises, besides the Central Bank, a number of commercial banks including several branches and several specialised credit institutions.

stress the contribution that these intermediaries can make towards raising the rate of savings, channelling them into productive investments , and generally providing the amount of liquidity needed for economic development. 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. 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 bureaux and non-financial institutions, and recently an EXIM-GUARANTEE Company[4].

In the formal sector, interest rates were controlled by the central bank and were institutionally determined for a large part of the sample period. The Bank of Ghana fixed interest rates and then asked commercial banks to adjust both their lending and deposit rates in accordance with a given band within which they could operate. Consequently, the interest rate is treated as exogenous in our model. The money demand equation is split into two equations: the demand for narrow money $(AMIP)_t$ and the demand for Quasi-Money (time and savings deposits) $(AQIM)_t$.

In line with basic theoretical considerations[5], the demand for narrow money $(AMIP)$ is thus, formulated to be a function of gross national income $(ZGNI_t)$ and the expected inflation

[4]These institutions help to provide unlimited credit to the government and the private sector and also offer economic and advisory services to the government. The issues pertaining to informal credits have been well documented by Killick (1996). He argued that a special loan scheme exists in rural Ghana, especially the cocoa growing areas. The need for credit arises because cocoa growing is a perennial activity and hence cocoa trees are acceptable forms of collateral by these lenders. Hence in most instances, cocoa farms are pledged as collateral 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. Because 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 C200 and agree to pay C500 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.

[5]see Adam (1992) for the theoretical specification of the equation for the demand for money.

rate ($INF_t^e$). Expected inflation, which measures the cost of holding money in terms of real assets is proxied by the past inflation rate ($ADIP_{t-1}$). The use of expected inflation rate as the proxy for the opportunity cost of holding money in terms of real assets is because there are no active stock markets in the country where agents could freely choose to invest in bonds or equities. In addition to the above, current changes in the parallel market exchange rate ($\Delta ABEX_t$), has been added to reflect the opportunity cost of holding the domestic currency as opposed to a foreign currency. On the choice of the appropriate deflator for this equation, we used the consumer price index in line with the suggestion by Adam (1992). By this formulation we have also taken into consideration the long-run price homogeneity assumption. The equation for the demand for currency is therefore formulated as:

$$(AMIP)_t = F_2\left(\underset{+}{ZGNI_t}, \underset{-}{ADIP_{t-1}}, \underset{-}{\Delta ABEX_t},\right) \tag{1.2}$$

where $(AMIP)_t = Ln\left(\frac{M1}{CPI}\right)_t$, $M1$ is narrow money supply, $CPI_t$ is consumer price index (1995=100); $ZGNI_t$ is the logarithm of real gross national income; $ADIP_{t-1} = \left[\frac{CPI_{t-1}-CPI_{t-2}}{CPI_{t-2}}\right]$, and $ABEX_t = Ln\left(BEX_t\right)$, where $BEX_t$ is the parallel market exchange rate; and $\Delta X_t = X_t - X_{t-1}$.

Similarly to narrow money, Quasi Money (time and savings deposits) is modeled as a function of real national income ($ZGNI_t$), expected inflation rate ($ADIP_{t-1}$), and the changes in he parallel market exchange rate $\Delta ABEX_t$. The equation is expressed as follows:

$$(AQIM)_t = F_3\left(\underset{+}{ZGNI_t}, \underset{-}{ADIP_{t-1}}, \underset{-}{\Delta ABEX_t}\right) \tag{1.3}$$

where $(AQIM)_t = Ln\left(\frac{QM}{CPI}\right)_t$, $QM$ is time and savings deposits held by the public. All

other variables are as defined previously.

## 1.5 The Parallel Market Exchange Premium

Ghana has operated a relatively open trade and payments regime since independence in 1957. However, as a result of substantial foreign exchange controls, quantity restrictions as well as the fixed exchange regime, the country has witnessed the emergence and growth of a parallel market for foreign exchange, amidst smuggling of imports and exports of goods and services. The importance of the exchange rate on the illegal parallel market grew rapidly as the official exchange rate remained stagnant throughout the entire 1970s. By 1983, while the parallel market rate was 76.58 cedis to one US Dollar, the official exchange rate was only 2.75 cedis to a US dollar. The development of a dual exchange rate is common to many developing countries. However, Ghana's case remain particularly interesting considering its size and the voluminous literature that has emerged since the introduction of economic reforms, with the view to explaining the factors responsible for the widening parallel market exchange premia. Indeed, there appears to be a surge in both theoretical and empirical studies of the exchange rate premia in Ghana since the introduction of the ERP in 1983 when Ghana shifted from the pegged exchange rate regime to a more flexible but still managed exchange rate. However, there is no consensus among various studies over the modelling of the exchange rate premia in the country. A comprehensive survey of the main strands of studies in the exchange rate determination is provided by Dornbusch (1980) and Macdonald and Taylor (1989). Also Garganas (1992) has shown that the difficulty in modelling exchange rate emanates from the fact that exchange rate regimes do not conform to the paradigm of either a completely fixed regime or freely floating

regime. These created problems for macro model builders particularly in the 1970s, hence most macro models treated the exchange rate variable as exogenous in their models.

In Ghana problems of modelling the exchange rate are compounded by the fact that the official exchange rate remained policy determined over relatively long period. As the policy makers objective shifted over time so it made the task of determining exchange rate movements very difficult. For instance for certain periods of time the policy makers have attempted to maintain external competitiveness by a policy of gradual effective depreciation of the cedi to compensate over time for inflation differentials between Ghana and its main trade partners. At other times they gave greater attention to anti-inflationary objectives when determining their exchange rate policy. Consequently, the official exchange rate depreciated at a significantly slower pace resulting in an appreciable loss of competitiveness. Throughout the 1970s and early 1980s, the cedi remained highly overvalued and served as a disincentive to exporters, thus leading to growth in the parallel market activities. Like most developing countries, activities in the parallel market became so large throughout the 1970s and led to capital flights and balance of payments problems.

During the period 1970-1982, the premia between the parallel market exchange rate and the official exchange rate rose massively to over 300 percent, but the gradual depreciation of the cedi at the inception of the ERP in 1983, helped to bring the premium down gradually.

Among the studies on Ghana that attempted to determine the determinants of the parallel market premia in Ghana are Chibber and Shaffik (1991). Their study was over the period 1965-1988, and find that the premia is caused by the real effective official exchange rate, with devaluation of the official rate leading to a reduction in the premia. They also contend that interest rate parity between Ghana and its major trading partners is a factor with a widening

differential causing an increase in the premium.

Gyima-Brempong (1992) cited in Aryeetey et al (2000), using quarterly data over the period 1972-1987 noted that it was the "official devaluation of the cedi as well as exchange control law enforcement that affects the widening of the premium". According to this study, "increased enforcement and policing of exchange rate laws decreases the supply of foreign exchange to the black market more than it decreases demand".

Islam and Wetzel (1994) in their study over the period 1969-1987 also show that it is fiscal deficits in Ghana that lead to the increase in parallel market premium. They argue that increased government consumption of tradeable goods reduces the supply of foreign currency to the private sector, and then pushes up the parallel market price of foreign exchange.

Aryeetey, Harrigan, and Nissanke (2000) conducted a similar study to that of Chibber and Shaffik (1991) on Ghana over the period 1963-1991 and argued that the main source of financing for parallel market activities is through over invoicing of imports and under invoicing of exports. Hence, they found a highly significantly negative relation between the parallel market premia and the ratio of exports to GDP.

In this study we have drawn, extensively, on Dornbusch et al (1983) who estimated a simple version of the parallel premium using a stock flow model. This model incorporates both portfolio and trade determinants of the parallel market premium. Here the portfolio determinant is the stock of domestic monetary assets measured in dollars at the official exchange rate $(M2/E)_t$. It is believed that any increase in money supply creates an attractiveness for foreign assets, and this appear to lead to excess demand for foreign currency at the parallel markets and thus raises the parallel market premium. He used interest rate parity $(IPD)_t$ as an additional explanatory variable, but this variable did not perform well in our model. We have thus deleted it from

the estimation. A rise in the domestic money stock measured in foreign exchange implies that there exists an excess relative supply of domestic assets denominated in cedis and hence would lead to a rise in the parallel market premium.

The real effective official exchange rate $(PW * E/P)_t$ is used as a proxy for the trade determinants. The $(PW * E/P)_t$ variable assumes that in the long run a real appreciation reduces overall exports (including unofficial exports). This would increase the value of the premium as it increases the smuggling of imports. The net effect of a real appreciation is therefore to worsen the unofficial trade balance for any given level of the parallel premium.

This study extends the study of Dornbusch et al (1983) by including the terms of trade $(ATOT)_t$ and also official aid flows proxied by the net external debt, otherwise known as net official debt inflows, $(AVAID)_t$. The inclusion of the $AVAID_t$ variable could be likened to an FDI inflows into the domestic economy. Since the era of high parallel market exchange rate premium was considered as an unattractive period fo foreign inflows, one expects that the current liberalisation program, which has led to the narrowing of the parallel merket premium should have a positive attraction to national external debt flows. Our formulation is similar to the study of Kaufmann and O'Connell (1991). The exchange rate premium is thus expressed as a function of:

$$ZPREM_t = F_{19}\left[\underset{+}{ARER_t},\ \underset{-}{AVAID_t}, \underset{-}{ATOT}, \underset{+}{AVM2E_t}\right] \tag{1.4}$$

where $ZPREM_t = Ln\left(\frac{BEX}{E}\right)_t$ is parallel market exchange rate premium, $E_t$ is the official market exchange rate; $ARER_t = Ln\left(\frac{PW*E}{P}\right), PW_t$ is the USA wholesale price index; $AVAID_t = Ln\left(EDEBT\right), EDEBT_t$ is total external debt; $AVM2E_t = Ln\left(\frac{M2}{E}\right)_t$.This vari-

able represents stock of domestic monetary assets measured in US dolars at the prevailing official exchange rate; and $ATOT_t = Ln\left(\frac{PX}{PM}\right)$, $PX_t$ is export price index, and $PM_t$ is import price index.

## 1.6 The Export Equation

The modelling of foreign trade for a small open country such as Ghana is very important because of its significant role in determining domestic economic activity. The foreign sector has been very important since it is the main source of foreign exchange earnings. This sector assumed special significance since the introduction of the ERP when floating exchange rates were introduced. The effect was clearly visible because of the important role played by the balance of payments (current account plus capital flows) in determining movements in the exchange rate which in turn affects prices and hence real domestic income. In fact as a result of the country's dependence on foreign trade, any major development or problem in the world economy such as declining levels of commodity prices and rising crude oil prices has a significant impact on its domestic economy. In this study we estimate the following three export equations: (i) exports of cocoa (ii) exports of gold, and (iii) other merchandise exports.

We formulate the cocoa exports equation as follows:

$$ACOV_t = F_4\left(\underset{+}{APCOCP_t}\right) \tag{1.5}$$

where $ACOV_t = Ln\left(COV\right)_t$, $COV_t$ is the volume of cocoa exports; $APCOCP_t = Ln\left(\frac{PCOC*E}{P}\right)$ is defined as the world cocoa price ($PCOC_t$) multiplied by the exchange rate $E_t$ and deflated by the domestic price level ($P_t$). It is expected that when the price of domestic tradable goods

(such as maize, cola, coffee, etc) increases most of the cocoa farmers go to the extent of felling cocoa trees and shift into the cultivation of new crops. Since the small open economy assumption is assumed, world income does not appear as an explanatory variable in the export equation. In addition, the response of exports to demand is likely to be very small. This is partially due to the long gestation periods associated with production of the country's principal exports which causes a slow response to any changes in demand. Besides, most of the primary exports are exhaustible resources such as minerals. 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. The total volume of gold exports is given by:

$$(AGVOL)_t = F_5 \left[ \underset{+}{ABEX_t},\ \underset{+}{GOLP_t} \right] \tag{1.6}$$

where $AGVOL_t = Ln\left(GVOL\right)_t$, $GVOL_t$ is the volume of gold exports; $ABEX_t$ is as defined previously; and

$GOLP_t = Ln\left(PGOLD\right)_t$, $PGOLD_t$ is the world price of gold.

The total real value of other merchandise exports ($LEXO_t$) is formulated in terms of relative world prices as follows:

$$LEXO_t = F_6 \left[ \underset{+}{(APWEP)} \right] \tag{1.7}$$

$LEXO_t$ is defined as $Ln\left(\frac{othex}{PX}\right)_t$ where $othex_t$ is the value of residual merchandise exports including non-traditional items; $APWEP_t = Ln\left(\frac{PW*BEX}{P}\right)$. All other variables are as defined previously.

We thus derive the total real value of exports ($XGV_t$) as:

$$GVEX_t = LEXO_t + Ln\left[\left(\left(COV_t * PCOC_t\right)/PX_t\right) + \left(\left(GVOL_t * GOLP_t\right)/PX_t\right)\right] \quad (1.8)$$

Total value of exports is given as:

$$XGV_t = EXP\left[GVEX_t\right] \quad (1.9)$$

## 1.7 Imports Equation

Empirical studies on the determinants of imports for Ghana is voluminous. However, none of these studies focused on the behaviour of Ghana's aggregate import and the main components of final expenditure. In the case of the UK, a recent paper by Abbot and Seddighi (1996) investigated the behaviour of UK aggregate import and argued that there is a long run relationship between aggregate imports and the main components of final expenditure. This section attempts to replicate the above study but with annual data. We thus, try to provide an analysis of the determinants of Ghana's aggregate import by following the traditional approach based on full competition on the market for imported goods and services.

There are three main determining factors for a country's demand for imports. These are; the final expenditure of a country which consists of consumption expenditure by the households and the government, investment expenditure that includes gross domestic fixed capital formation and the change in inventories, and thirdly, expenditure on exports. Household consumption expenditure refers to the value of final consumption expenditure on goods and services by households and private non-profit institutions serving households. It is calculated as the sum

of expenditure on consumption goods and services in the domestic market and consumption expenditure of residents abroad, less the expenditure of non-residents, such as visitors, in the domestic market. Government consumption expenditure refers to the recurrent expenditure on goods and services by the government and public corporations.

Gross domestic fixed capital formation covers the gross value of investment expenditure on machinery, equipment and computer software as well as building and construction; and costs of ownership transfer. A change in stocks refers to the value of physical change in the stocks of work-in-progress, raw materials and finished goods held by businesses mainly manufacturers and distributors.

Thirwall and Gibson, 1992 also argue that another major determinant for the demand for competitive imports is the ratio of the price of imports to the price of domestic substitutes. They argue further that if there is a decrease in the price of domestic substitutes relative to the price of imports then there will be a decrease in the demand for imports. This is because foreign goods are sold at exogenously given prices, as the developing economy cannot influence the price of foreign goods. However, the price of domestic goods are viewed as flexible and so can be altered to eliminate any excess demand in the country.

The third factor is related to the ability of a country to manufacture and provide for the goods it requires by itself. This is well captured through revenue generated from exports, (Thirwall and Gibson, 1992).

Conventionally, the imports equation is formulated as a function of real domestic income and the relative price of imports. Thus the typical imports demand equation can be written as

$$IMPV_t == F_7\left[\underset{+}{D_t}, \left(\frac{PM_t.E}{P_t}\right)_{-}\right] \tag{1.10}$$

where $IMPV_t = Ln\left(IM\right)$, $IM_t$ is the volume of imports, $PM_t$ is the unit price of imports, $E$ is the exchange rate $D_t$ is a real domestic demand or income variable $(GDP)_t$. Following the study by Abbot and Seddighi (1996), we have disaggregated the real domestic demand variable into the main components of final expenditures to help capture the main determinants of Ghana's aggregate imports. This allows us to investigate the long run equilibrium relationship between aggregate imports and its main determinants. A country's demand for imports depends on: (i) the final expenditures of a country which consist of consumption expenditures by households and the government, (ii) investment expenditures that include gross domestic fixed capital formation and the change in inventories, and (iii) expenditures on exports. Another factor relates to the ability of a country to produce and to provide for its imports. This can be captured through revenues generated from exports, (Thirwall and Gibson, 1992). Among successful studies in this area for the United Kingdom are Thirwall and Gibson (1992). Hence the estimated equation for the volume of imports is of the form:

$$(IMPV_t) = F_8\left[\underset{-}{APGC_t}, \underset{+}{AGFC_t}, \underset{-}{APIM_t}, \underset{+}{AEX_{t-1}}\right] \tag{1.11}$$

where:

$IMPV_t = Ln\left(\frac{IM}{PM}\right)_t$, $IM_t$ is the volume of imports;

$APGC_t = Ln\left(\frac{PC+GC}{P}\right)$, $PC_t$ is private consumption expenditures, $GC_t$ is government consumption expenditures,

$AGFC_t = Ln\left(\frac{GFCF+BILL}{P}\right)$, $GFCF_t$ is expenditures on gross domestic fixed capital for-

mation, and $BILL_t$ is change in inventories;

$APIM_t = Ln((PM_t * E)/P_t)$, the relative price of imports; and

$AEX_{t-1} = Ln\left(\frac{XGV_{t-1}}{PX_{t-1}}\right)$ expenditures on exports lagged one period during delays in getting export proceeds.

From standard demand theory, we expect the partial derivative of the demand for imports with respect to the price of imports to be negative. In other words, a rise in import prices would result in a decrease in demand as imports become more expensive. The effect of real income on the demand for imports is expected to be positive. Real imports are 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.

The total value of imports ( $IMP_t$) is then given by

$$IMP_t = EXP\left[IMPV_t\right] * PM_t \tag{1.12}$$

where $IMPV_t$, and $PM_t$ are as defined above.

## 1.8 Unit price of exports and imports

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

The following identities close the model:

## 1.9 Balance of Payment identity

$$R_t = \Delta NFA_t = TB_t + \Delta PKI_t + OTH_t \tag{1.13a}$$

where $BOP_t$ is the balance of payment, $\Delta NFA_t$ is change in net foreign assets,

$$TB_t = XG_t - IMP_t \tag{1.14}$$

is the trade balance, $\Delta PKI_t$ is the change in capital flows, and $OTH_t$ is other items including net errors and omissions .

External capital flows ($PKI_t$) are treated as exogenous. The balance for official financing is the sum of the current balance and capital account flows (plus net errors and omissions). These flows together with the change in public sector external debt are used to form the Bank of Ghana's net foreign assets which then feed into the monetary base to determine the monetary aggregates as well as sectoral credit flows.

## 1.10 Money Supply identity

$$M_t^s = K_t * (RM_t) \tag{1.15}$$

where $K_t$ is the money multiplier. $RM_t$ is reserve money given by:

$$RM_t = NFA_t * E_t + NDA_t \tag{1.16}$$

$NDA_t$ is net domestic assets.

## 1.11 Estimation Results

### 1.11.1 Unit Root Test

Before proceeding to estimation, we start by determining the time series properties of the variables in each equation of the model. The tests for unit roots cover the estimation period 1970-2000 except for the exchange rate premium equation which was estimated over the period 1983-2000. The ADF tests was aplied to the whole sample; choosing the correct sequential testing procedure to allow for the possible presence of multiple roots; using Peron's approach (Perron 1988) of including dummy variables to allow for structural breaks at specific dates; and finally using the sequential trend-break statistic of Bernajee et al (1992) to avoid imposing the date of the break. Outcomes of the entire unit root tests results are shown in Table 3. Both the ADF and the Phillips-Perron (PP) unit root tests used to investigate the stationarity status of each variable show that the variables under investigation each has a unit root against the alternative that they do not. We conclude from the unit root tests for the whole sample that almost all endogenous variables in the model are non-stationary in levels, but stationary after first diffirencing; the only exceptions are $AINF_t$, and $ZPREM_t$ which are I(0).

### 1.11.2 Test for cointegration

If two or more series exhibit a stochastic trend individually, the question arises whether they share a common stochastic trend. If they do then they are cointegrated; and under cointegration the series would move together over time after exogenous shocks suggesting that there exists a long run equilibrium relationship among them. The cointegration test results perofrmed on the residuals of the OLS estimations of the individual equations in the model are also reported

in Table 3. The computed ADF statistics show that the residuals are stationary. Therefore, based on the two step Engle -Granger cointegration test we conclude that there is a long-run equilibrium relationship between the dependent variables and the explanatory variables in the model. Table 3(b) reports the Johansen cointegration tests which include both the maximum eigenvalue ($\lambda_{\max}$) and the trace statistics, as well as the $\lambda$ values. Indeed we should not expect that the EG and Johansen cointegration tests would yield the same results. However, this difference is not unexpected since the two procedures are different techniques. While the Engle-Granger cointegration test uses ordinary least squares to estimate the cointegration vectors and the ECM in two separate steps, the Johansen method uses the maximum-likelihood procedures and estimates jointly the cointegration vectors and the ECM. The Johansen test results also suggest that the dependent variables are cointegrated with their explanatory variables. We thus proceed to give the economic interpretation to the results.

### 1.11.3 Economic Interpretation of results

Econometric studies have suggested that conventional regresion output be supplemented with a battery of diagnostic tests. In order to check the robustness of the results to ascertain whether or not the model is correctly specified, whether the errors are uncorrelated but not necessarily homocedastic in estimation, and that the model is structurally stable for inferences, it is essential to test these assumptions. To accomplish this goal we performed the serial correlation (LM), autoregressive conditional heteroscedasticity (ARCH), and Jarque-Bera non Normality tests. These results show no evidence of diagnostic misspecification, and thus lends credence to the empirical findings.

### 1.11.4 Prices

The long run price equation, $(A2.1a)$, shows that the general price index is a decreasing function of the labour productivity variable, but is an increasing function of the broad money to GDP ratio, as well as the price of imports (adjusted by the foreign currency premium rate). The results show that labour productivity exerts the largest negative impact on the domestic price level. This result supports the assertion that structural factors have a very important effect on inflation in Ghana. All the other variables have the expected coefficient signs and the various t-ratios are highly significant at the 0.05 level. In the long run, the explanatory variables together explain about 88 percent of the variation in the dependent variable as indicated by the adjusted $R^2$.

The results show that a percentage increase in broad money to GDP ratio would lead to a 0.65% increase in the price level in the long run. However, in the short-run equation $(A2.1b)$, a percentage change in this variable would lead to 0.40% increase in inflation. The results also show that both the depreciation of the exchange rate in the parallel market as well as import prices have positive and significant effects 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, as the parallel exchange rates is more volatile than official exchange rate, 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 $APIM_t$ the indicator for the parallel market rate and import prices would lead to 0.21% increase in domestic prices in the long-run. In the short-run, a percentage change in this variable would lead to an increase in inflation by 0.18%. This points to the

fact that the continuous depreciation of the exchange rate, coupled with increases in import prices, have contributed to the rapid upward movement in domestic prices in the country. As expected, the coefficient on the disequilibrium variable in equation $A2.1b$, $(ECP_{t-1})$ is negative and significant. It shows that the speed of adjustment to the long-run equilibrium in prices is 30% per annum. We also tested whether improved rainfall significantly reduces inflation (see Sarpong, 1995) but found that this variable was not significant. Our results confirm that inflation in Ghana is predominantly caused by structural factors, though growth in the money supply is equally a contributory factor.

### 1.11.5 The Demand for Money

Our ADF and Perons tests suggest that $AMIP_t$,and $ZGNI_t$ are integrated of order 1, but $ADIP_{t-1}$, and $\Delta ABEX_t$, are I(0), (see Table 4.3). The Johansen test for cointegration shows that $AMIP_t$ is cointegrated with the explanatory variables. The Engle and Granger (1987) cointegration test further supports this conclusion with a test value of ....., significant at the 95% level. We found similar results for the demand for real quasi money. The unit root tests show that $AQIM_t$, and $ZGNI_t$, are integrated of order 1, while $ADIP_{t-1}$and $\Delta ABEX_t$ are I(0). We also established a cointegration relationship between $AQIM_t$ and its explanatory variables. The Engle and Granger (1987) cointegration test further showed that $AQIM_t$ is cointegrated with the series with a test of ..... significant at the 0.05 level.

The estimated equations of both the demand for real narrow money and real time and savings deposits, $(A2.2a)$ to $(A2.3b)$, performed quite satisfactorily. All the explanatory variables have the expected signs and are significant at the 5 percent level or better. The adjusted $R^2$ value for the long run equation is 0.79. Equation $(A2.2a)$ shows that the demand for currency

depends positively on real national income ($XGNI_t$) but is negatively related to the parallel market exchange and inflation . We find that a percentage increase in real income results in an increase of 1.14% in the demand for real narrow money. Tseng and Coker (1991) report income elasticities 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. The long run equation shows that the elections of 1992 as well as the military change over in 1976 had positive and significant effects on the demand for currency in Ghana.

In addition, a unit change in inflation (a unit increase in $ZCPI_t$) generates a 0.35% decrease in the demand for narrow money. Furthermore, the rate of currency substitution, which is proxied by the inclusion of the parallel market exchange rate, is negative and significant with a partial elasticity of 0.22. In the short run equation ($A2.2b$), our results show that a percentage change in the parallel foreign exchange rate leads to a shift out of domestic narrow money balances by 0.30%, while a percentage change in real income ($ZGNI_t$) leads to a 0.29% change in the demand for real narrow money contemporaneously. The disequilibrium variable ($ECM1$) is negative and significant with a speed of adjustment to the long-run equilibrium of 17%. In the short run, both the 1992 elections and the introduction of the ERP in 1983 have had a positive influence on the demand for currency in Ghana.

With regard to the demand for real time and savings deposits ($AQIM_t$), we can see from equation ($A2.3b$) that in the long run it is influenced by real income, the paralel market foreign exchange rate, and the inflation rate. All the estimated coefficients are significant and have the predicted signs.

The long run income elasticity for real quasi money is estimated at 1.84 while the short run value is 1.29. Sowah (1993) estimated the income elasticity of the demand for broad money

for Ghana to be 0.72 and 1.16 for the long-run and short run equations, respectively. Sarpong (1995) estimates a short run income elasticity for Ghana of 1.97 over the period 1970-1987 while Gockel (1983) reports a short run income elasticity of 1.55 [6]. In their study on Kenya, Elliot et al (1986) estimate income elasticities of 1.1 and 1.2 for long-run and short run, respectively while Lipumba et al (1988) report an income elasticity of 1.4 for the short run and 2.2 for their aggregate long run money demand function. The disequilibrium variable ($ECQM$) is also negative and significant. It indicates that the speed of adjustment to the long-run equilibrium is 35% per annum. The change in inflation variable $\Delta ZCPI_t$ is negative 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. The results show that a percentage change in the rate of growth in prices would lead to 0.34% reduction in the demand for real quasi money. In the short run the adjusted $R^2$ shows that 56 percent of the variation in the dependent variable is explained by the explanatory variables.

### 1.11.6 The Parallel Market exchange rate premium

The terms of trade variable was dropped in order to get an interpretable long run equation. In the long run the parallel market exchange rate premium equation $A.2.4a$ shows that the main factors influencing the premium are the stock of domestic monetary assets measured in dollars at the official exchange rate, real effective official exchange rate, and also official aid flows proxied by the net external debt.

All the other variables have the expected coefficient signs. In the long run, the explanatory variables together explain about 89 percent of the variation in the dependent variable as

[6] cited in Sarpong 1997

indicated by the adjusted $R^2$.

The results show that a percentage increase in the stock of domestic monetary assets measured in dollars would lead to a 0.34% increase in the premium in the long run. However, in the short-run equation $A2.4b$, a percentage change in this variable would lead to 0.70% change in the premium. A percentage increase in official aid flows would lead to 0.33% decrease in the premium in the long-run. In the short-run, a percentage change in this variable would lead to a -0.72% change in the premium. The results also show that in the long run a percentage increase real effective official exchange rate, causes the premium to fall by 0.19%, while a percentage change in this same variable would cause a 0.23% decrease in the change in the premium in the short run. As expected, the coefficient on the disequilibrium variable in equation $A2.4b$, $(ECPREM_{t-1})$ is negative and significant. It shows that the speed of adjustment to the long-run equilibrium in the premium is 56% per annum.

### 1.11.7 Exports of goods and services

The estimated export equations are shown in equations$(A2.4a)$to $(A2.6b)$ .

Equation $(A2.4a)$ shows that the volume of cocoa exports is explained by the world market price of cocoa relative to domestic prices $(APCOCP_t)$. As indicated by the adjusted $R^2$, the explanatory variables explain about 79 percent of the variation in the volume of cocoa exports . The estimated coefficient of the price variable of 0.11 is positive and significant at the 5 percent level. It indicates that a percentage increase in the relative world market price of cocoa would lead to a 0.11 percent increase in cocoa exports. The reform programs that were initiated in 1988 as well as the change over of political administration from military to civilian regime in 1992 had a positive influence on cocoa exports both in the short-run and the long-run. This

is indicated by the positive and significant coefficients of the two dummy variables, $DUM88$ for 1988, and $DUM92$ for the year 1992. In the short run, the relative world market price of cocoa has no contemporaneous effect on cocoa exports. Rather, it has a positive effect on cocoa exports after one year with a positive and significant estimated coefficient of 0.09. Thus a percentage change in the relative world market price of cocoa relative to domestic prices would lead to a 0.09 percentage change in the volume of cocoa exports after one year. As expected, the disequilibrium variable is negative and significant at the 0.05 significance level. The adjusted $R^2$ is 0.51 indicating that 51 percent of the variation in the dependent variable is due to the explanatory variables.

Equations ($A2.5a$) and ($A2.5b$) show the long run and short run gold export equations, respectively. From equation ($A2.5a$), the volume of gold exports depends on the price of gold as well as on the depreciation of the domestic currency at the parallel market. The adjusted $R^2$ shows that these variables explain about 87 percent of the variation in the dependent Variable. We find that a percentage increase in the world market price of gold would lead to a 0.06 percentage increase in gold exports, while a percentage increase in the rate at the parallel market would lead to a 0.03 percent increase in gold exports. Two dummy variables, $DUM85$ and $DUM88$ both had a negative influence on gold exports indicating that policies that were initiated in those years affected adversely the export of gold. In the short run ($A2.5b$) shows that a percentage change in gold prices would lead to a 0.24 percentage change in gold exports while a percentage change in the parallel market rate would lead to a 0.09 percentage change in gold exports. The adjustment to disequilibrium variable ($ECGO_{-1}$) is negative with a coefficient of -0.13.

Equations ($A2.6a$) and ($A2.6b$) show that the other merchandise exports ($LEXO_t$) is ex-

plained by the relative world commodity prices and a dummy variable for 1983, $DUM83$. The adjusted $R^2$ is 0.88 and all the explanatory variables are significant at the 0.05 significance level. The estimates show that a percentage increase in relative commodity prices would lead to a 0.24 percent increase in the value of other merchandise exports. The ERP initiated in 1983 as well as the repatriation of over a million Ghanaians from Nigeria in the same year had a significant negative impact on exports. In the short run, the results show that a percentage change in the relative world commodity prices would generate a 0.38 percentage contemporaneous change in the exports of other merchandise commodities. The adjusted $R^2$ for this equation is 0.60 while the speed of adjustment to disequilibrium variable ($ECLEX_{-1}$) shows an estimated value of -0.63.

The results of our trade equations are not comparable to those from earlier studies since the earlier models used world income as well as relative prices as their explanatory variables for the volume of exports equation while we have only considered world prices under the small open economy assumption.

### 1.11.8 Imports Equation

Equations ($A2.7a$) and ($A2.7b$) summarize the results for the imports relationships. The adjusted coefficient of determination is 0.84 and 0.74 for the long run and short run equations, respectively.

The estimated equation ($A2.7a$) shows that the major determinants of the aggregate volume of imports ($IMPV_t$) in Ghana in the long-run are the sum of private and government consumption expenditures ($APGC_t$), expenditures on investment goods plus gross domestic fixed capital formation and change in inventories ($AGFC_t$) , the relative prices as a measure

of competitiveness $(APIM_t)$, and expenditures on exports $(AEX_{t-1})$. All the explanatory variables are significant and correctly signed according to our expectations. We find that the aggregate volume of imports decreases with aggregate consumption. Specifically, the regression results show that a percentage increase in $(APGC_t)$ would lead to 0.14% decrease in the volume of imports in the long-run. 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 $(AGFC_t)$ variable is significant at the 0.05 significance level and indicates that a percentage increase in this variable leads to an increase in imports by approximately 0.27 percent annually. Finally, a percentage increase in $(APIM_t)$ would lead to a 0.17 percent decrease in the volume of exports while a percentage increase in $(AEX_{t-1})$ would lead to an 0.05 percentage increase in imports.

## 1.12 Model Simulation

In this section, dynamic simulation techniques are used to evaluate the performance of the overall model. By this procedure, first, a baseline case is obtained, and deviations of the path of the economy from it in response to changes in policy variables are analyzed. Figure 1.0 shows the baseline solution of the endogenous variables in the model. The simulation results show that the goodness of fit of the whole model is excellent, and that the model is stable and robust. The baseline paths track the actuals fairly closely. All shocks are assumed to be fully anticipated. The policy simulations focus mainly on the dynamic effects of depreciation and how they contrast with the effects of tight credit policy. This is interesting because the IMF has almost always insisted on depreciation as a condition for extending loans to deficit

developing countries. Since 1983, Ghana has devalued its currency massively during the course of introducing the ERP. One would like to know if this policy path is the most effective as compared to other policies such as credit contraction.

### 1.12.1 Effect of 10% depreciation in cedi

We consider the impact of a 10 percent one-time depreciation of the parallel market exchange rate. As shown in Figure 1.1. The immediate impact of this shock on the general price level is a rise of 0.8 percentage above baseline, indicating that the depreciation has a positive effect on prices in the short-run as the cost of imported raw materials has risen. In the medium-run, the general price level oscillates 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 depreciation changes the domestic price level through the prices of traded goods. Also, Agenor and Montiel (1990) observe that a one time fully anticipated 10 percent depreciation leads to an increase of 1.2 percent in the domestic price level. However, they emphasise that the magnitude of this price increase depends very much on the country and the nature of data at hand. Sundararajan (1986) finds similar results for India. His study shows that a 10 percentage depreciation 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 the depreciation results in a short-run fall in imports but a rise in exports. The fall in imports is larger in magnitude. The trade balance improves marginally in the immediate period, but deteriorates subsequently before improving again, a classic $J$-curve effect. These responses are the consequence of the interaction between the relative price effect of Ghana's traded goods and the liquidity effect of depreciation. Within a year exports increase

by about 1.2 percentage as shown in figure 1.1 This automatically translates into increasing the level of reserves, though marginally. In terms of size the marginal increase could be large when considers the fact that the nominal figures are quoted in millions of dollars. Figure 1.1 also shows that the depreciation raises the money stock by 0.14 percent in the immediate period. However, there is a sharp fall in this variable in the second year, followed by a small oscillatory response to baseline level. The features exhibited by this model are consistent with expectations.

The trade balance is also affected by the liquidity effect following depreciation. In other words, depreciation 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 has risen. In subsequent years, however, as relative prices weaken, the negative liquidity effect becomes magnified resulting in a deterioration in the trade balance. Thereafter, as the liquidity effects turn positive and more than offset the weakening prices, the trade balance turns positive. Ahluwalia and Lysy (1981), have contended that "exports for example may not respond sufficiently enough to depreciation because in many developing economies exports are primary commodities whose supply is rigidly limited in the short run".

It is interesting to know that a depreciation causes the parallel market premium to fall by about 2.3 percent contemporaneously. Thereafter, it oscillates to the baseline within about 3 years. Agenor and Montiel (1990) have argued that, as 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 depreciation experiences in Latin America, Kamin's (1988) study of the behaviour of parallel exchange rates across 40 depreciation 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 depreciation plays as a monetary transmission mechanism in determining the behaviour of macroeconomic variables.

On the Ghanaian economy, Amoako (1980) finds that depreciation causes a deterioration in the trade balance. Ghartey (1987) confirmed that depreciation 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 work and argue that depreciation cannot be relied upon to redress the balance of payments problems of Ghana. Younger (1992) using time series evidence from Ghana also concludes that "devaluations in Ghana have had a small but statistically significant impact on the domestic CPI: for a 100 percent increase in the exchange rate, prices rise by 5 to 10 percent".

### 1.12.2 Dynamics of Credit Contraction

Figure 1.2 depicts the response following a contraction in money supply. The effects of credit policies are examined to see how adequately they can substitute for depreciation as well as help to ease inflationary pressures in Ghana. The results show that a percentage contraction in money supply produces 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 shows that a one-percent reduction in money supply leads to an immediate 6.0 percent reduction in the price level. Sundararajan's (1986) study on India reports similar findings. He shows that a percentage reduction in credit leads to a reduction of 0.6 in the money stock, and a fall of about 2 percentage points in the price level. Mohsin and Knight (1982) assert that following a contraction in money supply, domestic prices decline before rising back to their long-run equilibrium level but the moderation in prices persists for several years. Our analysis shows that the reduction in the price level raises the demand for real money balances which also has an 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, accompanied by a fall in imports, but the rise in exports is relatively stronger than the fall in imports. Consequently, as a result of these relative price effects and the negative liquidity effect, the trade balance improves strongly in the short run . Subsequently, all variables adjust gradually to their baseline levels. Generally, the price effect associated with a reduction in the money supply lasts longer than that resulting from a depreciation shock. It is also evident from figure

1.2 that the BOP rises instantaneously by about 2.5 percent following this shock.

The impact effect from the exchange rate action and for the comparable reduction in money supply are constracted graphically in figure 1.3. We notice that the impact effect of these two policy isues on inflation is severer with the exchange rate while the reduction in money supply reduces inflation dramatically.

Our results on the transmission of monetary policy resulting from the shocks considered in this model are consistent with the existing literature, especially studies that pertain to developing countries (see on India, Sundararajan, (1986); and Agenor and Montiel (1990) on 8 developing countries).

## 1.13 Conclusion

In this paper we have used annual data on Ghana (1970-2000) to construct a small macroeconometric 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 confirmed by our study. On the domestic front, the results show that inflation is principally caused by structural factors, though monetary factors are also play a significant role. Since importers obtain their foreign exchange mostly from the parallel market prevailing in the country any depreciation in the parallel market rate has a quick pass through effect onto domestic prices. The simulation also show that depreciation of the domestic currency as well as increases in money supply causes the parallel market exchange rate premium to increase.

Through simulations we were able to corroborate the Fund's assertion that both depreciation 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 programs to achieve major objectives at a 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 fuelling 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.

# 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. Detailed results are presented in table 3. A $LR$ test statistic greater than the critical value (also indicated in the square brackets) shows 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:**

$$\left(\widehat{APO}\right) = \underset{(-6.89)}{-6.7730} + \underset{(4.27)}{0.6506}AMEY + \underset{(2.14)}{0.2118}APIM - \underset{(-6.03)}{0.7873}AYEMP$$

$$\underset{(-3.03)}{-0.6041}D72 \qquad \text{(A2.1a)}$$

$\bar{R}^2 = 0.88, \qquad DW = 2.37, \qquad [t - ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test : LR = 55.31(5\%\ critical\ value = 47.21)]$

**Short run:**

$$\Delta APO = \underset{(6.89)}{0.2909} + \underset{(5.21)}{0.4033}\Delta AMEY + \underset{(5.29)}{0.1799}\Delta APIM - \underset{(-2.20)}{0.1232}\Delta AYEMP$$

$$\underset{2.52}{+0.0047}\Delta ALN(P)_{-1} - \underset{(-2.86)}{0.1615}D72 - \underset{(-2.64)}{0.2961}ECP_{-1} \qquad \text{(A2.1b)}$$

$\bar{R}^2 = 0.77, \qquad DW = 2.23, \qquad \sigma = 0.03351 \qquad [t - ratios\ in\ parentheses]$

| | | | |
|---|---|---|---|
| Breusch-Godfrey LM test (1) | Obs*$R^2$ | = 0.6334 | p=0.1321 |
| Arch LM test (1) | Obs*$R^2$ | = 2.7987 | p=0.9438 |
| White Hetroskedasticity test | Obs* $R^2$ | = 9.8423 | p=0.8141 |
| Normality test | Jarque-Bera | = 1.610 | p=0.5882 |

### A.2.2 The Demand for Money

**Long run:**

$$\widehat{AMIP} = \underset{(-8.31)}{-19.643} + \underset{(2.19)}{1.1402} ZGNI - \underset{(-2.088)}{0.3565} ADIP - \underset{(-4.43)}{0.228} ZBEX$$

$$+\underset{(3.11)}{0.3773} D92 + \underset{(2.12)}{0.2426} D76 \qquad \text{(A2.2a)}$$

$\bar{R}^2 = 0.79, \qquad DW = 1.98, \qquad [t - ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test : LR = 66.20 (5\%\ critical\ value = 62.99)]$

**Short run:**

$$\Delta AMIP = \underset{(-2.15)}{-0.0246} + \underset{(2.74)}{0.2881} \Delta ZGNI - \underset{(-2.04)}{0.3044} \Delta ZBEX$$

$$+\underset{(2.17)}{0.2251} D92 \underset{(-2.30)}{-0.2487}\, D83 - \underset{(-3.71)}{0.1706} ECM1_{-1} \qquad \text{(A2.2b)}$$

$\bar{R}^2 = 0.58, \qquad DW = 2.10, \qquad \sigma = 0.0948 \qquad [t - ratios\ in\ parentheses]$

| | | | |
|---|---|---|---|
| Breusch-Godfrey LM test (1) | Obs*$R^2$ | = 1.2840 | p=0.2703 |
| Arch LM test (1) | Obs*$R^2$ | =1.30591 | p=0.2531 |
| White Hetroskedasticity test | Obs* $R^2$ | =11.7036 | p=0.2314 |
| Normality test | Jarque-Bera | =0.5685 | p=0.7525 |

### A.2.3 Demand for time and savings deposits

**Long run:**

$$\widehat{AQIM} = \underset{(-5.23)}{-18.188} + \underset{(5.24)}{1.8402}ZGNI - \underset{(-4.036)}{0.0347}ADIP - \underset{(-3.11)}{0.1195}ZBEX - \underset{-2.23}{0.3242}D89 \qquad \text{(A2.3a)}$$

$\bar{R}^2 = 0.87, \qquad DW = 2.29, \qquad [t - ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test : LR = 77.35(5\%\ critical\ value = 62.99)]$

**Short run:**

$$\Delta AQIM = \underset{(-2.48)}{-0.3960} + \underset{(2.27)}{1.2963}\Delta ZGNI - \underset{(-2.00)}{0.4200}\Delta ZBEX - \underset{(-2.48)}{0.3960}D83$$

$$+\underset{2.1308}{0.3037}D92 - \underset{(-2.46)}{0.3559}ECQM_{-1} \qquad \text{(A2.3b)}$$

$\bar{R}^2 = 0.56, \qquad DW = 1.97, \qquad \sigma = 0.139322 \qquad [t - ratios\ in\ parentheses]$

| | | |
|---|---|---|
| Breusch-Godfrey LM test (1) | Obs*$R^2$ = 0.9360 | p=0.6262 |
| Arch LM test (1) | Obs*$R^2$ =0.08876 | p=0.7657 |
| White Hetroskedasticity test | Obs* $R^2$ = 6.8819 | p=0.6494 |
| Normality test | Jarque-Bera =0.6450 | p=0.7243 |

### A.2.4 Cocoa Export Equation (Volume)

**Long run**

$$\widehat{ACOV} = \underset{(2.16)}{0.2945} + \underset{(2.07)}{0.1062}APCOCP + \underset{(8.07)}{0.9770}ACOV_{-1}$$

$$+\underset{(3.06)}{0.4305}DUM88 + \underset{(2.24)}{0.3064}DUM92 \qquad \text{(A2.4a)}$$

$\bar{R}^2 = 0.79, \qquad DW = 2.23, \qquad [t - ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test : LR = 20.48 \ \ (5\%\ critical\ value = 15.41)]$

**Short run:**

$$\Delta ACOCV = \underset{(-1.98)}{-0.0519} + \underset{(2.81)}{0.0935}\Delta APCOCP_{-1} - \underset{(-2.81)}{0.1989}\Delta ACM_{-1} + \underset{(3.23)}{0.4594}\, DUM88$$

$$+\underset{(2.24)}{0.3292}D92 \qquad \text{(A2.4b)}$$

$\bar{R}^2 = 0.51, \qquad DW = 2.37, \qquad \sigma = 0.003221 \qquad [t - ratios\ in\ parentheses]$

| | | |
|---|---|---|
| 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 |

### A.2.5 Gold Export Equation (Volume)

**Long run**

$$\widehat{AGOVOL} = \underset{(-4.12)}{-0.3274} + \underset{(-2.85)}{0.0289}ABEX + \underset{(2.93)}{0.0624}AGOLP + \underset{(2.69)}{0.0895}AGOVOL_{-1}$$

$$\underset{(-9.67)}{-0.8211}D85 - \underset{(-3.56)}{0.0024}DUM88 \qquad \text{(A2.5a)}$$

$\bar{R}^2 = 0.87, \qquad DW = 2.37, \qquad [t - ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test : LR = 22.94(5\%\ critical\ value = 22.0)]$

**Short run:**

$$\Delta AGOVOL = \underset{(2.55)}{0.1521} + \underset{(4.17)}{0.0897}\Delta ABEX + \underset{(4.44)}{0.2448}\Delta AGOLDP - \underset{(-2.58)}{0.7279}DUM85$$

$$\underset{(-5.12)}{-0.3181}DUM88 - \underset{(-2.79)}{0.1294}ECGO_{-1} \qquad \text{(A2.5b)}$$

$\bar{R}^2 = 0.87, \qquad DW = 2.74, \qquad \sigma = 0.059554 \qquad [t - ratios\ in\ parentheses]$

| | | |
|---|---|---|
| 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 |

### A.2.6 Other Exports Equation (Value)

**Long run**

$$\widehat{LEXO} = \underset{(-2.48)}{-1.2526} + \underset{(2.83)}{0.2440} LN\left(\frac{PW * BEX}{P}\right) + \underset{(11.04)}{0.8168} LEXO_{-1}$$

$$\underset{(-3.07)}{-0.8542} DUM83 \qquad \text{(A2.6a)}$$

$\bar{R}^2 = 0.88, \qquad DW = 2.33, \qquad [t - ratios\ in\ parentheses]$

$[Johansen\ Cointegration\ test : LR = 17.04\ (5\%\ critical\ value = 15.41)]$

**Short run:**

$$\Delta LEXO = \underset{(-2.48)}{-1.2526} + \underset{(3.17)}{0.3808} \Delta LN\left(\frac{PW * BEX}{P}\right) + \underset{(2.28)}{0.5364} \Delta LEXO_{-1} + \underset{(2.82)}{0.5979} DUM97$$

$$\underset{(2.54)}{+0.5764} DUM85 - \underset{(-2.04)}{0.6326} ECLEX_{-1} \qquad \text{(A2.6b)}$$

$\bar{R}^2 = 0.60, \qquad DW = 2.75, \qquad \sigma = 0.006583 \qquad [t - ratios\ in\ parentheses]$

| | | |
|---|---|---|
| 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 |

### A.2.7 Aggregate Import Equation (Volume)

**Long run:**

$$\widehat{AIMPM} = \underset{(2.82)}{0.2707} - \underset{(-5.75)}{0.1489}APGC + \underset{(4.87)}{0.2685}AGFC - \underset{(-6.97)}{0.1751}APIM$$

$$+\underset{(2.62)}{0.0512}AEX_t + \underset{(6.19)}{0.4503}AIMPM_{-1} + \underset{(3.29)}{0.3097}DUM98 \qquad \text{(A2.7a)}$$

$\bar{R}^2 = 0.84, \qquad DW = 2.14, \qquad [t - ratios\ in\ parentheses]$

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

**Short run:**

$$\Delta AIMPM = \underset{(3.12)}{0.0040} - \underset{(-2.62)}{0.1712}\Delta APGC_{-1} + \underset{(5.23)}{0.3595}\Delta AGFC - \underset{(-2.939)}{0.0961}\Delta APIM$$

$$+\underset{(2.02)}{0.0916}\Delta AEX - \underset{(-2.31)}{0.6417}ECIM_{-1} + \underset{(3.37)}{0.3679}DUM98 \qquad \text{(A2.7b)}$$

$\bar{R}^2 = 0.74, \qquad DW = 2.35, \qquad \sigma = 0.0108002 \quad [t - ratios\ in\ parentheses]$

| | | |
|---|---|---|
| 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 |

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