

KWAME NKRUMAH UNIVERSITY OF SCIENCE & TECHNOLOGY, KUMASI

COLLEGE OF ARTS AND SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

**THE EFFECTS OF EXCHANGE RATE ON GHANA'S EXTERNAL
TRADE**

**A THESIS SUBMITTED TO THE DEPARTMENT OF ECONOMICS, IN
PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD
OF MASTER OF ARTS DEGREE IN**

ECONOMICS

BY

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SEPTEMBER, 2008

TITLE PAGE

DECLARATION

I declare that, I have personally, under supervision, undertaken the study herein submitted.

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I declare that, I have supervised the student in undertaking the study herein submitted and

I confirm that the student has my permission to submit for assessment.

Signature:

Date:

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Supervisor

DEDICATION

In recognition of their deep appreciation for education and of their love and support, I dedicate this to my parent Mr. and Mrs. Danquah.

To Gifty, my heart and the mother of our children: Kwasi Omenako and Nana Appiah

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ABSTRACT

This study examines the effects of exchange rates on Ghana's external trade. In so doing the study derived inter alia real exchange rate as a key determinant of imports and exports. That is to say, the study estimated three models, viz; imports, exports and trade balance, all incorporating real exchange rate as a determining factor using annual time series data from 1986 to 2005. The Autoregressive Distributed Lag approach to cointegration was employed to establish long run relationship between the variables in the various models. Furthermore, vector error correction model was employed in addition to cointegration analyses which confirmed a stable long run relationship between exports, imports and the real exchange rate. The results indicated that, the short run elasticities of imports and exports with respect to real exchange rate are inelastic and thus have contractionary effects of depreciation. The overall conclusion drawn from the study is that for improved balance of trade in Ghana, coordination between the exchange rate and demand management policies should be strengthened and be based on the long run fundamentals of the economy. Domestic industries should improve their level of efficiency and quality of their products in order to compete favourably with foreign goods in both home and the world markets. Though Trade liberalization has not helped much, it should not be completely condemned, as anti liberalization policies and trade restrictions may have retaliation effects. The campaign for patronization of made-in-Ghana goods by leaders of the economy, though not bad, needs some reconsideration and direction. The campaigners must recognize the fact that, the objective of the

consumer is utility maximization and does not take into consideration how the growth of domestic firms will affect the over all performance of the macro economy. Policy makers should direct much attention to the production side and let producers know the harm they cause their own businesses and the economy as a whole by producing shoddy goods in an inefficient manner.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Since the breakdown of the Bretton Woods Accord in 1973 and the advent of floating exchange rate, there has been renewed interest on the effect of depreciation of a country's currency on the trade balance of both developed and developing countries.

The late 1970's and early 1980's proved to be extremely trying economic times for the developing countries. Throughout this period, a combination of exogenous shocks, such as worsening terms of trade, falling growth rates in the cost and availability of foreign financing, created serious macroeconomic management problems for policy makers in these countries. Adjustment to these shocks required fiscal and monetary restraint to control both public and private spending and to prevent the emergence of unsustainable current account deficits and growing foreign competitiveness. With certain exceptions, developing countries generally did not follow this policy prescription and consequently compounded the negative effects of the exogenous shocks.

The Ghanaian economy with its long standing tradition in international trade experienced severe stress in the last three decades and has undergone major macroeconomic and trade policy reforms. In the early 1980s, Ghana was faced with severe competition in international markets for domestically produced primary goods. Coupled with this was

the political instability. In a climate of declining export values and rising imports, the balance of payment position of Ghana was dislocated resulting in the widening of the current account deficit. In response to the persistent adverse trade balance and disequilibrium in the balance of payments, the Ghana government accepted the stringent IMF and World Bank loan conditions under the Structural Adjustment Programme (SAP) launched in 1983. As part of the reform process, the policies implemented include fiscal stringency, devaluation of the Ghanaian cedi and liberalization of trade and financial markets. The Government of Ghana and the World Bank have argued that there has been an appreciable upswing in macroeconomic indicators, such as the relatively high annual growth rate and reduction in the level of inflation and the improvement in services resulting from the structural adjustment policies. In the early 1990s, Ghana's economic recovery was geared towards the export rather than the domestic market. Gross Domestic Product has risen by an average of 5 percent per year since 1984, inflation has been reduced by about 20 percent, and export earnings reached US\$1 billion. In 1990, mineral exports also increased by about 23 percent over the previous year (Anonymous, 2004). Ghana's experience of the SAP is admired by most in the developed and developing world and generally regarded by the Fund as a story. Despite the success, the adjustment programmes have been found to have a negative impact on employment generation and welfare of the populace (Boafo-Arthur, 1999).

According to the International Monetary Fund (IMF), the less active exchange rate policies of the low-income group of countries, most of which are exporters of only a few primary products, may have reflected, in part, the view of the national authorities that the

possibilities of substitution within their economies were relatively low, consequently the impact of changes in domestic prices and costs on the output of the export and import-substitution sectors was quite limited. In empirical terms, the possible effectiveness of exchange rate changes in the management of the external sector of a typical African economy is, therefore, a basic argument which requires some detail attention. One of the most important problems identified in developing economies especially in Africa is the deficit in the government budget and balance of payments. As a result, developing country governments have been put under enormous pressure to leave inward-oriented, export pessimism and import substitution industrialization (ISI) development strategies in order to have a stake in the future international market. The free market adjustment programme has advocated liberalization of markets; allowing prices to be set through the free inter play of market forces and promoting export oriented growth. The free market adjustment package have included greater incentives for export led activities, the switching of demand from imports to domestic products and ensuring that the exchange rate was set at a competitive level for exports.

There is a consensus that trade plays an important role in rapid growth and development, although the issues involved in enhancing these growth and development effects can be diverse and complicated, especially in developing countries like Ghana.

Getting the exchange rate right was an essential component of IMF conditionality under Structural Adjustment Policies (SAP). It was implemented reluctantly by developing countries. According to Musila and Newark (2003), it was the fear that the dismal

performance may not cover the cost of imports resulting from currency depreciation. The proponents of the flexible exchange rate regime argue that deregulation of the financial system serves to balance the country's international trade by making prices of internationally traded goods and services flexible.

The external trade of Ghana involves the Imports demand, the Exports demand and the Balance of Trade. Balance of Trade also known as net exports (NX) are the sum of the money gained by a given economy by selling exports, minus the cost of buying imports. They form part of the balance of payment, which also includes other transactions such as the international investment position. Factors that can affect the balance of trade include:

- Prices of goods manufactured at home (influenced by the responsiveness of supply)
- Exchange rates movement
- Trade agreement or barrier
- Other tax, tariff and trade measures

Most economists do not believe that trade deficits are inherently good or bad, some even believe that trade deficits are generally harmful when countries engage in currency controls such as fixed or pegged exchange rates. They argue that fixed exchange rate does not allow the market to naturally correct any current account problem.

Friedman and other economists point out that a large trade deficit (importation of goods) signals that the currency of this country is strong and desirable. Citizens of such a country

also receive the benefit of having the ability to choose between many competing consumables and lower prices than they would otherwise experience, if the currency was weaker and the country was enjoying a trade surplus. To Milton Friedman, trade deficit simply means that consumers get to purchase and enjoy more goods at lower prices, conversely, a trade surplus implies that a country exported goods that its own citizens did not get to consume and while paying high price for the goods that were consumed. (Ethier, 1983)

A positive balance of trade is a trade surplus and consists of exporting (in financial capital terms) than one imports. Negative balance of trade also known as a trade deficit or informally, as a trade gap consists of importing more than one export. Neither is necessarily dangerous in modern economies, although large trade surpluses or trade deficits may sometimes be a sign of other economic problems.

The balance of payments account is divided into current account, capital account and official financing balances. The current account balance is subdivided into two; the trade balance, which is the balance between visible exports and imports, and the balance of services or the balance of invisibles. A deficit in the balance of trade may likely affect the position of the current account leading to unfavourable balance of payments.

The nominal exchange rate is known not to be the only influencing variable on the real exchange rate and the effect of the nominal exchange rate on the real exchange rate has not been clear. Moreover, the assertion that the nominal exchange rate contributes more

to the movement of the real exchange rate has also not been made clear between the neo-Keynesian and the Classical schools of thoughts in economics. The computed correlation coefficient between the nominal exchange rate and the real exchange rate in Ghana seems to confirm the view held by the neo-Keynesian economists.

Ghana began the process of reforming trade, investment and exchange rate regime around mid 1980's; this process gathered pace through the 1990s as the reform widened in terms of country coverage. These reforms constitute a reflection, in most cases, of a shift from an inward-oriented and import-substituting industrialisation strategy to an outward-oriented and export-led development strategy. The primary focus of the export sector is to significantly expanding and diversifying Ghanaian exports. In this context, the emerging strategy appears to have at least two components, i.e., seeking improved external market access for a much wider range of Ghana's export products, as well as seeking ways to eliminate the export supply response constraints which have hindered the growth and diversification of the country's export basket. An integral part of this second component of the strategy consists of measures aimed at improving the incentives for exporting activities.

Accurate understanding of trade balance response to changes in exchange rate is a crucial factor in the coordination and implementation of trade and exchange rate policies. The conventional wisdom is that a nominal depreciation of exchange rate improves the trade balance in the long run while causing it to worsen in the short run. A change in the exchange rate has two effects on trade balance; the price effect and volume effect. While

the price effect works to make imports more expensive to natives, it causes domestic exports to be cheaper for foreign buyers, at least, in the short run, the volume of exports and imports do not adjust instantaneously in the short run and trade balance may initially experience some deterioration in the short run, following the currency depreciation. However, following eventual adjustment process of exports and imports to the currency depreciation, price effect will tend to dominate the volume effect in the short run whereas volume effect will dominate in the long run, hence, reversing the overall effect in favor of the trade balance improvement, assuming that the Marshall-Lerner condition holds. (Appleyard and Field, 1992)

1.2 Statement of the Research Problem

Exchange rate management is a challenging macroeconomic policy issue. There has been a broad consensus in policy circles in developing countries that the overriding objective of exchange rate policy should be to avoid the problem of persistence misalignments, in most developing countries. A correct exchange rate has been one of the most important factors for economic growth in the economies of southeast Asia and volatility in exchange rate has been one of the major obstacles to economic growth of many African and Latin American economies.

Many countries, especially developing ones face persistent balance of payments problems for many reasons; high debt servicing, deteriorating terms of trade, expansionary monetary policies, price distortions or a combination of these factors. In attempt to solve this problem, some nations seek balance of payment support from external sources

including the International Monetary Fund (IMF), debt relief from creditors, and planned adjustment process. Exchange rate adjustment is essentially part of this adjustment process.

Ghana has, since independence, been confronted with the problem of adopting the appropriate exchange rate policy that will be suitable for economic growth and stability. In order to achieve this objective, the country has carried out several major reforms in the exchange rate system, supported by macro-economic policies and liberalisation of the exchange rate and trade systems.

In addition to the above, it has adopted a number of corrective measures on her exchange rates dominated by devaluing her currency since 1967. The aim is to encourage exports and discourage imports for the purpose of improving her current account balance. However, the foreign exchange rate adjustments have not proved supportive to the country's external trade since our balance on the current account is dominated by deficits. This means that, the country has not achieved the desired objectives and that this has necessitate for a research of this kind. This has been an overriding problem to the Ghanaian monetary authorities. The research question is 'is a foreign exchange rate adjustment an appropriate measure to correct Ghana's external trade problems'? If not, suggest alternative measures that will be suitable for Ghana in order to improve her current account balances.

1.3 Objectives of the Study

The main purpose of this study is to examine the effects of exchange rate on Ghana's external trade. Among other things the study will also examine the exports and imports elasticities.

The specific objectives of this research are:

- To estimate the Export demands function and assess the effects of exchange rate on Ghana's exports.
- To estimate the Import demands function and assess the effects of exchange rate on Ghana's Imports.
- To assess the effects of flexible exchange rate on Ghana's external trade.

1.4 Research Hypothesis

The hypotheses to be tested in this study includes;

1. H_0 : Exchange rate adjustment has no significant effect on Ghana's exports.

H_1 : Exchange rate adjustment has significant effect on Ghana's exports.

2. H_0 : Exchange rate adjustment has no significant effect on Ghana's imports.

H_1 : Exchange rate adjustment has significant effect on Ghana's imports.

3. H_0 : Exchange rate adjustment has no significant effect on Ghana's External Trade.

H_1 : Exchange rate adjustment has significant effect on Ghana's External Trade.

1.5 Justification of the Study

The exchange rate and external trade are areas in modern economies which are of great concern to institutions like International Monetary Fund (IMF), World Bank, the Bank of Ghana and Ministry of Finance etc. Much research has not been carried out in the areas of effects of the exchange rate on a country's external trade. The research is intended to assess the effects of exchange rate on Ghana's external trade; exports, imports and the balance of trade. The responsiveness of export, import and trade balance to exchange rate changes is important to policy makers in formulating trade policies for Ghana. The research will reveal the malaise in the external trade and eventually presents a study capable of making contribution to international trade.

1.6 Scope of the Study

Foreign exchange rate and external trade are not only broad but also complex area so far as the Ghanaian economy is concerned. Because of limited time, space and resources, the study will be limited to effects of exchange rate on Ghana's external trade from 1986 – 2005, that is 20 observations using annual data. The Exports, Imports and Balance of Trade functions would be estimated empirically using appropriate macro econometric methods.

1.7 Organisation of the Study

The study is organized into five chapters. Chapter one looks at the general introduction comprising the statement of the problem, objectives of the study, hypotheses, justification of the study, scope of study and limitation of the study. Chapter two concentrates on the

review of relevant literature. Chapter three focuses on the methodology used in the study. Chapter four analyses the empirical results of the estimated models in the study. The final chapter summarises the major findings of the study, recommendation for policy considerations and conclusion.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the review of the relevant literature on the current study. In this chapter, efforts are made to explore the previous studies on the international sector models and their linkages to the domestic economy. More attention is given to various mathematical modeling, both theoretical and empirical, with regard to the determinants of imports, exports and the trade balance.

2.2 Import Function

According to Caves et al. (1999) the demand for imports, IM_D , is a decreasing function of the imports price expressed in domestic currency which is fixed price in foreign currency times the exchange rate:

$$IM = IM_D(EP) \quad (1)$$

Where IM is the volume of imports, E is the exchange rate and P is the price of imports. Imports are decreasing in the exchange rate and the prices of imports.

The above specification of the imports demand function is very general as its specific form is not known. It is too simple and does not include important variables such as the

gross national product (*GNP*), the domestic price level and the level of foreign exchange reserves. Depreciation raises the price of imports to domestic residents, reducing their demand, IM_D .

Rodseth (2000), states that the demand for imports is a function of the real exchange rate and the level of economic activity

$$IM = IM(E^*, Y) \quad (2)$$

$$IM_{E^*} < 0 \text{ and } IM_Y > 0$$

Where IM is imports demand, E^* is the real exchange rate or the relative price of foreign goods compared to home goods, Y is the level of economic activity, IM_{E^*} is the partial derivative of the imports demand function with respect to the real exchange rate and IM_Y is the partial derivative of the imports demand function with respect to the level of economic activity.

Increase in the real exchange rate make imports expensive and thus reduce the demand for them. Hence the restriction that $IM_{E^*} < 0$ is appropriate. Similarly, an increase in economic activity leads to a higher level of spending including imports. This implies that there exists a positive correlation between imports demand and the level of economic activity, making $IM_Y > 0$ a valid restriction.

One of the most common effects of trade liberalization, particularly in the third world countries is that it increases imports by a larger proportion than exports. Assuming that the price income elasticities of demand for imports are constant, the function can be written according to Thirlwall (2003) as:

$$IM = L \left(P^f \frac{E}{P^d} \right)^{\delta_1} Y^{\delta_2} \quad (3)$$

Where IM is imports demand, L is a constant, Y is domestic income level, P^f is the foreign price level, E is the nominal exchange rate, P^d is the domestic price level and δ_1 and δ_2 are the price and income elasticities, respectively. By taking the logs of the variables in the above import demand function and differentiating with respect to time we obtain the following import growth rate function:

$$im = \alpha + \delta_1 (p^f + e - p^d) + \delta_2 y \quad (4)$$

Where im is the growth rate in imports, p^f, e, p^d and y are the growth rates in the variables already defined. It is expected that $\delta_1 < 0$ and $\delta_2 > 0$. Considering the lag in the adjustment in a disequilibrium model of import demand, it is assumed that imports adjust only partially to the difference between imports demand in period t and the actual flow of imports in the previous period $(t-1)$. The dynamic import function is expressed as;

$$im = \alpha + \delta_1 p_t + \delta_2 y_t + \delta_3 im_{t-1} + \varepsilon_t \quad (5)$$

Where p_t is the rate of change of the real exchange rate, ε_t is the stochastic term and t represents the time period.

Musila (2002) also used similar application but in a functional form in his paper, Exchange Rate Changes and Trade Balance Adjustments in Malawi:

$$\ln(\text{Im}) = \alpha + \alpha_1 \ln(re)_t + \alpha_2 \ln(y)_t + \alpha_3 \ln(\text{Im})_{t-1} + \nu_t \quad (6)$$

This model is adopted for the study with slight modification. Foreign exchange rate reserve and Import price index will be introduced into the specification.

2.3 Export Function

Trade reforms have been important in reducing anti-export bias (policies to control the level of import such as tariffs, embargo and other inward looking policies like import substitution industrialization). However without appropriate real exchange rate adjustments, the incentive structure could still be significantly biased against exportable sector. Blassa (1990) finds exports in Sub-Saharan Africa to be highly responsive to exchange rate changes, especially agricultural exports.

Caves et al. (1999), in their book World Trade and Payments, specify the demand for exports EX_D as a decreasing function of their price expressed in foreign currency divided by the exchange rate:

$$EX = EX_D \left(\frac{P^x}{E} \right) \quad (7)$$

Where EX is the foreign demand for the home country's exports, P^x is the price of exports in units of domestic currency and E is the exchange rate, i.e. domestic currency per unit of foreign currency.

This function for the demand for exports like the imports demand function is over simplification of reality and its applicability for empirical purposes and policy recommendation is severely limited. A depreciation lowers the price of exports to foreigners thereby increasing the quantity of exports demanded, EX_D .

Rodseth (2000) said the foreign demand for a country's exports is a function of the real exchange rate, E^* and the level of economic activity in the rest of the world.

$$EX = EX(E^*, Y^f) \quad (8)$$

$$EX_{E^*} > 0, EX_{Y^f} > 0$$

Where: EX is the volume of foreign imports of home goods, i.e. the home country's export volume, Y is the level of economic activity in the rest of the world, EX_{E^*} is the partial derivative of the export demand function with respect to the exchange rate EX_{Y^f} the partial derivative of the export demand function with respect to the level of economic activity in the rest of the world.

Thrilwall (2003), by assuming constant price and income elasticities of demand for exports, made the following specification for the export function

$$EX = A \left(P^f \frac{E}{P^d} \right)^{\beta_1} Y^f{}^{\beta_2} \quad (9)$$

Where EX is exports, A is a constant, P^d is the domestic price level, P^f is foreign prices, E is the nominal exchange rate measured as the domestic currency per unit of foreign currency, and Y^f is the income of the rest of the world, β_1 and β_2 denote price and income elasticities, respectively. Taking the logs of the variables and differentiating with respect to time, we obtain the export growth function as follow:

$$ex = \alpha + \beta_1 (P^f + e - P^d) + \beta_2 y^f \quad (10)$$

Both elasticities, β_1 and β_2 , are expected to be positive. The model, however, assumes that exports adjust without a lag to changes in competitiveness and income, so there is no difference between short and long run elasticities. By assuming that exports adjust partially to the difference between export demand in period t and the actual flow of exports in the previous period ($t-1$), the lag of exports becomes an explanatory variable, given in equation:

$$ex_t = \alpha + \beta_1 p_t + \beta_2 y_t^f + \beta_3 x_{t-1} + \mu_t \quad (11)$$

Where p_t now denotes the rate of change of the relative price, μ_t is the stochastic term and t represents the time period.

Following Musila (2002) in his paper, Exchange Rate Changes and Trade Balance Adjustment in Malawi used similar but in a functional form:

$$\ln(Ex) = \delta + \delta_1 \ln(re)_t + \delta_2 \ln(y)_t^* + \delta_3 \ln(Ex)_{t-1} + \nu_t \quad (12)$$

This model will be use with little modification to the foreign income and the introduction of Export price index

2.4 Trade Balance

Trade balance, sometimes referred to as visible balance, represents the difference between receipts for exports of goods and expenditure on imports of goods. In other words, it is the difference between the monetary value of total exports and imports. Baharumshah (2001) suggested that trade balance is determined by a number of macro variables such as real outputs, exchange rate, money supplies, etc, the existence of direct or indirect causal feedback between trade balance and such macro variables cannot be ruled out.

Krueger (1983) expressed trade balance as:

$$TB = B\left(Y, \frac{E}{P}\right) \quad (13)$$

Where, TB denotes the trade balance, Y is the real domestic income, E is the nominal exchange rate and P is the domestic price level. Economic theory determines a number of key variables that have significant effect on imports and exports and hence trade balance.

Agbola (2004) defined the trade balance of an economy as the difference between export receipts X, and import expenditure M. Using a small country assumption, he expressed trade balance of Ghana as:

$$TB = X - M = P_x Q_x \left(\frac{P_x}{e}, Y^* \right) - e P_m^* (e P_m^*, Y) \quad (14)$$

Where TB is the trade balance, X is the export revenue, M is import expenditure, P_x is the cedi price of exports, Q_x is the quantity of exports, P_m^* is the foreign currency price of imports, Q_m is the quantity of imports, e is the value of foreign currency in the terms of the cedi, Y is domestic national income, Y^* is foreign income.

Krugman-Baldwin (1987) model is adopted for this study. An advantage of this model, in addition to its simplicity, is its ability to capture the effect of all the specified macro variables on trade balance. This two-country model stipulated that the demand for imported goods by domestic residents is positively related to real domestic income and negatively to relative price of imported goods. Hence, trade balance is given as:

$$TB = TB(Q, Y, Y^*) \quad (15)$$

Where $Q \equiv \left(\frac{e.P^*}{P} \right)$. In this expression, an increase in e would denote a depreciation of the domestic real exchange rate and vice-versa. Equation (13) can be estimated in a log-linear form by taking the logs on both sides to obtain the following estimation equation

$$tb_t = \alpha_0 + \alpha_1 q_t + \alpha_2 y_t + \alpha_3 y_t^* + \mu_t \quad (16)$$

Where lower-case letters represent logarithm of a variable and μ_t is white-noise process.

In the model, a four-variable system will be set up, denoted by the notations: log of trade balance is tb , log of real effective exchange rate (real exchange rate for Ghana) is q , compactly written as $x = (tb, q, y, y^*)$. In the study, trade balance is expressed as a ratio of exports to imports. Equation (16) is adopted for this study because it captures the most important variables in macroeconomic environment.

2.5 Empirical Review

Exchange rate effects on Agriculture Trade and Trade relation paper was presented by Orden (1999). He examined the question of impact of exchange rate on Agriculture in U.S.A. He said more generally exchange rates serves on international capital flows and the macroeconomic factors determining these flows, including monetary policy. Monetary shocks have non-neutral effects which explain some of the variability in agriculture prices. Moreover, macroeconomic condition are often decisive in determination of domestic agricultural policies and hence competitiveness in world

markets and tensions in trade relations. These structural policy implications of exchange rate movements, along with their direct effects on markets at any given moment in time are why exchange rates are important to Agriculture.

Stucka (2004) presents a paper on the effect of exchange rate change on the Trade Balance in Croatia. The paper attempts to estimate the impact of permanent exchange rate depreciation on the merchandise trade balance employing a reduced form model. The model was estimated using three methods – the ARDL ‘delta’ approach developed by Pesaran, Shin and Smith (1996). On average, a permanent 1 percent depreciation of the domestic currency results in an improvement of the trade between 0.94 percent and 1.3 percent. On average, the new equilibrium is established after approximately 2.5 years. The average length of the adverse effect of permanent depreciation is moderately above one quarter. It finds adverse effect of J-curve cure effect in Croatia.

An alternative modeling approach could utilize the disaggregated data according to standard international trade classification. Again, shipbuilding, as well as trade in oil derivative could be separately treated, which might lead to different outcomes.

Marquez et al (2004) did a study of Exchange rate Effects on China’s Trade, they estimate export and import trade elasticities, using a sample of quarterly data from 1995-2003. Their choice dates avoids the period of Structural Adjustment during which previous papers found the exchange rate to have little effect on trade. They report results for real exports and real imports but do not specify the way in which they deflated the nominal data. Their export equation focuses only on export to the G3 countries. It is

possible they are using import prices from those partner countries. Also, of interest is the fact that in modeling Chinese imports, they break down imports into imports for domestic use and imports for processing and re-export. In none of their equations do they get a significant coefficient on the exchange rate, but the results from the equations suggest that modeling processing and ordinary trade separately may be useful.

Thorbecke (2006) estimates income and exchange rate elasticities for China's multilateral exports and for trade with the US (export and import). The parameter estimates associated with multilateral exports are obtained using a panel data that includes trade with 30 countries from 1982-2003: the trade data are disaggregated across final products, intermediate products and capital goods. Thorbecke finds that the evidence for China is not conclusive enough to characterize the effect of a change in the exchange rate on China's trade.

Empirically Marial et al. (2005) did a study on the effects of exchange rate changes of trade balance in North Africa. The paper examines the effects of exchange rate changes on the bilateral trade balance of Egypt, Morocco and Tunisia vis a vis the U.S and Japan. The study employs the Johansen cointegration and error correction model on the annual data in the period 1970 – 2003. The findings confirms the existence of both the short run dynamics and long run causal relationships between trade balance and the set of specified independent variables. The results produce mixed evidence about the existence of the J-curve effect. A classic pattern is observed only in case of Morocco/Japan in which the trade balance deteriorates almost immediately following depreciation of the real

exchange rate and recovers after two years. The finding that exchange rate depreciation improves trade balance (in cases of Egypt/Japan, Morocco/Japan and Tunisia/U.S.) corroborate the conjecture in the literature that a country's trade balance may deteriorate following currency depreciation before improving in the long run. The finding of J-curve in three cases out of six in the paper does not help much in clearing the murk surrounding the issue of the J-curve phenomenon in the literature. These findings underscore the important implication that the effect of real exchange rates changes on the trade balance of any given country depends largely on the volume of trade activities between the countries concerned.

Bahmani-Oskooee and Alse (1994) tested 41 developed and less developed countries for the existence of cointegration and the J-curve effect applying the Engle-Granger two-step procedure. The results indicated that the trade balance and real effective exchange rate are co-integrated for only fourteen countries. In countries exhibiting cointegration, there was some evidence of the J-curve effect

Bhattarai and Armah (2005) study the effects of exchange rate on the trade balance in Ghana using a cointegration analysis. The results from this study show that the trade balance of Ghana will not improve in the short run unless it adopts policy rules in the foreign exchange market, but it may be costly if such adjustment were to occur unaided in the long run. The result also show that in the short - to - medium term, as well as in the long, income levels are not important determinants either of the import demand or the export demand of Ghana. It also shows that it is the exchange rate that is the significant

factor in the short term. In the long run however, the study reveals that only the real exchange rate significantly affects the trade balance. However, the estimate for Ghana show that even in the long run, the Marshall-Lerner-Robinson (MLR) condition for a successful devaluation is barely met and therefore, in Ghana's case the gains would not be enough to offset the losses in the trade balance in the short run.

In a paper on Exchange Rates and the Management of the External Sector in Sub-Saharan Africa, Delphin G. Rwegasira said the evidence and arguments in this article support the pursuit of a flexible exchange-rate policy in African economies. The region is faced with a very difficult and unsustainable balance-of-payments situation which cannot be helped by appreciating exchange rates. The direct controls of imports, in the situation described earlier, serves a very limited purpose if the aim is to achieve acceptable economic equilibrium. By considering structural and sectoral issues, however, his article cautions against the over-optimism which characterizes some quarters on this subject. When income-distribution considerations are added, thus alluding to the concept of social and economic equilibrium, they point to the advisability of using fairly small and timely changes in exchange rates, rather than the large adjustments which are sometimes advocated. This is still true even if there is an obvious long-term over-valuation of the currency. To be useful, any devaluation must, of course, be accompanied by other supportive policies, especially those relating to monetary and fiscal policies. It is important in these efforts to adopt a level-headed perspective of the nature of the balance-of-payments problems. The effect of terms-of-trade losses and domestic inflationary forces in developing countries cannot be simply reversed by exchange-rate changes

From the above, it is clear that neither theoretical nor empirical studies have established definitely whether a depreciation of a country's domestic currency would improve its trade balance. Understanding of the long run relationship between exchange rate depreciation and trade balance is important for policy formulation and implementation in developing countries, such as Ghana.

2.6 Ghana Exchange Rate System and External Trade

Ghana's policies on the exchange rate have been influenced by the contrasting political regimes that have been in place since independence in 1957. From independence in March 1957 – March 1983, Ghana adopted a fixed exchange rate regime in the management of its exchange rate. During this period, the Ghanaian cedi was pegged to the main convertible currencies, notably the British pound and the American dollar. The fixed exchange rate was not maintained by active intervention in the foreign exchange market, as was standard in market economies in those days.

Jebuni et. al. (1991) explains that the monetary authorities attempted to address the balance of payments difficulties by adopting a fixed exchange rate in addition to resorting to ad-hoc restrictions on trade and payments. A series of discrete devaluation of the cedi were implemented under a fixed exchange rate system by eight different governments, made up of three civilian and five military regimes, with different political and economic ideologies. The devaluation was attempts to realign the overvalued currency (the cedi)

and reduce the shortage of foreign exchange as well as the size of the parallel markets. Instead, the exchange rate was pegged more or less by decree and a series of administrative controls were instituted to deal with any possible excess demand for foreign currency. The issuing of import licenses was one such control.

In September 1986, the government adopted an auction market approach in order to accelerate the adjustment of the exchange rate and to achieve the object of trade liberalization, leaving it partially to market forces (demand and supply) to determine the cedi-dollar rates. This new arrangement was made up of a dual exchange rate comprising two windows. Window one was operated as a fixed exchange rate and pegged the cedi-dollar exchange rates at $\text{¢}90.00: \$1.00$ and mainly used in relation to earnings from the export of cocoa and residual oil products. Window two, which catered for all other transactions, was determined by demand and supply in a weekly auction conducted by the Bank of Ghana. The two systems were however unified in February 1987. The Dual-Retail Auction was adopted and was based on the marginal pricing mechanism. It required successful bidders to pay the marginal price. A second auction – the Dutch auction – was introduced and under it, successful bidders were supposed to pay the bid price.

Sowa and Acquaye (1998) have pointed out that the massive industrialization and modernization programme implemented by the government in the early 1960s depleted the country's reserves and Ghana began to see the signs of foreign exchange constraints. No doubt the first Exchange Control Act was passed to regulate the foreign exchange

market. The scarcity of foreign exchange notwithstanding, the cedi remained fixed to the pound sterling and was thus highly overvalued. Ghana retained this policy until 1983 when it embarked on the donor support ERP. In September 1986, Ghana reformed its exchange rate policy with the support of the IMF and World Bank under the ERP/SAP. Initially this was a two-tier system which was aimed particularly at an official fixed rate to take care of imports and exports of selected goods and a weekly auction rate for the remaining two thirds of Ghana's external transactions determined at weekly auction (Oduro and Harrigan, 2000)

The foreign exchange bureaux system was established in 1988 in an attempt to absorb the parallel market into the legal foreign exchange market. These "forex" bureaux were fully licensed entities operated by individuals, group or institutions. Their operation alongside the auction meant that the foreign exchange market was characterized by two spot foreign exchange rates. (It must be noted that the forex bureaux were not allowed to bid for foreign exchange in the weekly- retail auction).

In March 1990, the wholesale auction was introduced to replace the weekly retail auction. Under this system, a composite exchange rate system was operated, namely the inter bank and a wholesale system. Under the wholesale system, eligible forex bureaux and authorized dealer banks were allowed to purchase foreign exchange from the Bank of Ghana for sale to their end-user customers and to meet their own foreign exchange needs. They could now sell the foreign exchange obtained to their customers subject to a margin determined by each authorized dealer.

The wholesale auction system was abolished in April 1992 and replaced by the inter-bank market. Since then, both the commercial banks and the Forex Bureaux have operated in a competitive environment. It is clear that since 1986 the exchange rate policy of the Bank of Ghana has been the managed floating exchange rate. The Bank of Ghana's intervention in the foreign exchange market has been mainly to smooth fluctuations in the foreign exchange market (Bank of Ghana).

In 1992, the trade balance continued to larger deficits with imports soaring exports (ISSER 1992). Whereas merchandise export dropped from 997.7 million US dollars in 1991 to 986.3 million US dollars in 1992, merchandise imports increased from 1318.7 million US dollars to 1456.5 million dollars over the same period (ISSER 1993). As a result of the worsening trade balance situation, the current account balance also deteriorated sharply over the period.

The exchange rate system has had profound influence on the flows of exports and imports in Ghana. The pattern of trade has changed significantly since the trade reforms were initiated. In particular, the export to GDP ratio was higher (between 32.1% and 49.2%) in 1996-2000 than in 1994-1995 where the export to GDP ratio actually fell from 25.3% to 24.5%. In the later period however, the import to GDP ratio also was higher (between 40.09% and 69.59%) than in 1994-1995 (between 32.56% and 32.93%).

In spite of the increased flexibility in the exchange rate in the years after the reforms and in recent years, the trade deficit has increased and the balance of payments has continued to show strains. The overall balance was in surplus by US \$ 250.8 million in 1995 and in a small deficit US \$20.4 million in 1996. In 1998 it registered a surplus and declined again in 1999. In 2000 a large deficit of US \$258.5 million was registered. This deficit has been attributed in some quarters to the fact that 2000 was an election year and therefore government spending was high. This erratic behaviour of the economy has led to many questions being asked about the wisdom of implementing the ERP/SAP and has fuelled the already intense debate on the rationale of the reforms.

The annual average exchange rate shows a cumulative depreciation of 8.3 percent against the US dollar when compared to the average rate in 2001 in the inter bank market and the corresponding rate of depreciation in the forex bureau market, which was 11.1 percent. The relative stability of the cedi has been attributed in some quarters to the contraction in imports and increases inflows. The national exchange rate averaged ¢ 7,868.97 to US \$ 1 and ¢ 7,987.29 to the US \$ 1 in the inter market and the forex bureau markets respectively in 2002 (ISSER 2002).

Table 2.1: Exchange Rate Policy Episodes in Ghana 1957-2005

Episode	Period	Policy
1	1957-1966	Fixed to the British Pound
2	1966-1982	Fixed to the America Dollar
3	1983-1986	Multiple exchange rate system
4	1986-1987	Dual exchange rate system-auction determined, dual retail auction rate.
5	1987-1988	Dutch auction system
6	1988-1989	Foreign exchange bureaux.
7	1989-1992	Wholesale and inter-bank auction system.
8	1992- to date	Inter-bank market. The Bank of Ghana (BoG) selling and buying were determined by the average daily retail rates of commercial banks.

Source: IMF, Bank of Ghana

The exchange rate was more stable in the years that follow 2002. In nominal terms, the cedi depreciated against the US dollar while appreciating against the pound sterling and the euro. The end of inter-bank exchange rate for US dollar moved from ¢ 9,051.3 in 2004 to ¢ 9,130.3 in 2005, a depreciation of 0.9 percent. This compares favourably with 2.2 percent depreciation in 2004 (ISSER). Relative stability in the nominal exchange rate in 2005 was a result of a significant relaxation of foreign exchange constraint. HIPC resources, increases in private remittances and other official and private capital flows all

helped to reduce pressure on the exchange rate by counteracting the effect of the increase in the total import bill.

Balance of payments estimates for 1998 showed an improved external sector performance. Total export receipts (f.o.b) in 1998 increased by 11.3 percent from the outturn of US\$1,625.2 million. The total value of imports in 1998 is estimated at US\$2,346.0 million, a 10.2 percent increase over the amount for 1997. The trade balance recorded a deficit of US\$536.0 million as against a projected deficit of US\$353.7 million. Value of exports from Ghana increased from US\$1,489.9 million in 1997 to US\$1,809.6 million in 1998. In comparison, the value of imports increased from US\$2,128.2 million in 1997 to US\$2,346.0 million in 1998. The Trade Intensity Index (TII) which gives an indication of the size of Ghana's trade with the rest of the world in relation to its national economy (that is, the sum of exports and imports divided by GDP) increased from 52.6 percent in 1997 to 55.6 percent in 1998.

The value of exports from Ghana increased from US\$2,091 million in 1998 to US\$2,099.43 million in 1999. Despite the general feeling of a decline in non-oil imports, the value of imports increased from US\$2,897 million in 1998 to US\$3,228.2 million in 1999. Thus trade deficit increased from US\$805.7 million in 1998 to US\$1,128.8 million in 1999, an increase of 40.1 percent. The Trade Intensity Index (TII) increased from 66.8 percent in 1998 to 68.5 percent in 1999. The increase in trade intensity index has to do with the increase in the import bill, particularly oil imports.

The balance of payment in 2002 showed improved external sector performance over 2001, primarily due to an improvement in the trade account. Total receipts rose 1.3 percent in 2002 to US\$2,063.9 million, just over the target of US\$2,036.8 million, as a result of favourable international prices for Ghana's major exports. Ghana's trade deficit in 2002 was 71.7 percent less than in 2001, due in large part to the decrease in non-oil imports from US\$2,451.7 million in 2001 to US\$2,197.0 million in 2002. However, the Trade Intensity Index (TII) fell from a little over 90 percent in 2001 to about 80 percent in 2002.

In 2005 the current account recorded a significant deficit of US\$758 million, the highest level in five years and more than twice the 2004 deficit of US\$316 million. This deficit was primarily driven by the trade deficit which rose from US\$1,593 million in 2004 to US\$2,512 million, with imports as the main reason. The ratio of trade to GDP dropped only slightly from 79 percent in 2004 to 77 percent in 2005. The level of trade intensity as measured by these ratios is much lower than the levels recorded for 2000 when total trade was about 122 percent of GDP.

A critical look at the index shows that while import ratios have risen appreciably since 2003, the ratio of exports to GDP has fallen. From 43 percent of GDP in 2003, imports rose to 49 percent in 2004 and to 51 percent in 2005. In contrast, export as a proportion of GDP have consistently declined over the last few years, moving from about 34 percent in 2005 to 31 percent in 2004 and to 26 percent in 2005. Therefore, it can be said that Ghana

continues to operate as an open economy. However the intensity of trade favours imports relatively more than exports.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter looks at the econometric methods employed to study the effects of exchange rate on Ghana's external trade. The basic econometric models of imports, exports and trade balance are specified in the first section of this chapter, whereas unit root testing and cointegration method are explored in the last sections of this chapter.

3.2 Model Specification

The functional forms of the exports, imports and the trade balance models used in this study are standard in the trade literature and are used in Musila (2002) and others. This study considers the following functions for imports, exports and the trade balance respectively. A Logarithmic functional form is adopted because it allows imports and exports to react proportionately to changes in their arguments. In addition, Khan (1974) pointed out that this specification avoids the problem of drastic falls in elasticities. To capture the partial adjustment behavior, a lagged term in both dependent variables should be included in the estimated equations. Hence, the inclusion of lags in exports and imports, respectively, in the model; which assumes a small open economy similar to the Ghanaian.

$$\ln IM_t = b_0 + b_1 \ln Y_t + b_2 \ln E_t^r + b_3 \ln R_t + b_4 \ln P_t^m + b_5 \ln IM_{t-1} + e_t \quad (1)$$

$$\ln EX = \alpha_0 + \alpha_1 \ln E_t^r + \alpha_2 \ln P_t^x + \alpha_3 \ln EX_{t-1} + e_t \quad (2)$$

$$TB = \gamma_0 + \gamma_1 E^r + \gamma_2 Y + \gamma_3 Y^* + \psi_1 \quad (3)$$

Where

IM = total value of goods bought abroad including non-factor services

EX = total value of goods including non-factor services sold abroad

TB = trade balance

E^r = real effective exchange rate

Y = income proxied by the real *GDP* of Ghana

P^m = import price

P^x = export price

Y^* = foreign income

R = foreign reserves

t = is the time subscript

e and ψ = disturbance terms

Equations (1), (2) and (3) are estimated and used to evaluate the effect of changes in exchange rate on imports, exports and trade balance.

3.2.1 Imports Demand Function

As already indicated the import demand function is specified in a way that will capture both long run and short run effects. Log linear specification is used with focus of obtaining the short run elasticities directly. The aim is to estimate the structural parameters. By following Greene (2003) and Fan et al (2004) and assuming that the imports demand satisfy the assumption of partial adjustment model, the specified imports demand function for Ghana in a log linear as;

$$\ln IM_t = b_0 + b_1 \ln Y_t + b_2 \ln E_t^r + b_3 \ln R_t + b_4 \ln P_t^m + b_5 \ln IM_{t-1} + e_t$$

Where b_0 is a constant intercept and e_t is the stochastic term; it is expected that an increase in the real exchange rate makes imports expensive to domestic consumers and consequently reduces their demand for imports, hence $b_2 < 0$. The coefficient of Y , b_1 is the marginal propensity to import (the fraction of any additional income that is spent on imports) and must lie between zero and one, that is $0 < b_1 < 1$. Thus, an increase on domestic income leads to an increase in the demand for imports but not as much, in proportionate terms. It is also expected that an increase in total foreign reserves, all things being equal will lead to an increase in the domestic demand for foreign goods so that $b_3 > 0$. Ceteris Paribus, an increase in the price of imports will lead to a reduction in the demand for imports so that $b_4 < 0$. The parameter b_5 is the adjustment coefficient, in that it shows how imports demand in the current imports adjusts to its previous level. The adjustment coefficient must lie between zero and one in absolute terms.

3.2.2 Export Demand Function

The export sector of Ghana is modeled in the same functional form as the import demand in aggregate terms. It is assumed that the export demand also satisfies the assumption of partial adjustment. Again, following Greene 2003 and Fan et al 2004, the specify log linear form of the export demand function for Ghana as;

$$\ln EX = \alpha_0 + \alpha_1 \ln E_t^r + \alpha_2 \ln P_t^x + \alpha_3 \ln EX_{t-1} + e_t$$

Where α_0 is the constant intercept and e_t is the stochastic term in the log linear model. It is important to note that an decrease in the real exchange rate, all things being equal, will make export more competitive than before, resulting in an increase in the demand for

exports, so that $\alpha_1 < 0$. On the other hand, a rise in export price, ceteris paribus, will lead to a reduction in the demand for exports, hence $\alpha_2 < 0$. The coefficient, α_3 , in the export demand function is the adjustment coefficient, which shows how exports adjust to its past levels. As in the case of imports demand, no expectation was placed on the sign of the adjustment coefficient.

3.2.3 The Trade Balance

It is the difference between the monetary value of total exports and imports. It is determined by a number of macro variables such as real outputs, exchange rates, money supplies etc., the existence of direct or indirect causal feedback between trade balance and such macro variables cannot be ruled out. This two-country model stipulates that the demand for imported goods by domestic residents is positively related to real domestic income and negatively to relative price of imported goods. Hence the trade balance is given as;

$$TB = \gamma_0 + \gamma_1 E^r + \gamma_2 Y + \gamma_3 Y^* + \psi_1$$

$$\delta_1 > 0, \delta_2 > 0 \text{ or } < 0 \text{ and } \delta_3 > 0.$$

3.3 Time Series Analysis

3.3.1 Stationarity Test (Unit root test)

This study follows recent advances in the econometric literature of time-series analysis to investigate the long-run relationship between the time-series variables. To avoid spurious results unit root tests using Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979) is

performed to determine the time-series properties of the variables employed in the analysis. The auxiliary regression is run with an intercept and is specified as

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \sum_{j=1}^p \gamma_j \Delta y_{t-j} + \varepsilon_t \quad (4)$$

Where y_t is the variable, whose time-series properties are being investigated, Δ is the difference operator, and where ε_t is the random error term with $t = 1 \dots n$ is assumed to be Gaussian white noise. The augmentation term are added to convert the residuals into white noise without affecting the distribution of the test statistics under the null hypothesis of a unit root. As Alba (1999) notes, the ADF test has a null of unit root against the alternative of trend stationary.

3.3.2 Cointegration Test

Two or more variables are said to be co-integrated when they exhibit long run equilibrium (relationships), if they share common trend(s). Auto-regressive distributed lag bounds approach (*ARDL*) is used. The choice is based on several considerations. The *ARDL* models yield consistent estimates of the long run coefficients that are normal irrespective of whether the underlying regressors are $I(1)$ or $I(0)$. It provides unbiased estimates of the long run model and valid t-statistics even when some of the regressors are endogenous. It is also efficient in small sample cases. The *ARDL* representation for the model specifications is formulated as:

$$\Delta q = \beta_0 + \beta_1 t + \beta_2 q_{t-1} + \beta_3 x_{t-1} + \sum_{t=1}^k \beta_4 \Delta q_{t-1} + \sum_{i=1}^k \beta_i \Delta x_{t-1} + \varepsilon_t \quad (5)$$

Where q is the dependent variable, t is time trend, x is a vector of explanatory variables

3.3.3 Error Correction Model

When the variables are co-integrating, then tests involving differenced variables will be misspecified and some important information lost unless a lagged error-correction term is included. We estimate the error –correction model in which the error-correction terms (*ECM*), derived from long-run co-integrating vectors, and are included as independent explanatory variables in the estimation process in order to recover all the long-run information that was lost in the original estimation process. A general error correction representation of ARDL is formulated as follows:

$$\Delta q_t = \beta_0 + \sum_{i=1}^k \beta_1 \Delta q_{t-i} + \sum_{i=0}^k \beta_{2i} \Delta x_{t-i} + \dots + \lambda ECM_{t-1} + \mu_t$$

Where λ is the speed of adjustment parameter, *ECM* is the residual that is obtained from the estimated co-integration model of equation

3.3.4 Stability Test

Stability Test will be performed to check whether the estimation regression equations were stable throughout the sample the sample period. The plots of Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) test proposed by Brown et al (1975) will be used. The importance of this test is that a movement of the CUSUM and CUSUMSQ residuals outside the critical lines is suggestive of the instability of the estimated co-efficient and parameter variance over the sample period.

3.4 Description of Data and Source of Data

The data for this study is a time series data on the external sector of the Ghanaian economy over the study period (1986-2005). The data is sourced from the International Bank for Reconstruction and Development (*IBRD*), commonly referred to as World Bank, International Monetary Fund (*IMF*), and Bank of Ghana. The World Bank data are taken from its annual publication *African Development Indicators*, whilst the data from the IMF are taken from series of its annual publication *International Financial Statistics Yearbook*

CHAPTER FOUR

EMPIRICAL RESULTS AND ANALYSIS

4.1 Introduction

This chapter seeks to present and analyse the regression results of the functions specified in section 3.2. As was indicated in the previous chapter, the import and export demand functions were specified to capture both short run and long run effects. The empirical analysis is carried out using annual data on exports, imports, trade balance, real exchange rate and domestic output (GDP) between the periods 1986 to 2005. The unit root results on all the variables as well as the short and long run results of the various models are all presented and analysed in this chapter.

4.2 Unit Root Test

To preclude spurious regression (Granger and Newbold, 1974) and to ascertain that long-run relationships do exist among the variables, this study the unit root test for the order of integration of each of the series through the well know Augmented Dickey-Fuller (ADF) and Philips-Perron (PP). The study then test for cointegration among the series using the ARDL cointegration test. Before using these formal tests in the study, a rather casual graphical representation of all the variables was done to ascertain whether or not the variables are stationary. This is illustrated in Figure 4.1 in the appendix. The graphical results indicate that, all the variables contain unit roots at their levels but achieved stationarity after taking their first differences.

The ADF and PP unit root test results, reported in Table 4.1, also indicate that, real income, export price index as well as import price index are level stationary. That is to say that, they do not contain unit roots, and hence are integrated of order zero (*i.e.* $I(0)$). However, all the other variables are integrated of order one $I(1)$, that is, they achieved stationarity after taking their first differences.

Table 4.1: Results of the Unit Root Tests

Panel A: Level				
Variable	ADF		PP	
	Constant No Trend	Constant Trend	Constant No Trend	Constant Trend
Data Period: 1986-2005				
$\ln Y$	-2.072067	2.182105***	-2.905945*	2.182105***
$\ln IM$	-1.484283	-1.186797	-1.477066	-1.320346
$\ln P^m$	4.196465***	-2.282898	-10.73702***	-6.741532***
$\ln P^x$	-3.905445***	-3.255458*	-10.73702***	-6.741532***
$\ln R$	-1.409658	-3.814972**	-1.701666	-3.188512
$\ln \ln E^r$	-2.076371	-3.035228	-2.076371	-2.807043
$\ln EX$	-1.729538	-1.760917	-1.954393	-0.714085
$\ln Y^*$	2.291575	-1.429600	3.823096***	-1.199156
TB	-1.932505	-2.170584	-1.891833	-2.277016
Panel B: First Difference				
Variable	ADF		PP	
	Constant No Trend	Constant Trend	Constant No Trend	Constant Trend
Data Period: 1986-2005				
$\Delta \ln Y$	-0.120978	-2.268244	-0.796872	-2.225005
$\Delta \ln IM$	-3.833889***	-3.863342**	-3.838970***	-3.863342**
$\Delta \ln P^m$	-3.787441***	-4.211547**	-4.307161***	-5.650905***
$\Delta \ln P^x$	-2.627823	-3.602053**	-2.505323	-3.167228
$\Delta \ln R$	-3.222555**	-3.039349	-6.157514***	-5.872178***
$\Delta \ln E^r$	-4.156152***	-3.997228**	-4.172207***	-4.001183**
$\Delta \ln EX$	-0.905824	-5.418390***	-4.726418***	-5.418390***
$\Delta \ln Y^*$	-4.317912***	-4.456973***	-4.362402***	-9.272471***
ΔTB	-5.124621***	-5.125751***	-5.107996***	-5.125751***
The null hypothesis is that the series is non-stationary, or contains a unit root. *, ** and *** indicate the rejection of the null hypothesis of non-stationary at 10% , 5% and 1% significance level, respectively				

4.3 Bound Test Approach to Cointegration.

Having ascertained the absence of $I(2)$ variables in the series, the *ARDL* approach to cointegration is now applied to the models. This is first done by establishing a long run cointegrating relationship existing among the variables in all the models by means of a bounds test.

Table 4.2: Bounds Test for the Existence of a Long-run Relationship in the Models

Model	Computed F-Statistics	Testing for the Existence of a long-run relationship: Critical values of the F-Statistic	
		F-Statistic: Case II	Significance level
$IM_t = f(Y_t, E_t^r, R_t, P_t^m)$	3.725	2.525 – 3.560	90%
$X_t = f(E_t^r, P_t^x)$	4.140	2.915 – 3.695	90%
$TB_t = f(E_t^r, Y_t, Y^*)$	3.650	2.676 – 3.586	90%

From the table 4.2, all the variables used in the three equations have a stable long run relationship in their respective models. Their computed F-statistics exceeded the upper critical values of F-statistic at 90 percent significance levels. Therefore it is appropriate to use the endogenous variables for three equations: import demand function, export demand function and trade balance function, since they have long run relationship.

4.4 Results of the Long Run Imports Demand Function

In this section, the results of the long run import demand function is presented and analysed. The results are reported in Table 4.3 below. The results indicate that income obtained the expected positive sign and statistically significant at the 1 percent level of significance. Thus, a one percent increase in the real *GDP* would increase imports demand by 2.4 percent in the long run. The coefficient of the real income is suggestive

of a high income elasticity of imports demand. A rise in domestic income of Ghana encourages consumers to demand more foreign goods, leading to a deterioration of the trade balance in favour of our trading partners. The high income elasticity is consistent with economic theory, since most of Ghana's imports are necessary and luxury commodities and are expected to be positive and highly income elastic. The results confirm studies done by Bhattari and Armah, and Yol and Baharumshah.

Table 4.3: Estimated Long-Run Coefficients for the Imports Demand Function

ARDL (0,1,0,1,0) selected based on SBC		Dependent variable: $\ln IM_t$	
Regressor	Coefficient	Standard Error	T-Ratio
Constant	-17.8120	3.3500	-5.3170***
$\ln Y_t$	2.4098	0.18112	13.3053***
$\ln E_t^r$	-0.61119	0.16896	3.6173***
$\ln R_t$	0.026075	0.080642	0.32334
$\ln P_t^m$	-0.24699	0.69282	0.35650
<i>Note:</i> *** denotes significance at 1% level			

The import demand elasticity of real exchange rate measures the proportionate rate of change in imports demand as a result of a given proportionate rate of change in real exchange rate, *ceteris paribus*. The long run elasticity of import demand with respect to the real exchange rate is 0.6. The coefficient of real exchange rate has correct negative sign and significant at 1 percent level as the theory predicts, suggesting that increase in real exchange rate makes imports expensive to domestic consumers and consequently reduces demand for their imports. Thus, the elasticity of import demand with respect to the real exchange rate is inelastic in the long run.

The long run elasticities of import demand for Ghana with respect to foreign reserves 0.03 as expected in terms of the sign. The coefficient is not statistically significant at any of the conventional levels. An increase in total foreign reserves will not lead to a significant increase in the domestic demand for foreign goods. The long run elasticity of foreign exchange reserve is very low.

Owing to the results revealed above, it can be concluded with respect to the second hypothesis set in this study that, the null hypothesis is accepted against the alternative that exchange rate adjustment has no significant effect in Ghana's imports.

Additionally, the expectation of import price index was met but it was not significant at any of the conventional levels. Ghana's imports demand comprises more of goods that cannot be produced in the domestic economy. As a result, these goods are demanded even when people complain about their prices. The possible explanation to this outcome is that, the Ghanaian economy has not seen enough in terms of structure and growth as her imports still remain machinery, raw materials and manufactured goods that cannot be produced in the domestic economy. The economy is still undeveloped and depends mainly on the export of primary commodities-namely cocoa beans, timber and minerals.

4.5 Results of the Short Run Imports Demand Function

As indicated earlier on, the import demand function expressed in logarithms measures the degree of responsiveness of a change in imports to change in any of the explanatory variables, *ceteris paribus*. This section presents the short run dynamics of the import

demand function in the ARDL framework. The results are reported in Table 4.4. The incidental diagnostics do not reveal any serious modelling deficiencies.

From the results, the import elasticity with respect to real exchange rate in absolute terms is 0.25 which implies that a percentage increase in the real exchange rate will bring about a 0.25 percentage decrease in imports demand. Thus, the elasticity of demand for imports in the short run is inelastic with respect to the real exchange rate. However, this change in the real exchange rate has no significant impact on the demand for imports at least in the short run.

Table 4.4: Estimates of the Short-Run Error Correction Representation for the Import Demand Function

ARDL (0,1,0,1,0) selected based on SBC		Dependent variable: $\Delta \ln IM_t$	
Regressor	Coefficient	Standard Error	T-Ratio
Constant	-17.8120	3.3500	-5.3170***
$\Delta \ln Y_t$	7.3618	2.7519	2.6752**
$\Delta \ln E_t^r$	-0.24699	0.69282	0.35650
$\Delta \ln R_t$	-0.089668	0.057282	-1.5654
$\Delta \ln P_t^m$	0.61119	0.16896	3.6173***
ECM_{t-1}	-0.98125	0.00012	8177.0833***
$R^2 = 0.69698$ $\bar{R}^2 = 0.54548$ F-Statistic = 5.5204*** DW-Statistic = 2.4508			
, * indicates significance level at 5% and 1% levels respectively.			
NB. The ARDL yields consist estimates whether or not the series are $I(0)$ or $I(1)$. Hence, the short run regression of $I(0)$ and $I(1)$ series is still appropriate.			

Furthermore, the elasticity of imports demand with respect to the real gross domestic product is 7.36. Thus, a one percent increase in the real GDP brings about 7.36 percent increases in the demand for Ghana's imports. This implies that, import demand is income

elastic in the short run. The high income elasticity of import demand is consistent with economic theory since most of Ghana's imports are machinery and raw materials.

The import demand elasticity in the short run is -0.896 and 0.61 with respect to foreign reserve and the import price index respectively. That is, the demand for Ghana's imports is inelastic with respect to both variables. The inelasticity of import demand with respect to the imports price index is due to the fact that most of Ghana's imports are machinery and raw material that cannot be produced in the domestic economy, as the economy is not well industrialized.

The negative sign of the coefficient of the error correction terms ECM_{t-1} in the equation for import demand accord with a priori expectations and indicate that the model is dynamically stable. The relative magnitude, however, suggests that an imbalance in the long-run import demand is corrected much faster. That is to say, the coefficient of the ECM_{t-1} of -0.98125 suggests that approximately 98.1% of the disequilibrium generated in the short run will be corrected each year towards equilibrium in the long run in the case of a shock. This indicates that the rate at which the system corrects itself in the event of a shock is very high. The coefficient of the ECM_{t-1} is highly significant at 1 percent significance level indicating that the model is dynamically stable.

The model has an R^2 of 0.696 and \bar{R}^2 value of 0.545. An R^2 of 0.696 implies that approximately 70 percent of the variations in imports demand of Ghana are explained by the variations in the explanatory variables in the model. The F-statistic of 5.52 is

statistically significant at 1% significant level, thus indicating that all the explanatory variables jointly affect import demand significantly.

4.6 Results of the Long Run Export Demand Function

Like the import demand, the long run export demand function for Ghana is estimated via the *ARDL* framework. The results are presented in Table 4.5. All the coefficients of the regressors achieved their a priori signs.

Table 4.5: Estimated Long-Run Coefficients for the Export Demand Function			
ARDL (0,1,0,1,0) selected based on SBC		Dependent variable: $\ln EX_t$	
Regressor	Coefficient	Standard Error	T-Ratio
Constant	-85.7592	152.4583	-0.56251
$\ln E_t^r$	-3.5870	1.7833	-2.01143*
$\ln P_t^x$	-1.9282	0.7363	2.6188**

The results indicate that, in the long run real exchange rate revealed its expected negative sign with respect to export demand. The coefficient shows that there is an inverse relationship between real exchange rate and the demand for Ghana's exports, which is consistent with a priori economic theory. That is, increase in the real exchange rate (appreciation) of Ghana will make export uncompetitive and thus reduce the demand for our export. The elasticities of the export demand for Ghana with respect to exchange rate is 3.59 at 10 percent level of significance. The relationship indicates that a 10 percent increase in the real exchange rate decreases the value of exports by 3.6 percent. This suggests that an increase in real exchange rate would discourage exports and hence deteriorating the trade balance.

It can be stated with respect to the first hypothesis set for this study that, the null hypothesis is accept against the alternative that exchange rate adjustment has significant effects in Ghana's exports.

The coefficient of export price index indicates that, an increase will significantly decrease export demand. Specifically, a 5 percent increase in export price index will reduce export demand by 1.93 percent.

4.7 Results of the Short Run Export Demand Function

Like the other short run dynamic models, the estimated dynamic model for the export demand function is presented in Table 4.6. The signs obtained are consistent with their long run parameter estimates, albeit none of them was statistically significant. For instance, a one percent increase in real exchange rate will result in a 0.16 percent fall in Ghana's exports. This is suggestive of the inelastic nature of Ghana's export demand.

Table 4.6: Estimates of the Short-Run Error Correction Representation for the Export Demand Function

ARDL (1,0,0) selected based on SBC		Dependent variable: $\Delta \ln EX_t$	
Regressor	Coefficient	Standard Error	T-Ratio
Constant	-3.8908	2.6186	-1.4859
$\Delta \ln E_t^r$	-0.16274	0.13295	1.2240
$\Delta \ln P_t^x$	-0.76801	0.50542	1.5196
ECM_{t-1}	-0.045369	0.018686	-2.42797*
$R^2 = 0.29091$ $\bar{R}^2 = 0.14909$ F-statistic = 2.0513 DW-statistic = 3.0789 <i>NB. The ARDL yields consist estimates whether or not the series are I(0) or I(1). Hence, the short run regression of I(0) and I(1) series is still appropriate.</i>			

The coefficient of export demand with respect to export price index also indicates that, export demand will fall by 0.77 percent, should the export price index increase by one percent. This also confirms the inelasticity obtained from our long run estimates, which is attributable to factors that characterized the inelasticity of exports with respect to the real exchange rate.

The adjustment coefficient achieved the required negative sign and is significant at 10 percent error level. This coefficient shows how the actual levels of export demand for Ghana adjust to the desire level, hence the name adjustment coefficient. This coefficient is quite low and shows how the actual level of the demand for Ghana's exports sluggishly adjusts to its desire level. This is not surprising since the bulk of the country's exports are primary commodities with long gestation period. Thus we cannot meet international orders within a given time frame if our trading partners make such orders. Thus the low adjustment coefficient of the exports demand of Ghana is due to the very characteristics of the export sector.

The model has R^2 of 0.29091 and \bar{R}^2 value of 0.14909, suggesting that the model has a weak explanatory power. However, the F-statistic is significant at the 10 percent level of significance.

4.8 Results of the Long Run Trade Balance

This section presents and discusses the results of the trade balance model presented in the previous chapter. It must therefore be emphasized here that, unlike the export and import

demand models, the dependent variable in the trade balance model is not in the logarithmic form since some of the observations recorded negative values in some of the years under consideration. The results are illustrated in Table 4.7 below.

Table 4.7: Estimated Long-Run Coefficients for the Trade Balance

ARDL (0,1,0,1,0) selected based on SBC		Dependent variable: TB_t	
Regressor	Coefficient	Standard Error	T-Ratio
Constant	2.38733	0.45896	5.2016***
$\ln E_t^r$	-1.1989	0.3275	-3.6608***
$\ln Y_t$	-3.5004	0.6281	-5.5730***
$\ln Y^*$	1.3696	0.5820	2.3533**
<i>Note: ***,** denote significance at 1% and 5% levels respectively</i>			

The results indicate that all the coefficients are statistically significant at the required conventional levels. However, in the long run, the expected sign on the real exchange rate was not achieved. The coefficient of real exchange rate revealed in the results indicates that, Ghana's trade balance does not respond to changes in real exchange rate in the long run.

In the case of real income, no expectation was placed on it, that is to say, the expected sign is ambiguous. It assumes a negative sign and significant at 1 percent level, suggesting a rise in domestic income of Ghana encourages consumers to demand more of foreign goods, leading to a deterioration of trade balance in favour of Ghana's trading partners, which is consistent with theory.

The coefficient of foreign real income variable is significant at 5 percent significance level and obtained a positive sign, which suggests that an increase in foreign real income causes domestic trade balance to increase in the long run.

4.9 Results of the Short Run Trade Balance

The results of the short run model corroborate that of its long run counterpart, as all the coefficients of the former model achieved the signs as that of the latter. However, the real exchange rate variable is statistically not significant.

Table 4.8: Estimates of the Short-Run Error Correction Representation for the Trade Balance

ARDL (1,0,0) selected based on SBC		Dependent variable: ΔTB_t	
Regressor	Coefficient	Standard Error	T-Ratio
Constant	0.28373	0.04589	6.18283***
$\Delta \ln E_t^r$	-4.6912	3.2673	-1.4358
$\Delta \ln Y_t$	-0.35014	0.06281	-5.5746***
$\Delta \ln Y_t^*$	1.3676	0.5820	2.3498**
ECM_{t-1}	-0.99125	0.00015	6608.3733***
$R^2 = 0.63849$ $\bar{R}^2 = 0.53521$ F-statistic = 6.1817*** DW-statistic = 2.5674 <i>NB. The ARDL yields consist estimates whether or not the series are I(0) or I(1). Hence, the short run regression of I(0) and I(1) series is still appropriate.</i>			

The estimated coefficient of the error correction term (ECM_{t-1}) has the expected sign and significant at 1 percent level of significance. Thus, if in the long run the value of trade balance increase by 1 percent, over its equilibrium path, then its growth has to fall by about 0.99 percent in the short run to force trade balance back to their long run growth path.

Moreover, the model has an R^2 of 0.63849 and adjusted R^2 value of 0.53521, suggesting that the data fits the model quite reasonably well. The F-statistic of 6.1817 is statistically significant at 1 percent error level.

4.10 Stability Test

In addition, to check whether the estimation regression equations were stable throughout the sample period, the plots of Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests proposed by Brown et al (1975) were performed to ensure the stability of the parameter estimates in the various models. The importance of these tests is that a movement of the CUSUM and CUSUMSQ residuals outside the critical lines is suggestive of the instability of the estimated coefficients and parameter variance over the sample period. In this study, the test could not reject the null hypothesis that the regression equations are correctly specified at 5 percent level of significance in both the import and trade balance models, implying that there has not been systematic changes in the regression coefficients in these models. However, the plot of CUSUM for the export demand function falls within the 5 percent critical lines, but the plot of CUSUMSQ test exceeds the critical 5 percent. The period in which it went above the critical line was 1997 – 2000. This is the period in which Ghana experienced high levels of inflation, falling price of our major exports and soaring oil price. These could possibly be the reasons for the shifts in the parameters over the sample period.

CHAPTER FIVE

SUMMARY, POLICY RECOMMENDATIONS AND CONCLUSION

5.1 Summary of Major Findings

In this study, it was found that, the import demand elasticity with respect to the real effective exchange rate (used as a proxy for the real exchange rate) is elastic in both the short and the long run periods. It was also found that, the income elasticity of import demands for Ghana is elastic in both the short run and long run periods. However, finding on the elasticity of import demands with respect to foreign reserve revealed an inelastic situation in both time periods. The demand for Ghana's imports is also price inelastic in both the short run and long run periods. Moreover, it was found that, actual imports adjust sharply to its desired level.

On the export side, the elasticity of export demand for Ghana is inelastic with respect to the real effective exchange rate in both the short and the long run periods. The price elasticity of export demand is also inelastic in both periods. The actual levels of Ghana's imports demands adjust very fast, much faster than that of her exports to its desired level.

In the long run, the results show that a stable linear relationship exists among the imports, exports and trade balance, domestic income, foreign income, price indexes.

5.2 Policy Implications and Recommendations

The fact that import and export elasticities are low with respect to the real effective exchange rate and their respective price indexes has important implications for the effectiveness of the open economy macroeconomic policies such as exchange rate and price policies. All other things being equal, currency depreciation, which increases the price of imports and reduces the price of exports in terms of units of domestic currency, will increase the expenditure on imports, whilst export revenues fall as both imports and export are inelastic. This follows from the relationship between price elasticity and total expenditure (revenue) – an increase in the price of a good which is inelastic with respect to price, increases the expenditure on that good. The hope that flexible exchange rate system will automatically remove trade deficit and hence its adoption as part of the economic reform measures during the latter part of 1980s to the present is not felt. They rather aggravated the already fragile and volatile trade current account balance of the Ghanaian economy. The adoption of a flexible exchange rate from the late 1980s to date has not provided any hope and justification for its adoption. The cedi ever since, has depreciated against all the major trading currencies but the current balance has not seen any recovery. The simple conclusion here is that, reliance on exchange rate and or price policies alone are not sufficient to remove the trade and current account deficits.

With regard to the above discussion it is recommended that trade and the current account balance should be tackled through inward looking approach. The export sector needs to be diversified and an attempt should be made to process the export commodities before they are exported. Domestic industries should improve their level of efficiency and

quality of their products in order to compete favourably with foreign goods in both home and the world markets. Though liberalization has not helped much, it should not be completely condemned, as anti liberalization policies and trade restrictions may have retaliation effects. Improving domestic production in terms of quality and efficiency will be quite helpful. The campaign for patronization of made-in-Ghana goods by leaders of the economy, though not bad, needs some reconsideration and direction. The campaigners must recognize the fact that, the objective of the consumer is utility maximization and does not take into consideration how the growth of domestic firms will affect the over all performance of the macro economy. Policy makers should therefore direct much attention to the production side and let producers know the harm they cause their own businesses and the economy as a whole by producing shoddy good in an inefficient manner.

5.3 Conclusion

This study examines the effects of exchange rate on Ghana's external trade from a macro econometric perspective. The findings confirm the existence of both short-run dynamics and long-run causal relationships between the demand for imports, demand for exports and the trade balance on one hand and the real effective exchange rate, the real domestic product, foreign reserves, import price index, export price index and foreign income on the other hand. The import and export demand functions as well as trade balance model were estimated using Autoregressive Distributed Lag (ARDL) approach to cointegration and error-correction representation on the annual data between the periods 1986 and 2005. The objective of the study was to examine the effects of exchange rate on Ghana's

imports and exports demands, and also, the effects of exchange rate on Ghana's external trade. The results of the study indicated that flexible exchange rate does not have much impact on Ghana's external trade. Given that flexible exchange rate is not the solution to the external trade and balance of payments problems, the government and policy makers in the Ghanaian economy are urged to encourage technical innovation, remove structural bottlenecks and rigidities, encourage efficient resource allocation and investment in labour saving technology.

To sum up, the information provided in this study is a useful guide to policy makers, especially those in the Trade Ministry and the Central Bank who want to anticipate future changes in the external trade in response to currency depreciation and appreciation of the cedi. The results indicates that despite the economic reforms measures towards liberation, the Ghanaian economy is still fragile to respond to market signals so as to use the exchange rate policy to manage its external balance.

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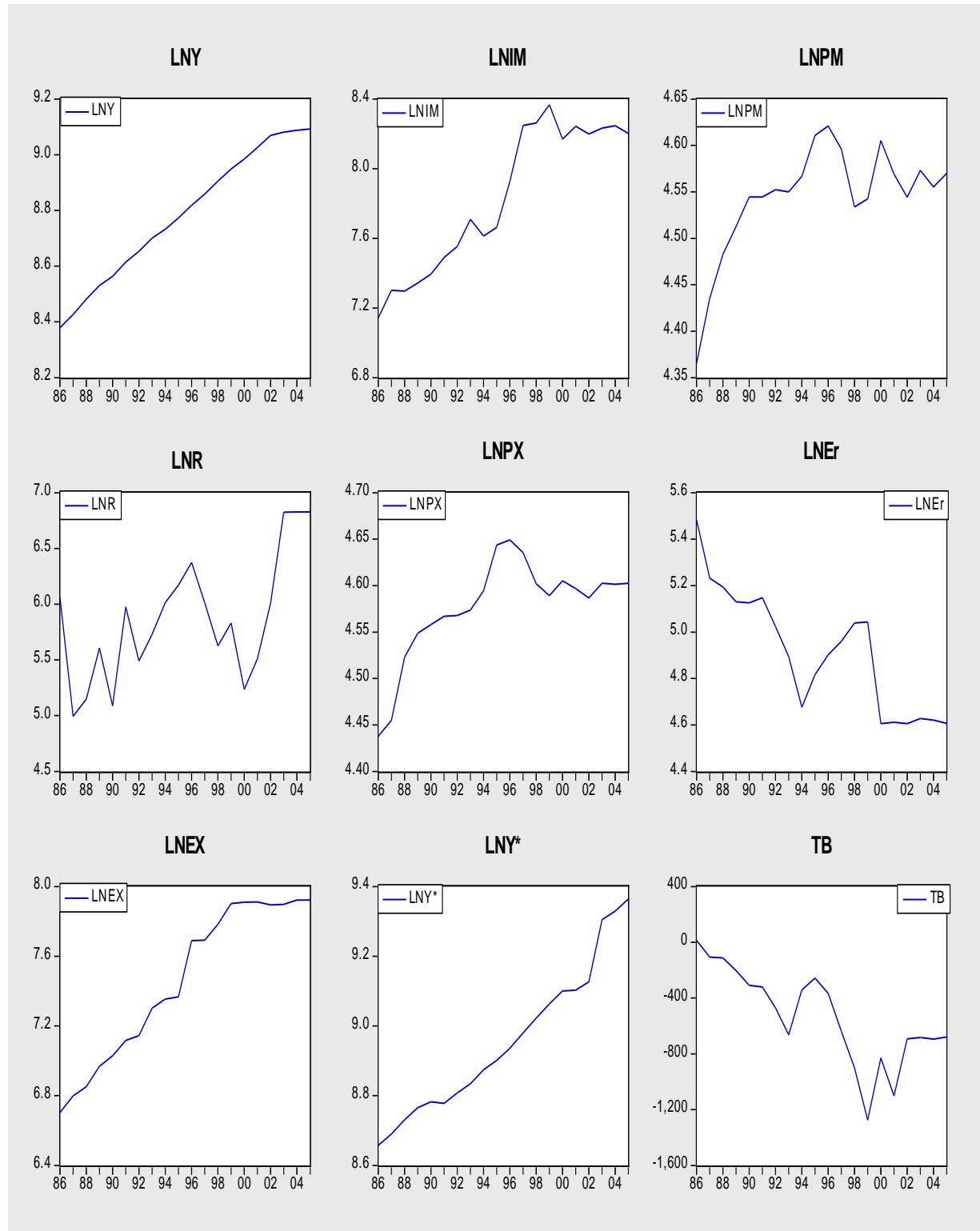
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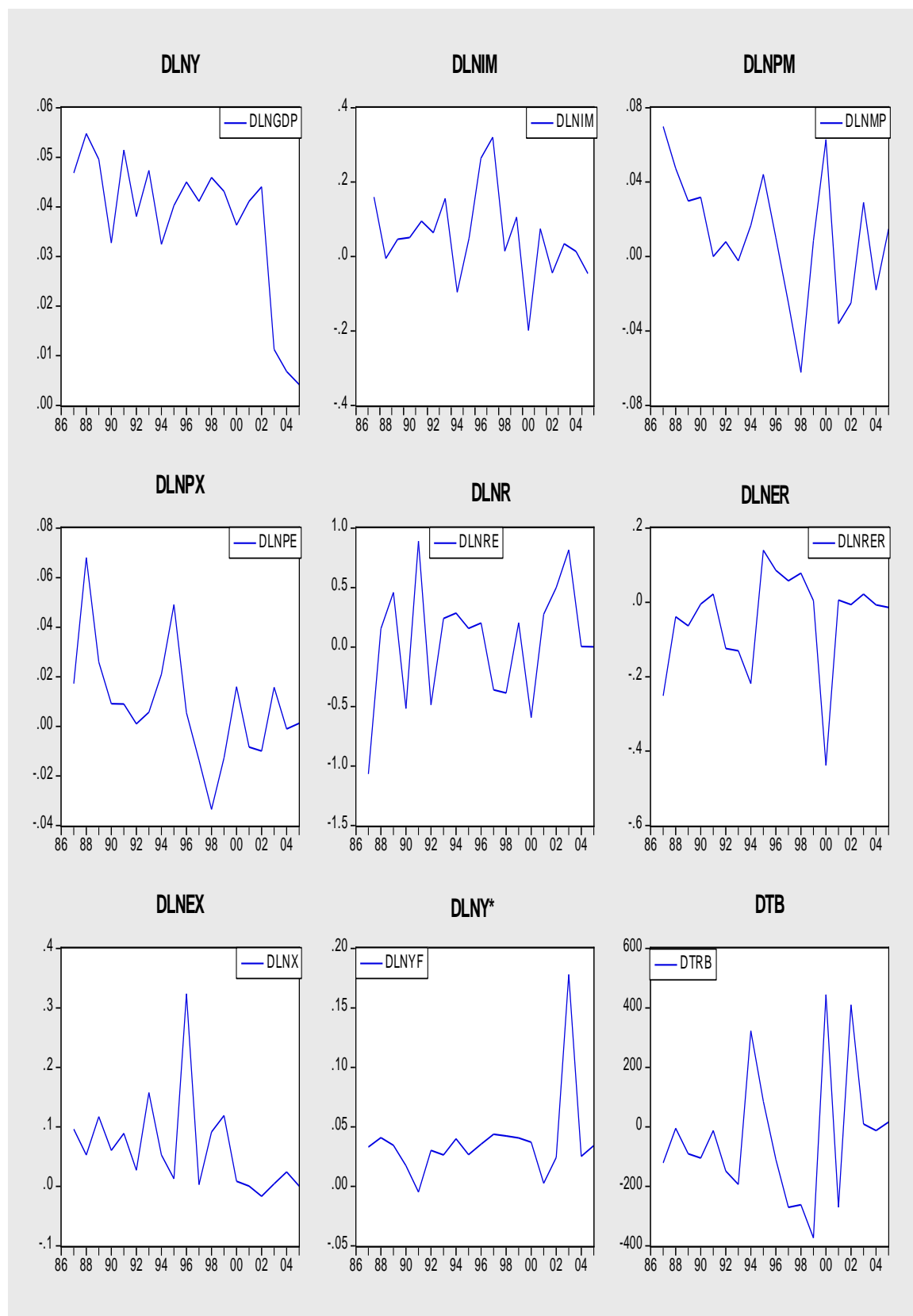
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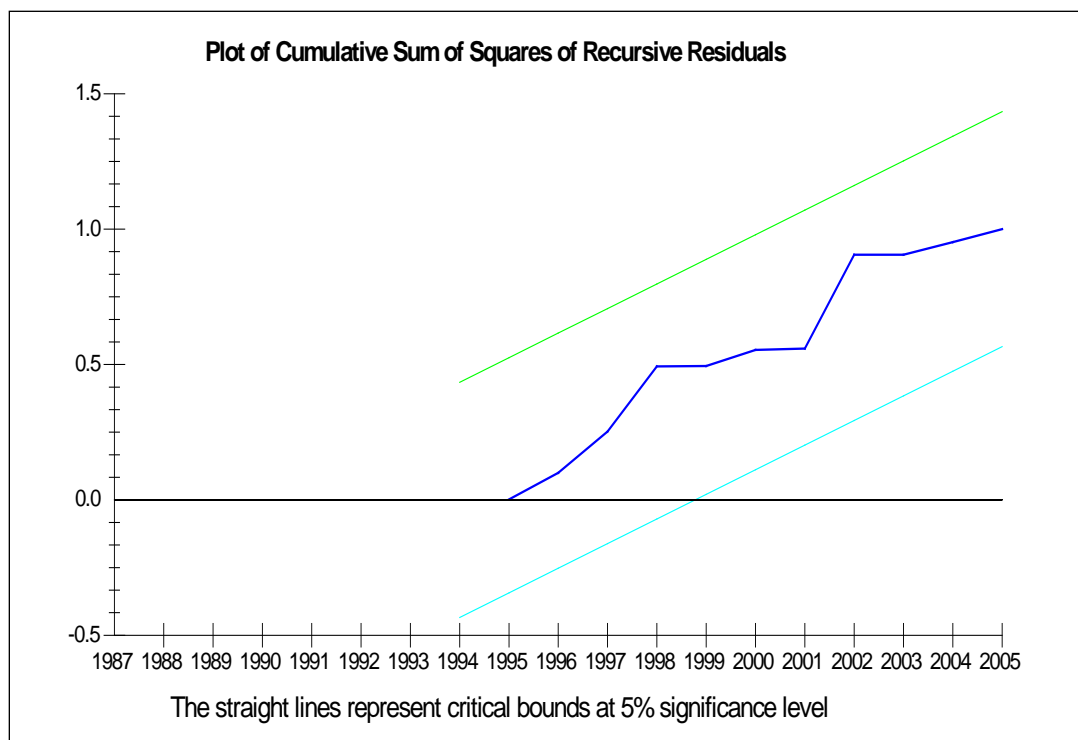
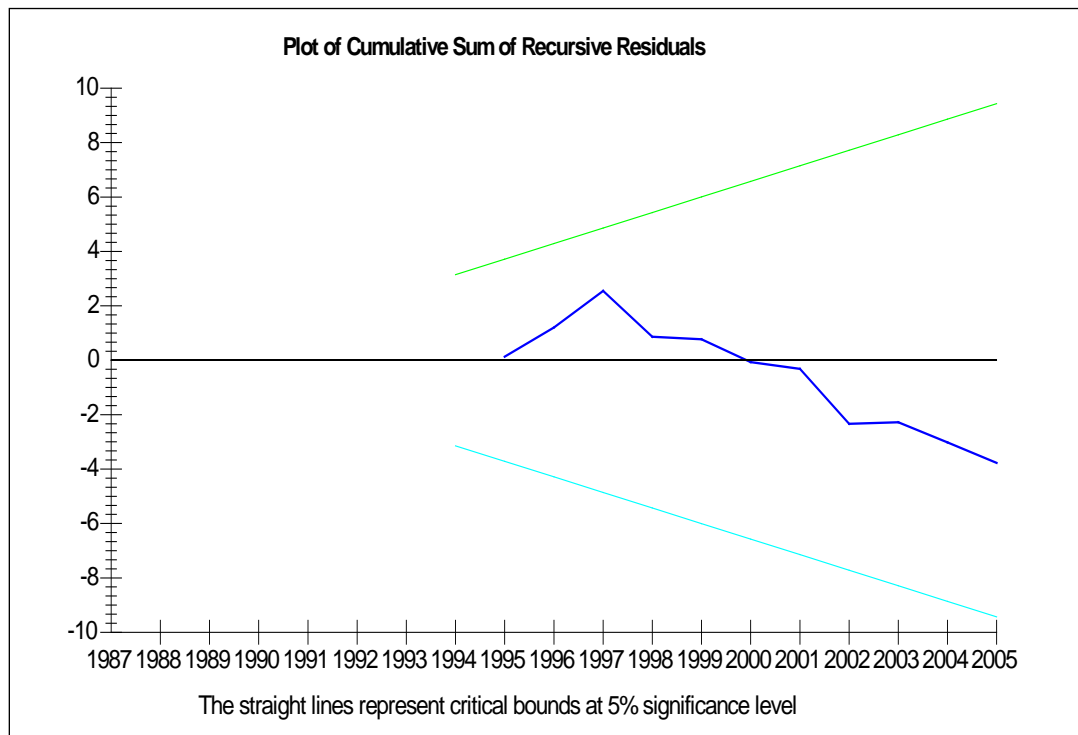
APPENDIX

Appendix A: Plots of the Variables in their Levels and First Differences

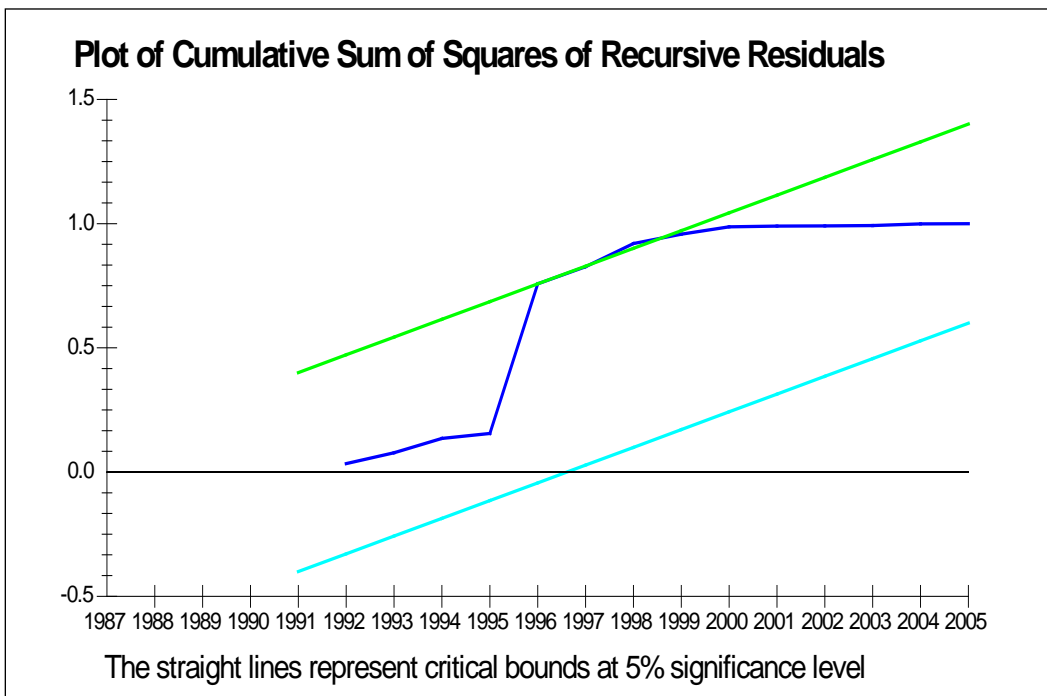
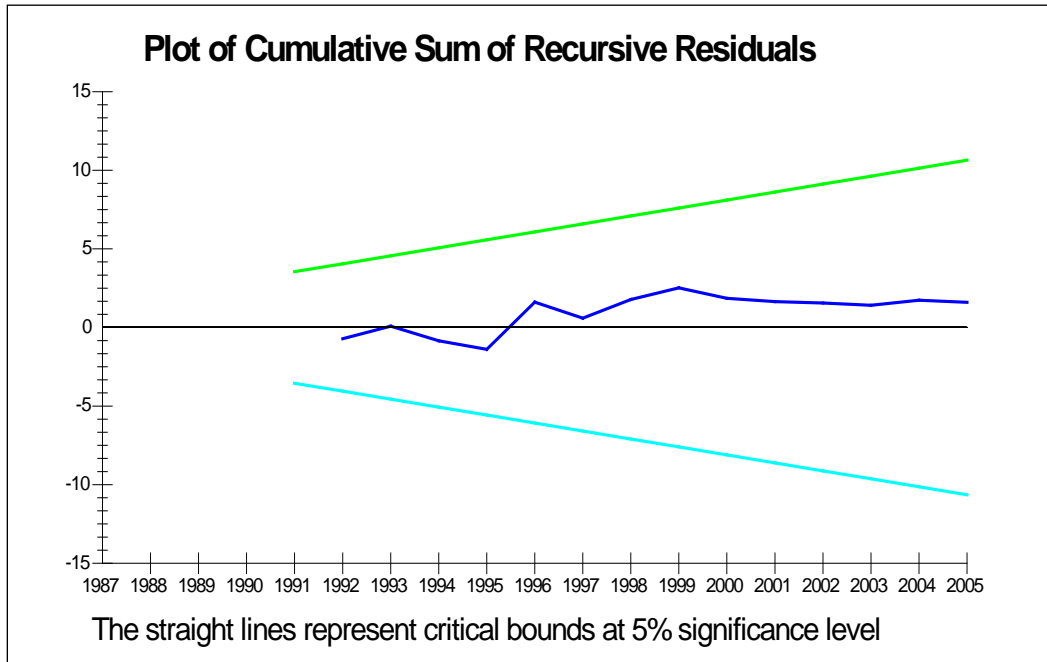




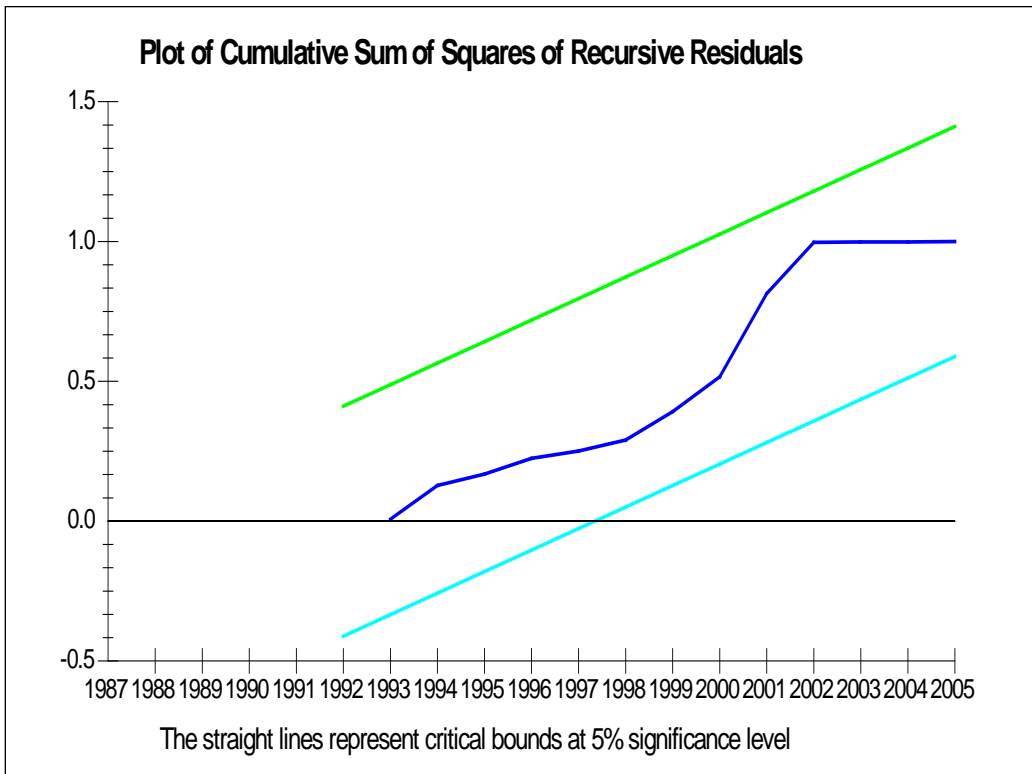
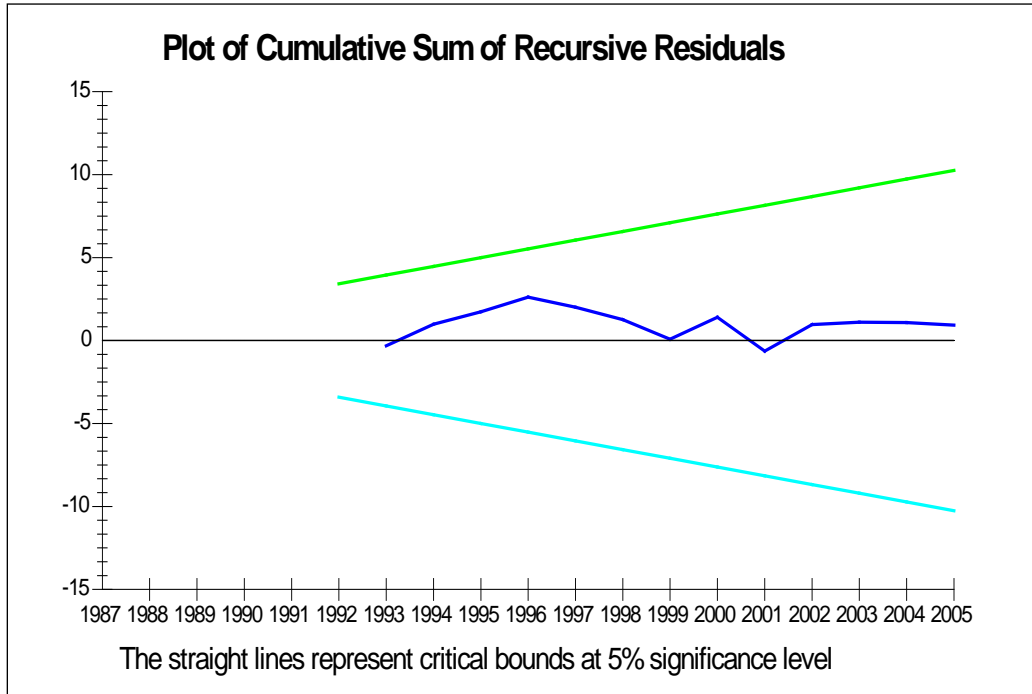
Appendix B: CUSUM and CUSUMSQ Tests (Imports)



Appendix C: CUSUM and CUSUMSQ Tests (Exports)



Appendix D: CUSUM and CUSUMSQ Tests (Trade Balance)



APPENDIX E: DATA

Year	Real effective exchange rate index (1995 = 100)	GDP (constant 1995 US\$)	Exports of goods and services (constant 1995 US\$)	Imports of goods and services (constant 1995 US\$)	Trade balance	Reserve
1986	1.95E+02	4.36E+09	8.14E+08	1.26E+09	-4.49E+08	91.78
1987	1.52E+02	4.57E+09	8.97E+08	1.48E+09	-5.86E+08	57.5
1988	1.46E+02	4.82E+09	9.45E+08	1.47E+09	-5.30E+08	77.14
1989	1.37E+02	5.07E+09	1.06E+09	1.54E+09	-4.82E+08	141.31
1990	1.36E+02	5.24E+09	1.13E+09	1.63E+09	-4.97E+08	113.44
1991	1.39E+02	5.51E+09	1.23E+09	1.79E+09	-5.55E+08	269.59
1992	1.23E+02	5.73E+09	1.27E+09	1.91E+09	-6.40E+08	192.24
1993	1.08E+02	6.00E+09	1.48E+09	2.23E+09	-7.46E+08	380.02
1994	8.69E+01	6.20E+09	1.56E+09	2.02E+09	-4.62E+08	663.24
1995	1.00E+02	6.46E+09	1.58E+09	2.13E+09	-5.44E+08	1079.91
1996	1.09E+02	6.75E+09	2.19E+09	2.77E+09	-5.84E+08	1182.1
1997	1.16E+02	7.04E+09	2.19E+09	3.82E+09	-1.63E+09	1337.62
1998	1.25E+02	7.37E+09	2.40E+09	3.87E+09	-1.47E+09	1464.04
1999	1.26E+02	7.69E+09	2.70E+09	4.30E+09	-1.60E+09	1382.3
2000	8.10E+01	7.98E+09	2.73E+09	3.53E+09	-8.04E+08	2522.36
2001	8.15E+01	8.31E+09	2.73E+09	3.80E+09	-1.08E+09	2865.35
2002	8.10E+01	8.69E+09	2.68E+09	3.64E+09	-9.56E+08	5728.16
2003	8.08E+01	8.77E+09	2.70E+09	3.71E+09	-1.01E+09	12937.2
2004	8.11E+02	8.82E+09	2.77E+09	4.19E+09	-1.42E+09	2522.36
2005	8.06E+02	8.94E+09	2.81E+09	4.32E+09	-1.51E+09	2865.35

Source: World Development Indicators (CD Rom, 2004)
International Financial Statistics (CD Rom, 2004)
World Trade Indicators (CD Rom)

APPENDIX F

Autoregressive Distributed Lag Estimates

ARDL(0,1,0,1,0) selected based on Schwarz Bayesian Criterion

Dependent variable is LNIM

19 observations used for estimation from 1987 to 2005

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LN _Y	7.3618	2.7519	2.6752[.020]
LN _Y (-1)	-4.9520	2.7377	-1.8088[.096]
LN _{ER}	.61119	.16896	3.6173[.004]
LN _R	-.089668	.057282	-1.5654[.143]
LN _R (-1)	.11574	.057100	2.0270[.065]
LN _{PM}	.24699	.69282	.35650[.728]
C	-17.8120	3.3500	-5.3170[.000]

R-Squared	.97248	R-Bar-Squared	.95871
S.E. of Regression	.080210	F-stat. F(6, 12)	70.6615[.000]
Mean of Dependent Variable	7.8660	S.D. of Dependent Variable	.39475
Residual Sum of Squares	.077204	Equation Log-likelihood	25.3447
Akaike Info. Criterion	18.3447	Schwarz Bayesian Criterion	15.0392
DW-statistic	2.4508		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	1.4290[.232]*	F(1, 11)= .89459[.365]*
* B:Functional Form *CHSQ(1)=	.0036845[.952]*	F(1, 11)= .0021335[.964]*
* C:Normality *CHSQ(2)=	.48040[.786]*	Not applicable
* D:Heteroscedasticity*CHSQ(1)=	.26957[.604]*	F(1, 17)= .24466[.627]*

A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

Appendix G

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Autoregressive Distributed Lag Estimates
ARDL(1,0,0) selected based on Schwarz Bayesian Criterion
*****
Dependent variable is LNX
19 observations used for estimation from 1987 to 2005
*****
Regressor      Coefficient      Standard Error      T-Ratio[Prob]
LNX(-1)        .95463              .068686             13.8984[.000]
LNER           .16274              .13295              1.2240[.240]
LNPX           .76801              .50542              1.5196[.149]
C              -3.8908             2.6186              -1.4859[.158]
*****
R-Squared      .97356              R-Bar-Squared      .96827
S.E. of Regression .073815          F-stat. F( 3, 15) 184.1159[.000]
Mean of Dependent Variable 7.4975          S.D. of Dependent Variable .41441
Residual Sum of Squares .081731          Equation Log-likelihood 24.8034
Akaike Info. Criterion 20.8034          Schwarz Bayesian Criterion 18.9146
DW-statistic    3.0789          Durbin's h-statistic -2.4644[.014]
*****

Diagnostic Tests
*****
*      Test Statistics      *      LM Version      *      F Version      *
*****
*      *      *      *      *
* A:Serial Correlation*CHSQ( 1)= 5.8774[.015]*F( 1, 14)= 6.2704[.025]*
*      *      *      *      *
* B:Functional Form *CHSQ( 1)= .30353[.582]*F( 1, 14)= .22729[.641]*
*      *      *      *      *
* C:Normality *CHSQ( 2)= 9.5491[.008]*      Not applicable      *
*      *      *      *      *
* D:Heteroscedasticity*CHSQ( 1)= .052236[.819]*F( 1, 17)= .046866[.831]*
*****
A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values
Estimated Long Run Coefficients using the ARDL Approach
ARDL(1,0,0) selected based on Schwarz Bayesian Criterion
*****
Dependent variable is LNX
19 observations used for estimation from 1987 to 2005
*****
Regressor      Coefficient      Standard Error      T-Ratio[Prob]
LNER
LNPX
C
*****

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Appendix H

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Autoregressive Distributed Lag Estimates
ARDL(0,1,0,0) selected based on Schwarz Bayesian Criterion
*****
Dependent variable is TB
19 observations used for estimation from 1987 to 2005
*****
Regressor          Coefficient          Standard Error          T-Ratio[Prob]
LNER               -469.1167              326.7339                -1.4358[.173]
LNER(-1)           -729.7613              304.0255                -2.4003[.031]
LNY                -3500.4                628.1412                -5.5727[.000]
LNFI               1369.6                581.9934                2.3533[.034]
C                  23873.3               4589.6                 5.2016[.000]
*****
R-Squared          .82736      R-Bar-Squared          .77804
S.E. of Regression  153.5650    F-stat.      F( 4, 14)  16.7735[.000]
Mean of Dependent Variable -560.3047    S.D. of Dependent Variable  325.9499
Residual Sum of Squares  330151.0    Equation Log-likelihood    -119.7071
Akaike Info. Criterion   -124.7071    Schwarz Bayesian Criterion   -127.0682
DW-statistic          2.5674
*****

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Diagnostic Tests
*****
*      Test Statistics      *      LM Version      *      F Version      *
*****
*      *      *      *      *      *      *      *      *
* A:Serial Correlation*CHSQ( 1)= 2.5448[.111]*F( 1, 13)= 2.0104[.180]*
*      *      *      *      *      *      *      *      *
* B:Functional Form    *CHSQ( 1)= .39427[.530]*F( 1, 13)= .27548[.609]*
*      *      *      *      *      *      *      *      *
* C:Normality          *CHSQ( 2)= 1.7112[.425]*      Not applicable      *
*      *      *      *      *      *      *      *      *
* D:Heteroscedasticity*CHSQ( 1)= 2.2105[.137]*F( 1, 17)= 2.2382[.153]*
*****
A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

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