ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

A DYNAMIC MONETARY MODEL OF ETHIOPIA

BY

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A THESIS SUBMITTED TO
THE SCHOOL OF GRADUATE STUDIES OF THE
ADDIS ABABA UNIVERSITY IN PARTIAL FULFILMENT
OF THE REQURIEMNTS OF THE
DEGREE OF MASTER OF SCIENCE IN ECONOMIC
POLICY ANALYSIS

JULY 2003

ADDIS ABABA

ACKNOWLEDGEMNETS

My deep and warmest appreciation goes to my family: Mom, Dad, Omer, Ibro, and Adu. Thank you all! Special thanks go to Dr. Haile Kibret for his very critical comments and patience to listen to and discuss whatever ideas I might have. I greatly benefited from discussions with Ato Seid Nuru, and Ato Daniel Zerfu. I am also indebted to those who have helped me throughout the last two years, specially Ato Melesse Minale and Ato Aberra Senbeta.

I am also grateful to the National Bank of Ethiopia and to the Economic Research Department. I would also like to thank the staff of the Documentation Division of the Research Department for their excellent service and cooperation, particularly, W/ro Tiruwork Alemayehu and Ato Wondeyefraw Taddesse.

Finally, I would like to thank the African Economic Research Consortium (AERC) for sponsoring my stay at Nairobi and also for sponsoring the research project.

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Abstract

The paper has developed a very small monetary model of the Ethiopian economy. The model is made up of five behavioral equations linking the monetary sector, aggregate demand and supply, and the external sectors of the economy. The motivation for the study is derived from the desire to present a model that would help us analyze the behavior of key macroeconomic variables in Ethiopia and help us address the effectiveness of stabilization policy.

The model was estimated using the cointegration technique.. In all the equations the variables in the long run equations were first tested and found to be cointegrated of order one. The integrated series of variables were then tested for cointegration by the Johnsen Cointegration test. Annual data from 1965/66 to 2001/02 was used to estimate the behavioral equations of the model. Individual equations of the model satisfied a number of statistical diagnostic tests and the model as a whole was found to be stable with very good within sample tracking performance.

Two dynamic counterfactual simulations were carried out using the model. The first simulation tried to assess what the performance of the Ethiopian economy would have been without the 1992 devaluation. The results indicate that without the devaluation, the performance of the external sector would have been very poor. The overvalued exchange rate would have resulted in a deteriorated trade balance, on average by 26 percent per year. The second policy experiment considered the effect of sustained credit contraction. The results seem to indicate that sustained domestic credit contraction could reduce output with very little improvement in the net foreign asset position of the economy.

The policy implications that could be derived from the study are that overvalued exchange rate adversely affects economic performance. This empirical finding is similar with the findings of Ghura and Green(1993). Another important policy implication of the study is that policies accompanying devaluation i.e. such as domestic credit restraint should be

scrutinized carefully as credit restraint may result in reduced output with out much improvement in external balance of the economy.

Keywords: Stabilization policy, Monetary Model, Cointegration, Simulations, Devaluation, Monetary Restraint.

INTRODUCTION

Like most developing countries, Ethiopia has been experiencing severe macroeconomic imbalances in the form of fiscal and balance of payment deficits. The causes of such a dismal state of the economy is traced either to domestic factors such as excessive fiscal deficit or to external factors such as deterioration in the terms of trade. Stabilization policies are basically put in place to help reduce these internal and external imbalances.

Economic reform began in Ethiopia in the early 1990s with the general aim of bringing about macroeconomic stability and fostering long run economic growth. As a result important demand management polices such as fiscal, monetary, and exchange rate policies were put in place. Since the beginning of the last decade, then, the Ethiopian government's macroeconomic stabilization efforts have been supported by policies that aimed at establishing the fundamental conditions that are needed for internal and external balance.

Macroeconomic policies of stabilization have simultaneous effects on many of the target variables such as output, inflation, and the balance of payments. In other words, while the main objective of stabilization policy is to reduce internal and external imbalances, the specific policy instruments that are used are likely to have ramification on the other variables of interest. The effectiveness of these stabilization policies also depend on the dynamic interrelation among the major macro variables. The motivation for this study is derived from the desire to present a model that would help us analyze the behavior of key macroeconomic variables in Ethiopia and help us address the effects of a reform package similar to those

implemented in the early 1990s. The framework is designed to simultaneously capture the relationship among money, income, price, and the balance of payments. In short, the purpose of the study is to develop a formal framework that would enable us analyze the effects of stabilization policies.

Specifically, the purpose of the paper is twofold. First to construct a monetary model that incorporates interactions among the monetary sector, aggregate demand and supply, and the foreign sector. The next step to estimate the model using annual data from 1965/66 to 2001/02 for the Ethiopian economy, and test the validity of the model. The second and important objective of the paper is to perform simulation exercises to examine the effects of stabilization policies. In this regard, the paper would try to see the dynamic responses of the economy to two major stabilization policies i.e. devaluation of the exchange rate and to tight credit policies.

The study is useful because monetary, fiscal, and exchange rate policies are used in Ethiopia to address internal and external imbalances. Thus, the model can be used as a formal way of analyzing the effectiveness of stabilization policy to bring about internal and external balance in the Ethiopian context.

The remainder of the paper is organized as follows. Chapter two deals with an overview of the Ethiopian economy including structure and macroeconomic performance over the last four decades. Chapter three presents the survey of the relevant literature on stabilization policy. Chapter four is devoted to specification of the model and interpretation of the

estimation results. Chapter five presents the policy experiments regarding stabilization policies. Chapter six concludes the paper.

CHAPTER TWO

A BRIEF REVIEW OF THE ETHIOPIAN ECONOMY

2.1 Economic Structure and Performance

Ethiopia is the third largest country in Africa with an estimated population of 65 million at the end of 2002. The Ethiopian economy is predominantly agricultural, although the relative importance of agriculture has been steadily declining over the last four decades. In 1960/61, agriculture, forestry, and fishing accounted for about 75.8 percent of the gross domestic product (GDP), compared to 43 percent at the turn of the century. The important role of Agriculture is further highlighted by the fact that about 85% of the population depends on the sector for a livelihood, mainly in subsistence and self-employment basis.

Ethiopia does not have diversified agriculture. Hence, only few cash and food crops are cultivated. Being immensely dependent on agriculture, the economy has particularly been susceptible to unpredictability in weather conditions. Added to this is the total neglect of irrigation scheme to combat inadequate rainfall. The area under irrigation is very limited which means that agricultural production is greatly affected by changes in weather conditions. Cyclical drought and famine together with the civil war have made it impossible to bring about structural transformation in the agricultural sector of the economy.

Periodic review of the growth performance of the Ethiopian economy shows that during the last twelve years of the Imperial regime i.e. 1960/61-1972/73, real GDP recorded an average annual growth rate of 3.8 percent against 2.3 percent annual rise in population growth, leading to an increase in real per capita income of 1.5 percent. Many attribute this positive increase in per capita income to high level of private investment participation and to a consistent and generally sound management of the economy (Eshetu and Mekonen, 1992).

Table 2.1. Selected Macroeconomic Indicators

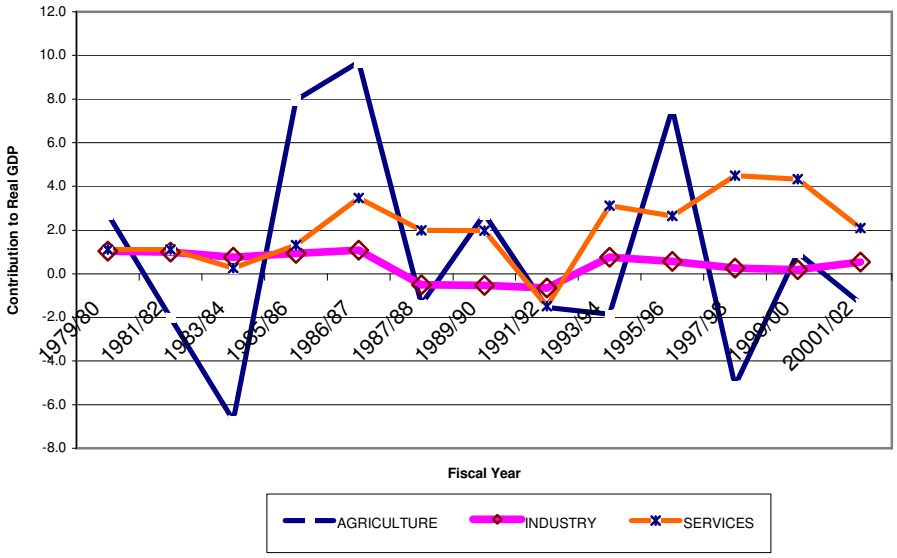
				Period Averages		
	1999/00	2000/01	2001/02	60/61-73/74	74/75-90/91	91/92-01/02
GDP at Current Prices	53189.7	54210.7	51760.6	4301.4	11755	40171.3
GDP Growth (% p.a.) [1]	5.4	3.7	3.7	3.8	1.9	4.5
Growth in Agriculture	2.2	11.5	-3.1	2.1	1.5	2.2
Growth in Industry	1.8	9.6	6.4	7.5	1.3	2.2
Growth in Services	9.5	4.7	4.6	7.8	3.3	7.2
Fixed Investment/GDP (%)	15.9	17.8	20.5	16.2	13.2	16.1
Domestic Saving/GDP (%)	0.9	2.6	1.8	14.1	7.5	4.4
External Transactions						
Current Account Balance/GDP (%)	-9.6	-10.1	-12.8	-1.3	-4.3	-7.8
Debt/Export (%)	556.9	579.7	583.3	-	304.4	540.3
Official Exchange rate *(Annual Average*)	8.1	8.3	8.5	2.5	2.07	6.4
Parallel exchange rate (*Annual Average)*	8.3	8.8	8.7	2.5	4.3	8
Government Finance						
Domestic Revenue /GDP (%)	17.9	18.8	20.1	9.8	17.7	18.1
Current Expenditure/GDP (%)	25.8	19.1	20.4	10.2	17.9	18.2
Current Surplus/GDP (%)	-8	-0.4	-0.3	-0.3	-0.3	-0.2
Capital Expenditure/GDP (%)[2]	7.8	7.7	8	96.5	36.2	10.3
Overall Deficit/GDP (%)	-15.8	-8	-8.3	-96.9	-36.5	-10.5
Money Supply and Price Movements						
Broad money (% increase p.a.)[3]	14.4	10.5	9.7	11.3	12.7	11.8
CPI (Addis Ababa) % increase p.a. [4]	4.2	-1.4	-5.5	1.5	9.1	3.9

Source: Ministry of Finance and Economic Development (MOFED) and National Bank of Ethiopia
1/GDP at constant (1980/81) factor cost
2/ Data available beginning 1965/66 fiscal year
3/ Data available beginning 1963/64 fiscal year

4/ Data available beginning 1967/68 fiscal year

Sectoral decomposition of GDP during the period 1960/61-1972/73 shows that the source of growth was distributed rather unevenly among the economic sectors. While the average annual growth of manufacturing, mining, and construction was over 7 percent and that of services almost 8 percent in real terms, the agricultural sector as a whole grew at an annual rate of about 2.1 percent. However, the subsistence sector of agriculture, whose production is for home consumption and where the bulk of the population is employed, grew at an average rate of only 1.9 percent in real terms, which is less than the rate of population increase of 2.7 percent per annum.

Figure 2.1.1. Sector Contribution to Real GDP growth



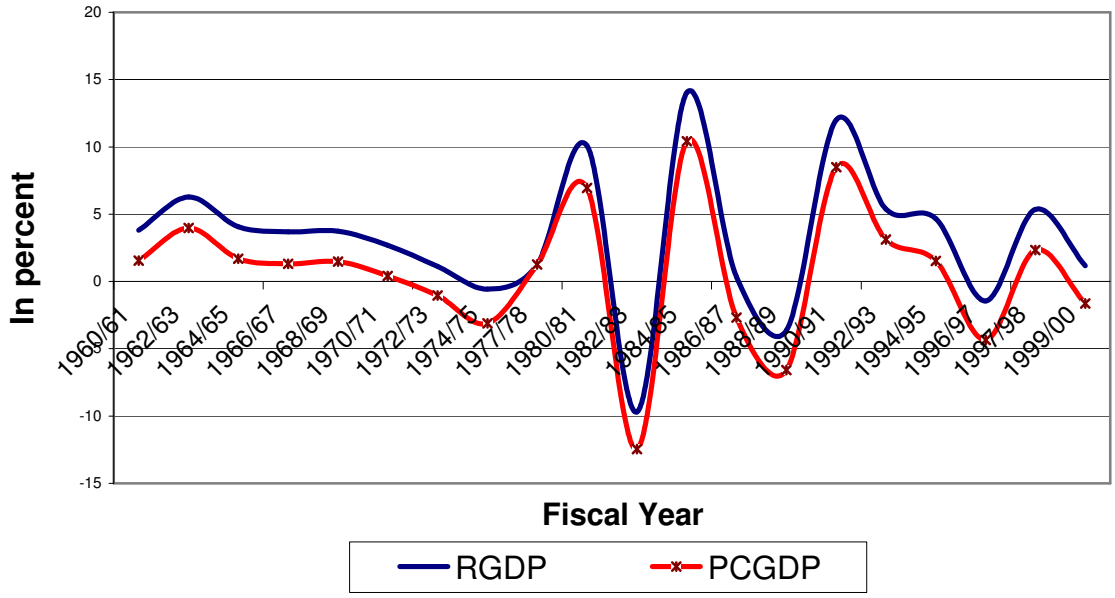
Source: Based on data from Ministry of Finance and Economic Development (MOFED)

The mobilization of domestic saving was high at these early days of economic development. As such, gross domestic saving amounted to 14 percent of GDP per annum during 1960/61-1972/73. This early period of development is also characterized by relative degree of price

stability with the increase in consumer price index being less than two percent for the years 1966/67-1972/73. The relative price stability coupled with conservative fiscal developments seems to have contributed to growing saving performance and low external debt profile during the period under review (Eshetu and Mekonen, 1992).

The macroeconomic performance of the country during the military regime of the Derg (1974/75-1990/91) was rather unsatisfactory. Over this period, real GDP grew at an average rate of 1.9 percent per annum against population growth rate of 2.6, indicating declining per capita income. This weak result is attributed, among other things, to poor performance of the agricultural sector, huge military spending, and very protective and inward looking trade policy. The only good performing part of GDP was the services sector mainly consisting of hotels and restaurants (MEDaC, 1999).

Figure 2.1.2. Growth Rates of Real GDP and Percapita income



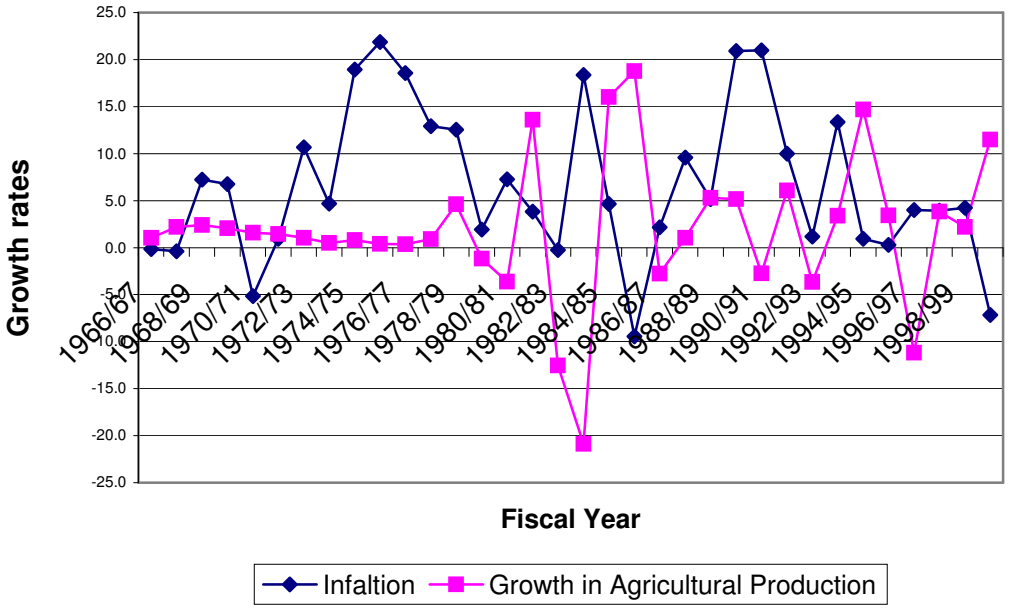
Source: Based on data from Ministry of Finance and Economic Development (MOFED)

Gross domestic expenditure was persistently increasing throughout the Military regime, rising from an average of about 6.1 percent in 1960/61-1973/74 to 7.3 percent in 1974/75-1990/91. On the consumption side, private consumption had the lion's share i.e. more than 70 percent. However, during the same period, public consumption consistently increased as one might expect in a centrally managed economy. On balance, during the Derg regime there was higher volatility of domestic saving ranging from a high of 13 percent in 1987/88 to as low as 3.4 percent in 1990/91. Gross fixed capital formation as percent of GDP averaged about 14 percent per annum during the 17 years reaching a peak of 20.4 percent in 1987/88. The gap between investment and domestic saving required foreign savings, which comes in the forms of grants and loans. This is very much reflected in the countries debt burden, which increased from 14 percent of GDP in 1975 to a high of 214 percent of GDP in 1990/91 averaging about 21 percent over the 17 years of the military regime (Befekadu et al , 2001).

The military government also operated a system of price control on almost every commodity that gets to the market. However, inflation rose to 8.4 percent per annum during 1974/75-1989/90. The rise in the average rate is mainly explained by weather conditions that affected agricultural production. For example, the particularly good performance of prices in 1980/81 when inflation rate was 1.9 per cent is associated with the 4.8 percent growth in agricultural production in 1979/80.

With the change of government in May 1991 there came a radical change in economic orientation away from the "socialist" regime of the Derg in to the more liberal capitalist system of the free market. In mid-1992, the government began implementing significant economic reforms aimed at stabilizing the economy and deregulating economic activity.

Figure 2.1.3. Trends in Price and Agricultural Output



Source: Based on data from Ministry of Finance and Economic Development (MOFED) and National Bank of Ethiopia

The policy measures aimed at lifting restrictions on the private sector, reducing macroeconomic imbalances, realigning the exchange rate and liberalizing the trade system. Added to these reform measures is the decentralization of the political system and reform of the civil service.

The economic reform measures seem to have paid off, or at least it could be argued that the economy is recovering, with the average growth rate of real GDP for the period 1992/93-1997/98 reaching about 6.7 percent. The annual rate of inflation also dropped from 21 percent in 1990/91 and 1991/92 to an average rate of 5 percent during the 1992/93-1997/98 period.

The trend of saving and investment also showed some improvement compared to the pre-reform period indicating that some of the measures taken by the government to encourage saving, such as raising the deposit rate significantly, have made some impact. Even then, the highest level of gross domestic saving achieved during the first six years of the reform is only about 9.9 percent of GDP in 1996/97.The trend of investment started to show a steady recovery since 1992 increasing to about 18 percent in 1997/98. The low level of saving, however, has meant widening resource gap, which reached an average of –7.9 percent of GDP during the last 11 years (Befekadu et al, 2001).

2.2 Fiscal Policy

Despite the important role of fiscal policy, the implementation of the policy has been characterized by inefficiency and lacking direction. However, owing much to the fiscal conservatism that the Imperial government perused, the budget deficit was at a relatively lower level. This helped to have low level of borrowing requirement, which contributed to slow the growth rate of money. For instance, the share of expenditure and revenue in GDP, on average, stood at 11 percent and 8.5 percent per annum over the period 1966/67-1972/73,

respectively. In addition, the government was able to finance the overall deficit largely by non-inflationary borrowing from the domestic market.

During the time of the Derg i.e. 1973/74-1990/91, the government pursued expansionary fiscal policy, which resulted in huge budget deficit mainly financed from domestic bank borrowing. The government introduced new taxes and augmented the existing tax rates, enabling it to tap significant amount of domestic revenue. As such, total government revenue stepped up from Birr 771.4 million in 1974/75 to Birr 3142.6 million in 1989/90 i.e. a growth rate of 342 percent. As a share of GDP, revenue rose from 8.4 percent in 1970/71 to 24.7 percent in 1988/89, and then went down to 18.7 percent at the end of the 1989/90 fiscal year.

Table 2.2. Summary of General Government Finance

(In percent of GDP)

						Period Averages		
	1997/98	**1998/99**	**1999/00**	**2000/01**	**2001/02**	***66/67-73/74***	***74/75-90/91***	***90/91-01/02***
Domestic Revenue	18.8	19.4	19.0	19.5	20.1	8.0	17.2	18.1
Of which: Tax Revenue	*11.8*	*11.5*	*12.1*	*13.7*	*15.3*	*6.9*	*12.7*	*12.2*
Current Expenditure	16.0	20.7	25.8	19.8	22.3	8.3	17.5	18.2
Of which: General Services	*7.4*	*11.5*	*15.6*	*10.1*	*8.9*	*4.1*	*17.5*	*18.2*
Current Surplus	3.0	-1.4	-6.9	0.4	-0.3	-0.3	-0.3	-0.2
Capital Expenditure	9.2	9.1	6.4	9.2	11.8	2.1	7.2	9.3
Overall Deficit	*-6.5*	*-10.5*	*-13.3*	*-9.5*	*-14.0*	*-2.4*	*-7.5*	*-9.5*
Financed By								
Foreign (net) and Grants	4.0	5.4	4.9	8.6	15.2	1.7	4.7	7.0
Domestic Borrowing (net)	1.9	4.1	8.7	0.5	-0.2	0.6	2.8	2.4
Banking System (net)	*1.3*	*1.8*	*10.3*	*-0.4*	*1.4*	*-*	*3.3*	*2.1*
Other	0.6	1.0	-0.3	0.3	-0.9	-	-0.7	0.2
GDP (Current Market Prices)	*44840.3*	*48803.2*	*53189.7*	*54210.7*	*51760.6*	*5268.6*	*11755.*	*40171*

Memorandum Items: Changes over the Previous Year (%)

	1997/98	1998/99	1999/00	2000/01	2001/02	
Total Revenue		20.8	12.4	6.7	4.9	-1.6
Tax Revenue		11.5	6.1	15.3	15.4	6.5
Current Expenditure		26.8	43.0	35.8	-24.7	2.0
Capital Expenditure		-10.1	6.8	-22.7	46.0	22.5

Source: Ministry of Finance and Economic Development and author's calculations

Like revenue, government expenditure experienced a general increasing trend during the military regime. It rose from about Birr 663.9 million in 1973/74 to Birr 5283.1 million in 1989/90 i.e., from 10.3 percent to 31.3 percent of GDP. This increase in expenditure that was much faster than revenue led to persistent deterioration of the fiscal balance in the 1980s. The budget deficit has enlarged from 1.2 percent of GDP in 1971/72 to 12.7 percent in 1989/90. The observed high expenditure to GDP ratio is mainly attributed to growing defense expenditure, the proliferation of state owned enterprises and the increasing debt service payments. According to African Development Indicators (2001), Ethiopia's deficit (including grants) to GDP ratio, recorded at 9.8 percent in 1990 was higher than the sub-Saharan Africa average of 4.3 percent of GDP.

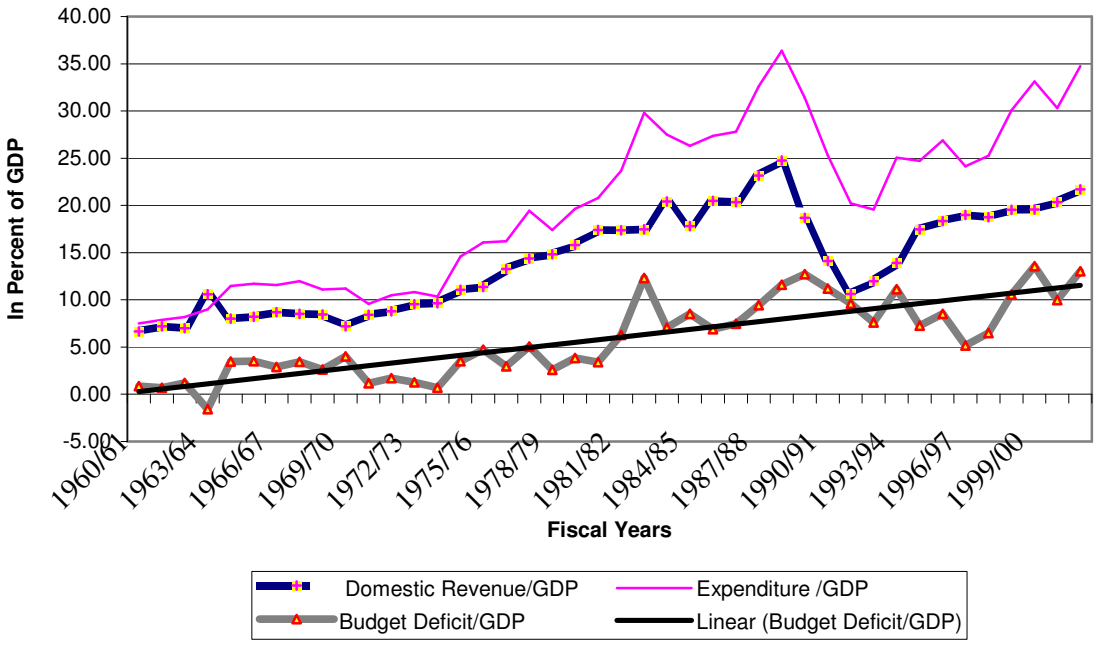
In sum, the assessment of fiscal performance during the 17 years of the Derg show that the policy was rather focused on regulating the economy rather than allocating, stabilizing, and promoting growth. In fact fiscal policy has been one major destabilizing factor as in case of revenue shortfalls the government resorted to borrowing from the banks leading to monetary expansion. Hence money supply, M1 and M2, showed almost 5-fold increase from 1974/75 to 1989/90(Getachew, 1992).

The fiscal position showed signs of improvement at the start of the reform program. The fiscal performance during 1992/93-1994/95 mainly reflected the postwar availability of

external funds, reforms to the tax system, and efforts to restrain and reorient expenditure. Government revenue performance improved from 11 percent of GDP in 1991/92 to 13.7 percent by 1993/94.

However, the rise in revenue counterbalanced by the surge in expenditure from about 20 percent of GDP in 1992/93 to 25 percent in 1993/94 before dropping back to 24 percent in 1994/95. The overall fiscal deficit (excluding grants) increased to 11 percent of GDP in 1993/94 before narrowing down to 7.6 percent in 1994/95.

Figure 2.2. The Fiscal Structure



Source: Based on data from Ministry of Finance and Economic Development

The inflow of foreign resources has enabled the government to reduce bank financing such that during 1992/93 -1994/95 external financing (net) covered about 72.6 percent of the

deficit enabling the government to make substantial repayments to the banking system (World Bank, 2001).

Between the periods 1995/96-1997/98 both total revenue and total expenditure increased as a percentage of GDP, but revenue increased faster that expenditure leading to a reduction in fiscal deficit from 8.7 percent of GDP in 1995/96 to 6.5 percent in 1997/98 excluding grants, and from 5.9 percent to 3.6 percept including grants. During the same period, the government borrowing from the banking system was -0.3 percent of GDP i.e. the government was actually repaying rather than borrowing.

The relatively good start of the fiscal situation changed dramatically during the period 1998/99-19999/00 as a result of the border conflict with Eritrea in that defense expenditure increased from 3.0 percent of GDP during 1995/96-1997/98 to 13.1 percent of GDP in 1999/00. Total expenditure increased from 24 percent of GDP in 19996/97 to 33.1 percent in 1999/00. As a result, the deficit (excluding grants) increased to 14.8 percent of GDP in 1999/00.The way the deficit was financed also shows the impact of the war. Before the conflict started in 1998, the government was actually repaying the banking system. This, however, changed when government borrowing from the domestic sources increased from 3.1 percent of GDP in 1998/99 to 9.6 percent in 1999/00. Especially, the conflict has caused significant reallocation of resources from key priority sectors such as health and education (World Bank, 2001).

2.3 Monetary Policy

The growth of money supply during the pre-revolution (1974) period was quite modest. For example during the period 1966/67-1972/73 the average growth rate of M2 was around 9.3 percent per annum compared to a 5.4 growth in nominal income. In the following years, however, the average growth rate of M2 surged to two digit figures.

The command economy that the country followed during the military regime preordained that there be direct control on money and its components. In line with the "socialist" ideology, the government nationalized all private banks, imposed a credit ceiling on banks, set up administered interest rates so as to favor public enterprises, channeled credit to priority areas and introduced controlling mechanisms on money. With inflation rate averaging 9.8 percent during the period, this meant that real deposit rate was negative.

The practice was that banks had very little authority in their lending activity as the government compelled them to provide credit for public enterprises and cooperatives. Consequently, claims on central government (net) grew on average by 25 percent during 1974/75-1991/92. The increase was, in some measure, due to the government's decision to bring down the debt-equity ratio of the public enterprises. This was achieved mainly through a substantial sale of bonds by the treasury to the banking system. When the recapitalization of public enterprises was completed during the 1984/85-1987/88 period, the contribution of this component to domestic credit subsided to an average of 11.7 percent for the period 1987/88-1991/92. The foreign reserve of the country during the Derg period was so low having small contribution for growth of money supply. (Befekadu and Berhanu, 2000).

Despite the prevalence of negative real returns on deposits, savings have been growing at about 10 percent per annum during the 17 years of the Derg mainly due to the absence of alternative investment outlets. This has enabled the government to channel financial resources to the "socialized" sector while maintaining a stable macroeconomic environment in the face of faster money supply growth than the nominal value of the production of goods and services in the economy (MEDaC, 1999).

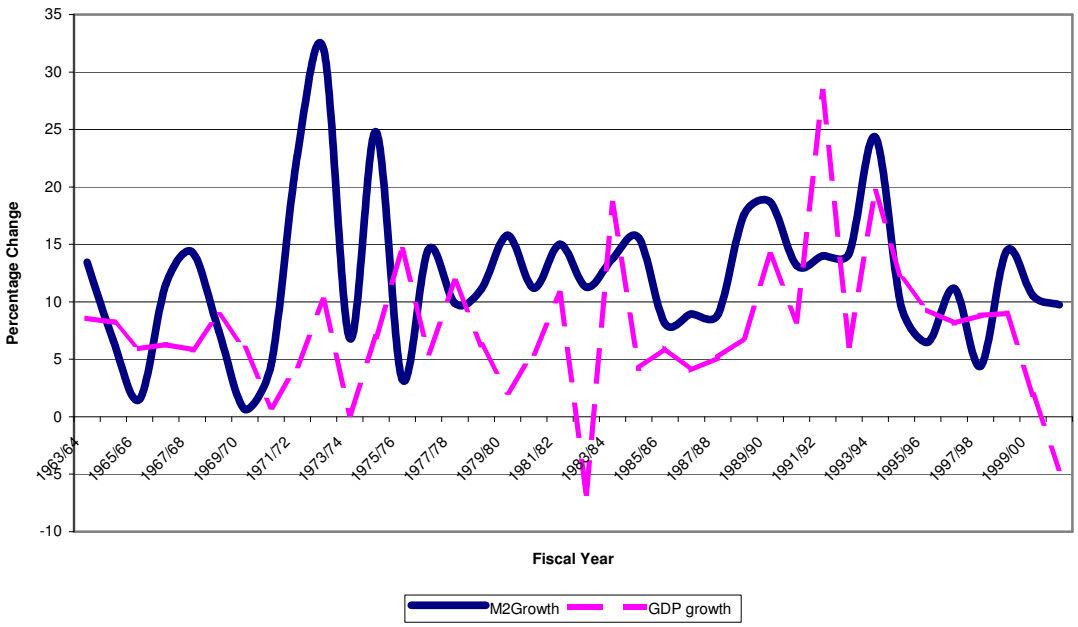
The monetary policy of the reform program dictated money supply to grow at a rate that is consistent with inflation, economic growth, and the balance of payments, while allowing reasonable credit for the private sector. The stock of money supply, which has been expanding during the pre-reform periods, has maintained a more or less stable path during the fist period of the reform program.

During 1991/92-1997/98, the average annual growth rate of broad money was 13 percent. The growth in credit to the government declined from its peak of nearly 28 percent in 1989/90 to 2.2 percent in 1995/96. On the other hand, claims on other sectors grew on average by 27.4 percent. If anything, the growth of money supply over the above three fiscal years mainly resulted from increased credit demand by the private sector.

The situation of tight monetary policy changed at the beginning of the border conflict with Eritrea, and money supply started to increase considerably. In 1999/00, M1 and M2 sharply increased by 14.6 and 14.3 percent, respectively, compared with a nominal GDP growth of 9 percent. Component wise, domestic credit showed an increase of 31 percent annual growth as claims on government skyrocketed by more than 54 percent year-on-year basis. The conclusion of the war saw a reversal of this high growth of money supply relative to

domestic income. As such, the growth of M1 and M2 subsided to about 7.8 and 10.9 percent per annum, respectively, during 2000/01-2001/02 fiscal years.

Figure 2.3. Growth Trends in Broad Money supply and Nominal GDP



Source: Based on data from Ministry of Finance and Economic Development (MOFED) and National Bank of Ethiopia

This was mainly due to the slow down in claims on government, which registered an average annual growth of only 4 percent after the end of the war. The conclusion of the war also brought about a turnaround in the net foreign asset position that showed an annual average increase of 31.7 percent growth compared to the 1999/00 level.

Steps were also taken to pave the way for fostering financial markets and so as to introduce new and indirect monetary policy instruments. Accordingly, T-bills auction market was

introduced in January 1995. Currently, T-bills with three types of maturity that is 28 days, 91 days and 182 days are auctioned at fortnightly basis. However, at present the market operates to satisfy the budgetary requirements of the government. This has handicapped the role of monetary authorities since government with annual deficit of 7 percent of GDP is not concerned to repurchase the bills for the sake of stabilizing the demand and supply of money.

Although a few years have passed since the issuance of the directive to establish an inter-bank money market, very few transactions have been effected to date. The main reason for the low interaction might be the considerable excess liquidity existing in almost all of the commercial banks.

2.4. External Trade and Exchange Rate Policy

2.4.1 External Trade

Foreign trade is an important sector in the Ethiopian economy. One basic character of this sector has been the consistent trade deficit (except registering surpluses in 1972/73and in 1973/74), has meant that Ethiopia has been a net importer in its international transactions for the past four decades.

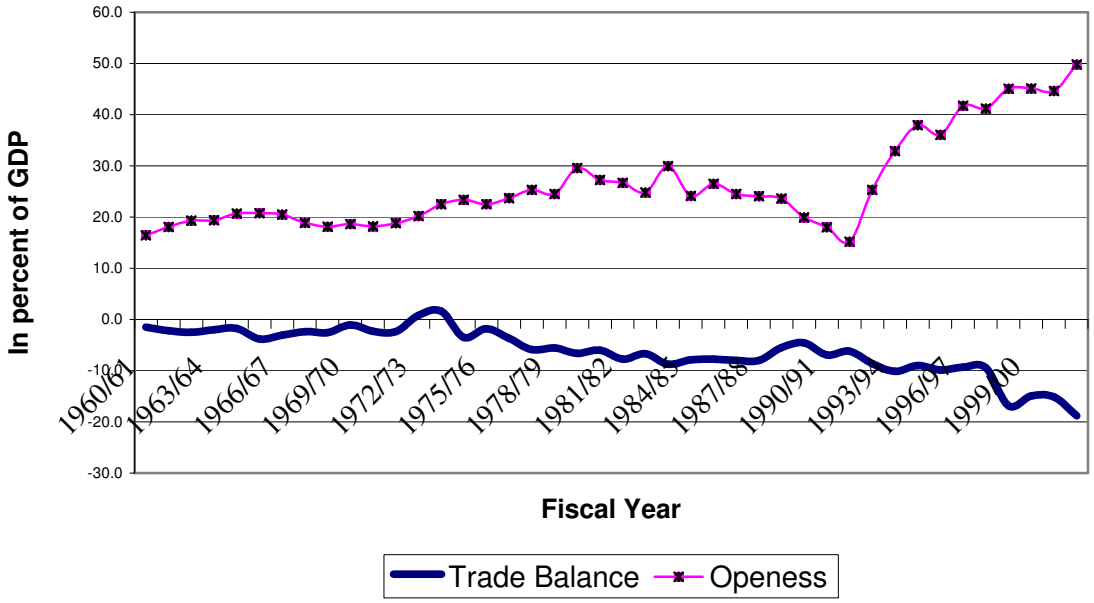
The openness of the Ethiopian economy, as measured by total trade (i.e. the ratio of the sum of imports and exports to GDP) increased significantly from about 21 percent in 1964/65 to more than 49 percent in 2001/02. During 1960/61-1972/73, exports were growing on average by 9.6 percent while imports were showing an annual average growth of 6.9, entailing an annual average trade surplus of 2.1 percent of GDP. The export sector suffered

much in the 1980s mainly due to the inward looking policy of the "socialist" government. In 1973/74-1990/91 the annual average growth of export was 2.7 percent against an import sector that grew by 8.5 percent per annum. The net effect of the steady increase in imports against the dreary of exports during 1973/74-1990/91 was the steady increase in the country's trade deficit. As a ratio of GDP, the trade deficit, which was 3.5 percent of GDP in 1974/75 climbed to 7 percent in 1990/91.

During 1991/92-2001/02, an average of about Birr 2.8 billion worth of goods were exported while imports amounted, on average, to about Birr 8.6 billion. The relatively high quantity of imports is mainly attributed to trade liberalization measures (such as lifting of import restrictions) taken by the government as part of its reform program. The effect of the liberalization, however, is felt more in the growing trade deficit, which rose from 8.6 percent of GDP in 1992/93 to reach 18.8 percent in 2001/02. The ever-widening trade balance has meant that export earnings are continually dwindling and not being able to cover import bills of the economy. This calls for measures to be taken to diversify exports, which are currently concentrated on some agricultural exports whose price has continually been declining in the international market.

In sum, the export sector is still very much dependent on few agricultural products with no sign of structural change. In addition the amount of export earnings of the economy has been secularly declining due to slowdown in commodity prices in international markets. The ever-widening trade balance has lead to an increasing reliance on external financing in the form of aid and credit.

Figure 2.4.1. Openness and Trade Balance



Source : National Bank of Ethiopia, Various Issues

2.4.2 Exchange Rate Policy

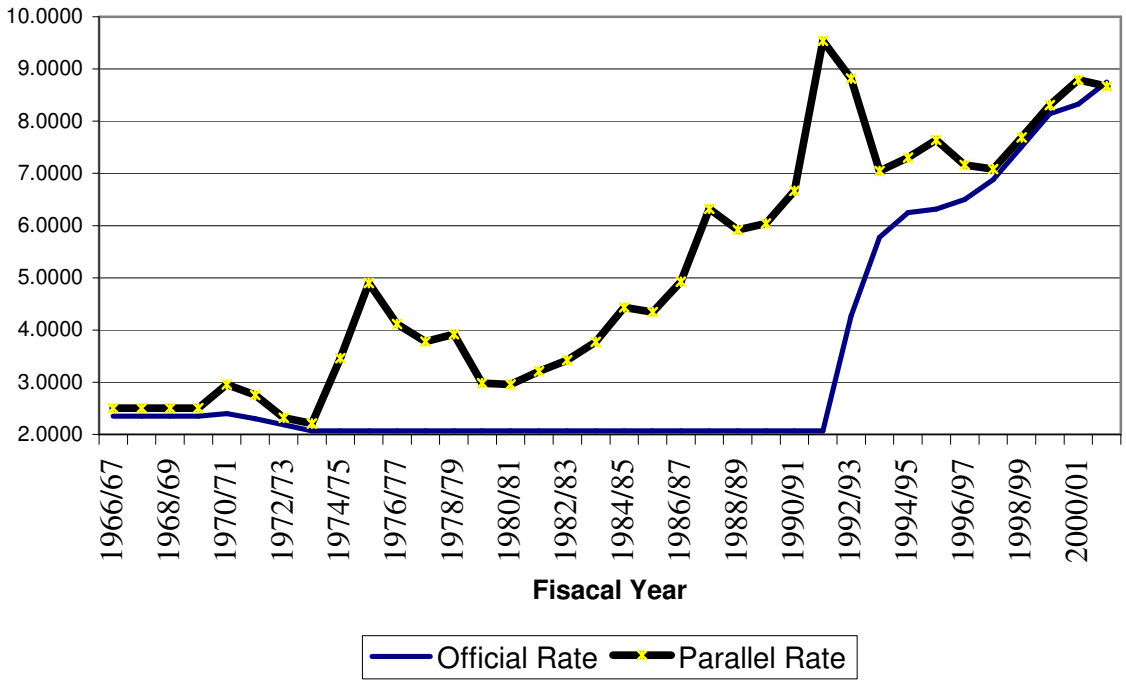
The Ethiopian Birr was first introduced in 1945 with an official exchange rate of Birr 2.48 per US dollar. A small adjustment was made in 1964, which devalues the rate to Birr2.5 per US dollar. In December 1971 when US dollar was floated and ceased its convertibility to gold, the Birr appreciated to a rate of Birr 2.3 for one US dollar. The currency further appreciated to Birr2.07 in 1973 and it remained at this rate until October 1992 when it was devalued to Birr 5 for one US dollar (Ibrahim, 1992).

The liberalization of the foreign exchange rate was facilitated with the introduction of retail auction market in May 1993. Since then, several key modifications have been made to the

auction market. The retail auction system was later replaced by wholesale auction in September 1998. In the same year, inter-bank foreign exchange market was introduced and for sometime both the inter-bank and the wholesale auctions were working together. Beginning October 2001, however, foreign exchange auction market has been totally replaced by the inter-bank foreign exchange market.

As shown in figure 2.4.2, during the imperial period both the official and parallel exchange rates were moving very close to each other. The parallel market for foreign exchange seems to have expanded during the 17 years of the Derg regime (1974-1991), especially in the late 1980s, due to foreign exchange rationing and capital controls.

Figure 2.4.2. Trends in Official and Parallel Exchange Rates



Source : National Bank of Ethiopia, Various Issues

If we are to assume that the parallel market rate represents the true value of the currency, then the Birr was clearly overvalued during the Derg period. Consequently, the parallel rate was about 136 percent higher than the official rate in 1975/76 and it further climbed up to a 222 percent in 1990/91. However, following the devaluation of the Birr and the subsequent policy measures taken, the parallel premium has come down to a level of being almost equal to the official rate at the end of 20001/02.

To sum up, growth performance of the Ethiopia economy has been rather slow with average GDP growth rate less than 4 percent per annum during the last four decades. There has also been a very slow change in the structure of the economy over the years. The share of agriculture in GDP is declining. Sadly enough, this declining share of agriculture is not taken up by the industrial sector but rather by the services sector, which have very little contribution for industrialization. Low economic growth, rising unemployment, and increasing poverty all have culminated in a vicious cycle of low income, low savings and low investment, and as a result have led the country to a low level of economic development. Furthermore, deteriorating performance of the agriculture sector, despite the highest priority placed on it, has been the major factor hindering economic growth and well being of the society.

CHAPTER THREE

A SURVEY OF THE LITERATURE

3.1. Theoretical Literature

Overall economic performance in sub-Saharan Africa during the last three decades has been disappointing relative to the strong performance of developing countries of Asia and Latin America. While Asia and Latin America benefited from rising per capita income right through the 1970s, sub-Saharan Africa languished and in a number of instances average per capita income of the region declined. In the 1980s most Asian countries continued to enjoy the benefits of sustained economic growth while the situation in sub-Saharan Africa failed to show any signs of improvement in terms of macroeconomic performance (World Bank, 2000).

The literature attributes both domestic and external factors to the unsatisfactory macro economic performance. Sharp declines in commodity export prices and the considerable decline in terms of trade has essentially characterized the external environment facing African countries. This has been compounded by the nature of African governments and the inefficient public administration that they run. Finally, and more importantly, the inappropriate and sometimes haphazard nature of economic policies that these countries were following has made its own contribution to the poor macroeconomic performance (Ghura and Hadjimichael, 1996).

The essence of stabilization policy is to bring about a balance between demand and supply of the economy. For this to be realized there are varieties of policies that can be employed i.e. demand management and supply side policies.

The monetarist view contends that letting aggregate demand expand more than aggregate supply usually causes inflation and balance of payment problems. Consequently, stabilization can be achieved only if demand is restrained to the economy's supply capacity. Demand management policies mainly encompass fiscal and monetary policies with the primary impact falling on containing domestic absorption. The major instruments of demand side stabilization program of macroeconomic policy includes:(1) restrictive fiscal policy which seeks to shrink overall public sector deficits, (2) tight monetary policy which restricts money growth to be close to the rate of economic growth and places emphasis upon the role of interest rates in stimulating savings, and (3) devaluation of the exchange rate as a starting point for further liberalization to make it market determined.

These policies are supposed to foster low inflation, increased savings and investment, and enable the progress of a competitive exchange rate. These outcomes in turn are expected to bring about a reasonable and sustainable rate of economic growth.

There is, however, continuous debate on the subject of whether monetary and fiscal policies are reliable and effective stabilization policy instruments in developing countries. The criticism has particularly focused on IMF type stabilization policy recommendations. The main critics are the structurallists who contend that supply side policies, which aim to

promote restructuring of real side of the economy, should be given priority in stabilization programs (Mosely et al, 1995).

3.1.1. Conventional Theories of Stabilization

The main purpose of this section is to review the different views expressed regarding macroeconomic targets of stabilizations policy. In what follows attempt will be made to present the existing literature on stabilization policy relating it to the objective of the study.

3.1.1.1 The Balance of Payments

The balance of payments is one key macroeconomic variable and as a result there has been extensive literature and different approaches to explain the determinants of the balance of payments position of a country. The elasticity, absorption and monetary approches to the balance of payment are discussed in brief below.

In simple terms, the elasticiy approach states that the elasticity of demand for exports by foreigners and that of imports by domestic residents determine the position of the current account or the balance of payments. The approach relies on the use of devaluation to bring about equilibrium in the current account, which depends crucially on the elasticity of export, and the demand for imports. This is what is called the Marshall-Learner condition. The general consensus among economists regarding the empirical evidence of the elasticity approach is summed up by the J-curve effect. The J-curve effect simply states that the short

run effect of devaluation is to worsen the current account while it will improve shortly afterwards.

As the name implies, the absorption approach emphasizes the difference between domestic output and absorption. This approach predicts that balance of payment problems can be dealt with the use of expenditure switching and/or reducing policies. The overall implication of this approach is that the effect of devaluation on the current account depends on two crucial factors. First, the assumption made about the state of the economy i.e. the relative position of the economy to its full employment point. Secondly, on the fulfillment of the Marshall-Learner condition.

The monetary approach to the balance of payment, on the other hand, views disequilibrium in the balance of payments as being determined by disparity in the demand for and the supply of money. Thus, the overall balance of payment as measured by the amount of international reserves, is influenced by imbalances of the money market. Assuming fixed exchange rates, we can derive that excess money supply causes excess aggregate expenditure which forces domestic money holders to demand foreign goods and services. This demand for foreign goods can only be satisfied by running down international reserves, which leads to balance of payment deficit. Since by definition, changes in money supply is equal to changes in international reserves and changes in domestic credit, the outflow of reserves forces money supply to decline until it reaches to new equilibrium level. Alternatively, an excess demand for money causes foreign exchange inflow i.e. following the same logic as outlined above (Polak 1997).

The formal presentation of the monetary approach consists of the following set of equations.

$M^s = R + D.$ .....(1)

$M^d = f(Y, P, I)$ .....(2)

$M^s = M^d$ .....(3)

The first equation presents the definition for the supply of money (M^s) to equal to the sum of international reserves(R) and domestic credit (D). Equation (2) is the formal presentation of the demand for money i.e. nominal money balances is a function of income (Y), prices (P), and the opportunity cost of holding money, interest rate (I). Combining the first two equations and representing them in change forms and solving for the change in international reserves, we derive the following final equation.

$\Delta R = \Delta[f(Y, P, I)] - \Delta D$ .....(4)

Equation (4) simply states the above arguments, such that, the change in balance of payment (represented by the change in international reserves) is the result of the difference between the growth of money demand and the growth of domestic credit.

As can be easily discerned a change in domestic credit, say for example a decline, will bring about an equal and opposite change in the level of international reserves. For all of this to hold, however, it is necessary that the first term in the right hand side i.e. the money demand function, be stable. Given this the policy recommendation has been tight credit policy, fiscal restraint and devaluation of the exchange rate. The monetary approach has its origin in the IMF and is associated with financial programming, which the Fund uses to forecast macroeconomic developments in member countries.

On the other hand, structuralists view balance of payments problem from the perspective of economic structure and international economic forces. The nature of exports from developing countries face inelastic demand on international market. This leads to adverse terms of trade situations. As pointed out above, export instability not only causes inflationary pressures to develop but it also contributes to deteriorating balance of payment condition.

3.1.1.2. Theories of Inflation

Inflation is basically defined as a continuous and sustained increase in the price level. A methodical dealing of the causes and sources of inflation started with the quantity theory of money. According to this theory, inflation is purely a monetary phenomenon both in the long and short run. This argument is based on the assumption that the economy is operating at full employment. However the basic premises of such view has to come from the classic dichotomy, which argues that the product and money markets are completely independent (Miskin, 1997). Thus the solution to inflationary problems is to control the growth of money supply such that it follows the growth of demand for money.

The Keynesian model usually referred to as the inflationary gap model is another model developed by Keynes. This Keynesian model points out that the economy is always in a dynamic disequilibrium i.e. downward inflexible wages and prices prevent the economy from reaching full employment (Miskin, 1997).

The Keynesian analysis of inflation at full employment level starts with the argument that monetary policy could be accommodative. The inflationary gap model, accordingly, argues

that the money market has no role in determining inflation but rather it is the goods market that causes inflationary pressures. If increase in money supply causes inflation it must be through reduction in interest rates (real balance effect). The reduction in interest rate increases both consumption and investment, thus, increased domestic absorption (Miskin, 1997).

On the other hand, the structuralist School contends that the causes of inflation should be looked at beyond monetary factors. They emphasize on the supply side. One type of structural rigidity that is commonly pointed out relates inflation to the price distortions due to inelastic food supply. This is associated, among other things, with the growth of population, growth of living standard, and urbanization might cause higher demand for food. If the production of food fails to meet this increased demand there will be increased food prices. This phenomenon will have ramifications on the rate of inflation in general through its effect also on the demand for imported food and thus on the foreign exchange rate. The second type of rigidity comes from foreign exchange rate constraints that affect the production side since it is true that most industries in developing countries depend on intermediate inputs. The third type of rigidity that has been raised is the issue regarding export instability, which causes inflationary and balance of payment imbalances.

3.1.2. Policy Instruments of Stabilization Policy

The basic essence of stabilization policy is to bring about a balance between demand and supply in the economy. For this to be realized there are varieties of policies that can be employed. There is, however, continued debate regarding the effect of stabilization policies

and how they operate to bring about the desired balance. The contending views come from the monetarists and the stucturalists.

The monetarist view contends that letting aggregate demand expand more than aggregate supply usually causes inflation and balance of payment problems. Consequently, stabilization can be achieved only if demand is restrained to the economy's supply capacity. The major instruments of demand side stabilization program of macroeconomic policy includes:(1) restrictive fiscal policy which seeks to shrink overall public sector deficits towards zero, (2) tight monetary policy which restricts money growth close to the rate of economic growth and places emphasis upon the role of interest rates in stimulating savings, and (3) devaluation of the exchange rate as a starting point for further liberalization to make it depend on market forces. Demand management policies mainly encompass fiscal and monetary policies, which have their primary impact on containing domestic absorption (Khan, 1987).

Supply side (or structural) policies emphasize the significance of improving the productive sector of the economy. Unlike demand side policies, there is no specific policy that can be pointed out. Khan and Knight (1982) classify structural policies in two major categories; those that target improving the efficacy of resource allocation like labor and capital; and those targeting the long run growth of capacity output. The second category of policies usually involves improving the incentive structure of the economy and building the institutional infrastructure of the economy.

The structuralists, on the other hand, contend that rigidities in the production and demand would prevent monetary or fiscal restraint from being reflected in inflationary pressures and on external sector of the economy. The basic argument is that demand restraint would lead to a decline in domestic output, which is argued to lead to decline in investment, which in turn affects the economy's long run ability to earn foreign exchange. The policy implication is that economic policy should give priority to reducing supply side bottlenecks and other observed rigidities so as to achieve increased overall capacity output (Taylor, 1988).

Exchange rate presents a combination of both demand side and supply side stabilization policies. The role of exchange rate management in stabilization policies emerge because it affects the competitiveness of the economy and thus can give rise to internal and external imbalances. Besides affecting competitiveness, exchange rate also affects domestic absorption by changing the incentive structure to produce tradable good. It is important, however, to point out that the use of exchange rate as a stabilizing tool has created heated debate among economists (Khan, 1987).

The theoretical literature concerning the effect of exchange rate (defined as the domestic price of one unit of the foreign currency, say the dollar) depreciation on the balance of payments is somewhat mixed. For example, studies by Krugman and Taylor(1978), Dornbush (1982), Porter and Ranny (1982) and Lizondo and Montiel(1989) seem to imply that there will be an improvement in the balance of payments following exchanger rate devaluation. Taylor (1981), however, pointed out that the depreciation of the exchange rate has an unclear effect on the balance of payments.

The controversy surrounding the output effect of devaluation has generated extensive literature. One argument is that devaluation not only fails to improve the balance of payments but also it leads to stagfationary situation. (Krugman and Taylor, 1978; Wigenbergen, 1986).

The consensus now seems to be that devaluation is contractionary, at least in the short run. Wigenbergen(1986), for example, discusses three channel through which devaluation might exercise contractionary effect on the aggregate supply side of the economy. These are via the local currency costs of intermediate imports, through the existence of wage indexation, and finally via a reduced volume of real credit to firms in the economy. To elaborate on the final channel, it is true that reduction in the real volume of credit will force firms to look for funds in the curb market and face higher interest rate. This is made worse if devaluation is accompanied by domestic credit reduction, as is typically the case.

The study of Porter and Ranny (1982) arrived at the conclusion that devaluation has an ambiguous effect on output of less developed countries while it has an expansionary effect for developed countries.

An enduring effect of devaluation on domestic prices can be seen from the distinction of tradable and non-tradable goods. If devaluation makes home goods cheaper relative to traded goods, the demand for home goods rises. For producers, this is an incentive to shift production to traded goods. If nominal domestic costs of production remain untouched after devaluation, then domestic costs will fall relative to foreign costs.

However, because some inputs such as machinery are imported, domestic production costs will rise after devaluation. Or more directly, devaluation increases the price of imports and therefore directly increases the domestic price level. Yet still, the main components of domestic costs are wage bills, and these may rise when there is devaluation (Fisher, 1988). However, a study by Lizondo and Montiel (1989) established disinflationary effects of nominal devaluation. The theoretical study by Porter and Ranny (1982) argued that devaluation is inflationary in more developed countries than in less developed countries.

As has been pointed out, fiscal restraint is one main element of stabilization policy. However, there does not seem to exist much theoretical writing concerning the direct impact of fiscal restraint on the balance of payments and inflation. Dornbush (1982) argues that fiscal restraint improves the balance of payments while the work of Lizondo and Montiel(1989) shows an ambiguous effect of fiscal restraint on the balance of payments. Fiscal restraint, as a component of stabilization policies, is expected to lead to lower inflation (Lizondo and Montiel :1989, Porter and Ranny,1982).

In a Keynesian framework, a change in government expenditure will have a multiplier effect on the level of income. When it comes to developing countries direct evidence on the relationship between government expenditure and taxes, and economic growth is rarely established. The suspected complementarily between government and private investment in developing countries seem to indicate that fiscal policy could have a positive effect on economic growth. Conversely, reduced government expenditure, as demand controlling measure, could have adverse effects on economic growth, at least in the short run. Some theoretical enquiries have shown that fiscal restraint to be expansionary (Lizondo and

Montiel, 1989). Dornbush(1982), however, argues that fiscal restraint is rather contractionary. In Porter and Ranny(1982) the contactioanry effect of fiscal restraint is evendent only in less developed countries while fiscal contraction being expansionary in more developed countries(MDCs).

Monetary restraint[1]has been an important component of stabilization policy. However, the relationship between monetary expansion and output is far from clear. According to the monetary approach to the balance of payment, discussed earlier, a reduction in domestic credit will have an equal and opposite effect on international reserves, in the end restoring money stock to its original level. This implies that such policy action will have no long run lasting effect on the level of output relative to its trend or on the rate of growth of output.
It is argued, however, that during periods of adjustment a decrease in domestic credit will lead to a decrease in capacity utilization given downward inflexible prices. As such, according to Khan and Knight (1985) the contractionary effect of monetary restraint depends on:

1. The speed with which a decrease in domestic credit is offset by an increase in international reserves,
2. The response of domestic inflation to the excess demand for real money created by monetary restraint,
3. The extent to which the excess demand for money reduces aggregate demand. This effect depends on the amount of excess demand for output in the economy. In general, the larger the excess demand, the smaller the effect will be, and;

[1] Since the relation between money inflation and the balance of payments has already been presented, the emphasis here will be on the output effect of monetary policy

4. The effect on private investment of the availability of credit.

The likely effect of monetary policy on growth is through domestic investment. It is now a well acknowledged fact that investment in developing countries is constrained by availability of financial resources rather than the cost of finance as is the case in advanced economies (Fry, 1984). The issues seem to require empirical test to establish the relationship between monetary restraint and output.

The studies by Dornbush(1982), Porter and Ranny(1982), and Lizondo and Montiel(1989) seem to support this hypothesis. However, the theoretical study of Porter and Ranny (1982) seem to indicate the possibility that in the long run real output might be unaffected by the monetary restraint.

3.2. Empirical Literature

3.2.1. Exchange Rate Devaluation and Stabilization

Early research into the effects of devaluation in less developed countries was mainly interested in considering the effectiveness of devaluation in strengthening the current account and balance of payments. This relied on considering whether developing countries complied with the Marshall-Learner condition and whether devaluation would lead to increasing inflation eroding competitiveness of the economy. The general consensus seems to be that, provided domestic monetary policy was not excessively expansionary, the net effect of devaluation would be to strengthen competitiveness (Bird and Rajan, 2000).

Solimano(1986) employed a computable general equilibrium model to examine the effect of devaluation using data from Chile. The simulation exercises that he employed seem to indicate that currency devaluation is contractionary in the short run to the medium run but found to be expansionary in the long run .The author argued that it takes about two years and a half for the contractionary effect of devaluation on output to disappear.

Khan and Knight (1981) used a structural model that endeavors to describe policy instruments with targets. The model consists of five behavioral equations and three identities. The authors carried out a simulation exercise for 29 developing countries for the period 1967-75. The main intention of the study was to assess the design and result of policy alternatives. Regarding the effect of exchange rate devaluation, they argue that devaluation is contractionary in the short run. This result is also similar to the findings of Khan (1990) and Agenor (1990) who contended that the contractionary effect of devaluation was found to hold only in the short run, while in the long run, it was found to be expansionary. In Edwards (1986), the contractionary effect of devaluation is a short run phenomenon. In fact Edwards (1986) clearly points that in the long run real devaluation was found to be neutral. Regarding the impact of devaluation on the inflation rate and the balance of payment Lizondo and Montiel (1989) found disinflationary effect after nominal devaluation.

3.2.2. Domestic Credit Restraint and Stabilization

Khan and Knight (1982) used controlled experiments in which the effects of devaluation and domestic credit restraint on prices, output, and the balance of payments was examined using a structural model. The model consists of five behavioral equations for inflation, the balance

of payments, government sector, real income, and expected inflation and three identities for the domestics credit, money supply and real money balances. The authors carried out a simulation exercise for 29 developing countries for the period 1967-75. The results of this study seem to indicate that domestic credit restraint halts the price level and rather improves the balance of payments. Domestic credit was found to have contractionary effect on output, mainly through the investment function which, in developing countries, depends crucially on the amount of credit available.

Blejer and Khan (1984) estimated a model for 24 developing countries with pooled data over the period 1971-79. The purpose of the study was to search for a well-specified empirical function for private investment in developing countries. The study explored the interaction between government policy and investment. Among other findings, the study documents that tight monetary policy have had adverse effects on the level of private investment and reduced economic growth. The results seem to indicate that the short run effect on the growth of output of a 10 percent growth in money supply is to reduce output growth, on average, by 0.8 percent over one year period. Leiderman (1984) used quarterly data from Columbia and Mexico and reports contractionary effect of monetary restraint i.e. for example, a 10 percent change in the growth of money supply would lead to, on average, a 0.2 percent reduction in output.

Khan (1990) employed the before after method in his study of 69 countries under the IMF supervision over the period 1973-88. The target variables were the balance of payment, the current account balance, the inflation rate and growth. The results for the one-year before and after comparisons indicate that there appeared to be a substantial improvement in the

overall balance of payments and the rate of inflation but the coefficients are insignificant. The rate of growth fell in the program year but the coefficient was also statistically insignificant. In conclusion, Khan (1990) pointed out that the programs led to an improvement only in the current account position while worsening inflation.

Silumbu (1995) used both annual and quarterly data to examine the impact of domestic credit on the balance of payments for Malawi. Accordingly, the study argues that there is no one-to-one relation between domestic credit and the balance of payment as suggested by the monetary approach. However, Silumbu (1995) concludes that restraining domestic credit will help improve the balance of payment. Similarly, Dhiwayo(1996) using annual data for Zimbabwe, also confirmed the relevance of domestic credit to explain the change in reserves i.e. money played a significant role in determining the balance of payments in Zimbabwe.

Haile (2000) empirically tested the reserve flow equation to explore the impact of domestic credit on the balance of payment in Ethiopia using quarterly data for the period 1967/68-99/00. The results seem to suggest that domestic credit restraint will help improve the balance of payment.

3.2.3. Fiscal Restraint and Stabilization Policy

Christie et al (1992) used a VAR technique on ten key macroeconomic variables from Pakistan's annual data. The results appear to indicate that fiscal restraint increases the price level both in the short and long run. Other empirical studies seem to support this hypothesis such as Edwards (1986) and Agenor (1990). Agenor (1990) also found that fiscal restraint

decreases output while at the same time improving the balance of payments in the short run. However, the same author documents expansionary effects of fiscal restraint in the long run.

Killick (1995) also used the before-after approach to examine the effect of stabilization policy on 16 developing countries covering the period 1979-1985. The main variables under study include balance of payments, inflation, economic growth and total absorption. The results indicate that the effect on the BOP was significant, especially the current account, for countries which completed the adjustment programs. As regards the rate of growth, the results are weak whether the programs are completed or not.

To recap, the exposition made so far is intended to show lack of consensus in both theoretical and empirical grounds regarding the effectiveness of monetary, fiscal and exchange rate policies. Most of the empirical studies as presented in the last section demonstrate the fact that country specific study is imperative to properly analyze the effect and potency of stabilization policy. The study is useful because monetary, fiscal, and exchange rate policies are used in Ethiopia to address internal and external imbalances. Thus, the model can be used as a formal way of analyzing the effects of stabilization policy to correct internal and external imbalances.

CHAPTER FOUR

MODEL SPECIFICATION, ESTIMATION AND ANALYSIS OF RESULTS

4.1. Model Specification

The purpose of this section is to present the main model that will be used to estimate the results. Accordingly, the model has five behavioral equations representing money demand, price, export supply, import demand, and non-agricultural output. The model is highly aggregative in nature but is full of insights for stabilization policy.

4.1.1. The Demand for Money

The demand for money, including savings and time deposits, is assumed to be a function of real income, interest rate, and the expected rate of inflation. Economic theory points that the desired real demand for money is positively related to the scale variable, income, and negatively related to the opportunity cost of holding money. The domestic interest rate and expected inflation are proxies for the rate of return on alternative financial and physical assets, respectively. For this study inflation expectation is proxied by lagged value of actual inflation rate in the following money demand equation.

$$\log\left(\frac{M}{P}\right)_t^d = \alpha_0 + \alpha_1 \log RY_t + \alpha_2 \pi_t + \alpha_3 NIR_t + \alpha_4 \log\left(\frac{M}{P}\right)_{t-1}$$

$$\alpha_1 > 0, \alpha_2 \gtrless 0, \alpha_3 < 0, \alpha_4 > 0$$

Where;

M/P =*Real money balances*
Y =*Real output*
π = *Expected Inflation*
NIR = *Nominal interest rate*

4.1.2. The Price Equation

The price equation relates the consumer price index (P) to money supply (M), real exchange rate (RER), output gap (OTG) as a proxy for excess demand[2], and import price index (PM). Theoretically, we would expect all of the above variables to have a positive influence on the price level.

$$Log\ (P)_t = \alpha_5 + \alpha_6 log(M)_t + \alpha_7 log(OTG)_t + \alpha_8 log(PM)_t + \alpha_9 log(RER)_t$$

$$\alpha_6 > 0, \alpha_7 > 0, \alpha_8 > 0, \alpha_9 > 0$$

4.1.3. Import Demand

For the purpose of this paper we distinguish between imports for consumption (COI) and imports for production i.e. intermediate imports (IMI). As will be shown later on, we assume that imported intermediate goods inter into the production function as factors of production. This is important in the case of Ethiopia since the lack of imported materials has often created a serious supply bottleneck in the economy. Meanwhile, this paper will assume imports of consumer goods are exogenous to the model.

[2] Output gap (or excess demand) is the gap between aggregate expenditures (AGE=PC+G+I) real output. Where: PC is private consumption= Government Expenditure, I=Investment Expenditures.

On the basis of economic theory, we postulate that the demand for real intermediate imports (IMI) is a function of real income (RY), relative prices (PM/P), real exchange rate (RER), lagged net foreign assets (NFA_{t-1}), and the amount of export earnings of the economy, which is approximated in this study by the value of total exports (EX).

$$\log IMI_t = \alpha_{10} + \alpha_{11}\log(RY)_t + \alpha_{12}\log(\frac{PM}{P})_t + \alpha_{13}\log NFA_{t-1} + \alpha_{14}\log(RER)_t + \alpha_{15}\log EX_t$$

$$\alpha_{11} > 0, \alpha_{12} < 0, \alpha_{13} > 0, \alpha_{14} < 0, \alpha_{15} > 0$$

Where:

IMI = Import of intermediate goods

NFA =Net Foreign Asset position
RY =Real Income
PM = Import Price Index
P = Domestic Price level
EX = Total Exports
RER = Real exchange rate

Thus, total imports are the sum of consumer goods imported (COI), and intermediate goods imported (IMI), and other miscellaneous imports (OTI).

IM=COI+IMI+OTI

4.1.4. Export Supply

The supply of export of goods is one major function of the current model. Accordingly export supply is determined by relative prices and the real exchange rate. The relative price effect captures the relative profitability of producing exports relative to home goods. These are important on the basis that export supply is highly influenced by incentive structure and exchange rate policy. Of particular interest is the response of export supply to devaluation.

The inclusion of the real income variable is on the basis that as our output increase so would our exports.

$$\log(EX)_t = \alpha_{16} + \alpha_{17}\log(\frac{PX}{P})_t + \alpha_{18}\log(RER)_t + \alpha_{19}\log(RY)_t$$
$$\alpha_{17} > 0, \alpha_{18} > 0, \alpha_{19} > 0$$

Where:
EX = Total Exports
PX = Price Index of Exports
P =Domestic Price Level
RER =Real Exchange rate
RY =Real Income

4.1.4 Output Supply

The supply of output of the economy is divided in to real output in the primary sector i.e. agricultural (**RYA**) and the non-agricultural sector (**RYNA**). The agricultural sector, consisting mainly of agricultural products, fishing and forestry, is assumed to be exogenous, where as the non-primary sector is determined within the system and is influenced by labor force in the sector, capital stock, import of intermediate inputs, and capacity utilization rate. Intermediate inputs are considered as factors of production mainly because the manufacturing sector of the Ethiopian economy relies heavily on the import of raw material and other intermediate goods. Thus output in the non-agricultural sector is estimated as follows;

$$\log RYNA_t = \alpha_{20} + \alpha_{21}\log L_{nagr} + \alpha_{22}\log K_t + \alpha_{23}\log IMI_t + \alpha_{24}\log DC_t$$
$$\alpha_{21} > 0, \alpha_{22} > 0, \alpha_{23} > 0, \alpha_{24} > 0$$

Where;
RYNA = *Non-Agricultural output*

Lnagr =*Labor force employed in the non-agricultural sector*[3]

K = *Capital Stock*
IMI = *Intermediate Imports*
DC = *Domestic Credit*

The inclusion of the domestic credit variable is based on the argument that in the Ethiopian context existing capacity is not fully utilized in every period and this utilization rate is affected greatly by the availability of factors such as credit. Accordingly, domestic credit should have a positive impact on the growth pattern of non-agricultural output. The identity closing the supply side of the economy is therefore;

RY =RYA +RYNA

4.1.5 The Supply of Money

The supply of money is taken to be equal to the sum of stock of international reserves (NFA), converted into domestic currency by multiplying by the exchange rate, and domestic credit (DC);

$$M_t = NFA_t + DC_t$$

The Net Foreign Asset *(NFA)* position of the monetary sector is directly linked to the balance of payments position. Thus changes in NFA is defined as:

$$\Delta NFA = NFA_t - NFA_{t-1} = EX - IM + FK, and$$
$$NFA_t = NFA_{t-1} + TB$$
$$TB = EX - IM$$

[3] Labor force is calculated by adjusting the total labor force data by the capacity utilization rate in the non-agricultural sector.

Where;

EX =*Total Exports*

PX =*Price of Exports*
IM =*Total Imports*
PM =*Price of Imports*
TB =*Trade Balance*
FK =*Net Foreign Capital Inflow*

The price of Imports is assumed to be determined exogenously; where as the volumes of imports of intermediate goods (IMI) are determined endogenously with in the model (See the demand for Intermediate Imports). In the context of the Ethiopian economy, the government has always controlled the capital account. Consequently, the net capital flow (FK) is an exogenous variable[4].

The Complete Model

1 $\log(\frac{M}{P})_t^d = \alpha_0 + \alpha_1 \log RY_t + \alpha_2 \pi_t + \alpha_3 NIR_t + \alpha_4 \log(\frac{M}{P})_{t-1}$

2. $Log\ (P)_t = \alpha_5 + \alpha_6 log(M)_t + \alpha_7 log(OTG)_t + \alpha_8 log(PM)_t + \alpha_9 log(RER)_t$

3. $\log(IMI)_t = \alpha_{10} + \alpha_{11} \log(RY)_t + \alpha_{12} \log(\frac{PM}{P})_t + \alpha_{13} \log NFA_{t-1} + \alpha_{14} \log(RER)_t + \alpha_{15} \log EX_t$

4. $\log(EX)_t = \alpha_{16} + \alpha_{17} \log(\frac{PX}{P})_t + \alpha_{18} \log(RER)_t + \alpha_{19} \log(RY)_t$

5. $\log(RYNA)_t = \alpha_{20} + \alpha_{21} \log L_{nagr} + \alpha_{22} \log K_t + \alpha_{23} \log IMI_t + \alpha_{24} \log DC_t$

[4] FK is derived as a residual from the NFA identity equation

Identities and Definitions

1 M = NFA+DC
2 NFA = NFA(t-1)+TB+FK
3 TB =EX-IM
4 IM =COI+IMI+OTI
5 RY =RYA +RYNA
6 OTG = AGE- RY

Definition of Variables

1 Endogenous Variables

EX = Total Exports

IM =Total Imports

IMI = Intermediate Imports

NFA =Net foreign asset

RY =Real GDP at constant 1980/81 prices

RYNA = Non-agricultural output

P = Domestic Price level

M = Nominal stock of broad money

OTG =Output Gap

M/P = Real Money Demand

TB = Trade Balance

π =Expected inflation

2 Exogenous Variables

NIR = Nominal interest rate

RYA =Real output of the agricultural sector

Lnag =Labor force in the non-agricultural sector

K =Capital Stock

DC = Domestic Credit

RER =Real Exchange Rate

PM =Price index of imports

PX =Price Index of Exports

COI =Imports of Consumer Goods

OTI =Other Imports

FK =Capital Inflow

AGE =Aggregate Expenditure

Workings of the Model

To elucidate the workings of the model, consider the effect of an increase in the supply of domestic credit. This will increase the stock of money supply, which will lead to an increase in the price level, which in turn is likely to increase the import of intermediate goods as the relative price of import prices fall relative to the general domestic price level. This will increase import demand and output leading to worsening of the balance of payments. The decline in the balance of payments will eventually help the movement towards equilibrium by offsetting the initial increase in money supply.

An exchange rate policy that decreases the value of the Birr per USD (i.e. depreciation) tends to increase the general price level. The depreciation of the currency would initially increase the local currency value of net foreign assets (NFA) of the central bank. However, due to the price inelastic import function for intermediate imports, the local currency value of imports tends to increase offsetting the initial increase in NFA. The increase in relative value of intermediate inputs will reduce real income through the production function. However, as the income continues to fall, so does the volume of imports. As a result the NFA position will increase helping the movement towards equilibrium.

4.2 Methodology and Analysis of Results

4.2.1. Methodology

After specifying the model, the next step in macro systems is the choice of the estimator to be used. There are quite a number of estimators available but the choice depend on the purpose and sometimes on the availability of data. Challen and Hagar (1983) point out three types of estimators are classified based on the amount of information the estimator utilizes from the system of equation. Accordingly, there are those estimators, which make use of no more information than what is contained in a single equation. These groups of estimators are called single-equation estimators. The Ordinary Least Squares estimator is a good example. There are also estimators, which utilize a limited amount of information contained in a system of equations. These are called limited information estimators. The third and final group of estimators are those that use the full information contained in the system. The best-known estimators of this group are the 3SLS and full information maximum likelihood (FIML).

But there is still one major important issue, which any of the above estimators cannot satisfactorily handle. This relates to the non-stationarity of time series data. A variable is stationary when its mean, variance and covariance are time invariant. The fist step in time series modeling involves examining the time series property i.e. the order of integration of the variables involved in the model. A variable, X, is said to be integrated of order d if it becomes stationary after differencing d times, i.e. $X \sim I(d)$. By the same token, a stationary series is an $I(0)$ variable. Even if variables are not stationary individually, they could have long run relationship if they are cointegrated. Since almost all macro variables are non-

stationary, it is imperative to difference them before proceeding to estimation. However, differencing the variables removes any long run information contained in the variables of interest. To retain the long run information we resort to what is known as the Error Correction Mechanisms, which allows the estimation of the short and long run behavior of economic variables.

Thus, the model is tested along the line of the cointegration technique. In all the behavioral equations the variables in the long run equations were first tested and all most all were found to be cointegrated of order one i.e. I(1) and the residual formed a stationary process of I(0) at the 5% significance level using the Dicky-Fuller and Augmented Dickey-Fuller tests. The integrated series of variables i.e. the I(1) variables in each of the long run equations were then tested for cointegration by the Johnsen Cointegration test. The ordinary least square (OLS) estimator was used to estimate both the long run and short run structural equations of the model. It is argued that OLS is a consistent estimator if the variables are cointegrated[5] (Harris, 1995 ; Musilia,2002).

Annual observations from 1965/66 to 2001/02 were used to estimate the behavioral equations of the model. The data is obtained from various secondary sources such as the International Financial Statistics CD-ROM, Ministry of Finance and Economic Development, and the National Bank of Ethiopia.

[5] See Annex 2 and Annex 3 for further details of time series property of the data and also for the results of unit root tests applied on each variable in the model.

4.2.2. Analysis of Results

4.2.2.1.The Demand for Real Balances

We begin our estimation with cointegration test for presence of a long run relationship among the variables of money demand. The cointegration tests are reported in Table 4A.

Table 4 A The Johansen Cointegration Test for Money Demand.

Null hypothesis	Eigenvalues	λ max	λ max (95%)	λ trace	λ trace (95%)
r = 0	0.65	36.49**	27.1	60.96**	47.21
r ≤ 1	0.41	18.08	21.0	24.46	29.68
r ≤ 2	0.16	6.21	14.1	6.38	15.41
r ≤ 3	0.005	0.17	3.80	0.17	3.8

The Johansen conitegration test supports the existence of long run relationship. Consider first the trace statistics, which tests the null hypothesis that there is at most ***r*** cointegrating vectors. We can see from the table that we can reject ***r=0*** at 5% significance level. In addition use is made of the maximal eigenvalue test, which evaluates the null hypothesis that there are ***r*** cointegraing vectors against the alternative of ***r+1*** vectors. Using this test, we reject the hypothesis of ***r=0*** in favor of the alternative ***r=1***. Thus both the trace and maximal eigenvalue tests yield identical results. The eigenvalue associated with the first vector is certainly dominant over the corresponding vectors, further strengthening the evidence of a unique vector. Furthermore, on the basis of the trace statistics its possible to see that there is only on cointegrating vector since the trace statistic associated with the null hypothesis of ***r=1*** is not rejected.

Long Run

$\log(M/P) = -4.41 + 0.70*\log(RY) - 0.034*\log(\pi) + 0.66*\log(M/P)_{t-1}$
(t-values) (-4.13) (3.18) (-1.64) (7.93)

R-square	*=0.981*	
R-square Adjusted	*=0.978*	
Normality: Jarque_Bera	*= 0.75*	*prob=0.68*
*LM serial correlation test(1)(Obs*R-squared)*	*=0.27*	*prob=0.54*
Ramsey reset Test (1)(F-statistics)	*= 0.50*	*prob=0.47*
*White Heterosckedasticity Test(Obs*R-squared)*	*=11.3*	*prob=0.18*

Short Run

$\Delta\log(M/P) = 0.029 - 0.024*\Delta\log(\pi) + 0.59*\Delta\log(RY) - 0.33*ECM(-1)$
(t-vaules) (1.73) (-1.67) (1.99) (-2.00)

R-square	*=0.29*	
R-square Adjusted	*=0.21*	
Normality: Jarque_Bera	*= 1.3*	*prob=0.50*
*LM serial correlation test(1)(Obs*R-squared)*	*=0.59*	*prob=0.44*
Ramsey reset Test (1)(F-statistics)	*= 0.13*	*prob=0.71*
*White Heterosckedasticity Test(Obs*R-squared)*	*=7.00*	*prob=0.42*

Results from money demand equation show that the model is quite good in terms of diagnostic tests. For example, in the estimated long run equation, the null of normally distributed error terms could not be rejected. In the Lagrange Multiplier (LM) test, the null of no serial correlation could not be rejected. Likewise, the equation is free from heterosckedasticity, as null of White's test for no heterosckedasticity could not also be rejected. The Ramsey reset diagnostic tests for three things. One is that there are no omitted variables in the equation. The second is the right functional form while the third is testing for correlation between the error term and the independent variables. If any of these three are present, then the error terms will have an non-zero mean, rendering conventional inference procedures invalid. Accordingly, both the long and short run estimated equations have passed the Ramsey test and thus have error terms with zero mean.

The sign, if not the magnitude, of real income conform to a priori theoretical expectations. From the above long run estimated results, elasticity of demand for real balances with respect to income is very much closer to one. Similar high income elasticity have been reported for other developing countries. It is argued that higher income elasticity might suggest the fact that income velocity falls with the rise in income, which is expected in a developing country as a result of progressive monetization (Alemayehu et al, 2001).

The sign on expected inflation seems to require some explanation. Some argue that expected inflation affect the demand for money negatively. This is as the result of economic agents preferring to hedge against inflation by holding other assets rather than holding money in the face of expected higher inflation. It is also possible that expected inflation to have a positive effect on money demand. as agents expect prices to rise , they could simply increase their money holdings to match the expected rise in nominal expenditures. The issues can only be settled empirically (Sriram, 1999). The results from our case seem to support the idea that agents want to hedge in the face of expected inflation as the sign of the coefficient is negative.

The nominal interest rate was not found to significantly affect the money demand in Ethiopia. This may be due to the fact that the financial sector of the economy is not that well developed or conversely, much of the economy is not monetized i.e. lies outside the scope of the formal financial sector. Finally, the coefficient of the long run adjustment has the expected sign and is significant at 5% level. Accordingly, the error term adjusts by 33 percent in one year.

4.2.1.2. The Price equation

Table 4B The Johansen Cointegration Test for Price

Null hypothesis	Eigenvalues	λ max	λ max(95%)	λ trace	λ trace(95%)
r = 0	0.72	43.17**	27.1	60.46**	47.21
r ≤ 1	0.34	14.36	21.0	16.75	29.68
r ≤ 2	0.049	1.71	14.1	2.93	15.41
r ≤ 3	0.019	0.68	3.8	0.68	3.76

The results of unit root tests (Table B of Annex 3) show that the variables are not integrated of order zero and are non-stationary following I(1) process. Therefore, we next proceed by conducting the cointegration test. This will enable us to establish whether or not the variables have a long run relationship. From the Johnasen cointegration test reported in Table 4B, we can see that there is reduced rank and both the trace and maximal statistics support the existence of one contegrating vector at 5% level of significance.

Long Run

log(P) = -9.94 + 0.252*log(PM) + 0.62*log(RER) + 0.88*log(M) +
(t-values) (-5.99) (1.43) (1.99) (6.51)

0.49*log(OTG)
(4.99)

R-square	*=0.936*	
R-square Adjusted	*=0.928*	
Normality: Jarque_Bera	*= 1.31*	*prob=0.51*
*LM serial correlation test(1)(Obs*R-squared)*	*=0.59*	*prob=0.44*
Ramsey reset Test (1)(F-statistics)	*= 2.36*	*prob=0.12*
*White Heterosckedasticity Test(Obs*R-squared)*	*=16.2*	*prob=0.038*

Short Run

$\Delta logP = 0.04 + 0.08*\Delta logOTG + 0.37*\Delta log\ P_{t-1} + 0.03\Delta log\ PM_{t-1} - 0.201*ECM_{t-1}$ ***(t-values) (2.96) (2.82) (2.86) (1.68) (-4.48)***

R-square	*=0.59*	
R-square Adjusted	*=0.53*	
Normality: Jarque_Bera	*= 0.71*	*prob=0.70*
*LM serial correlation test(1)(Obs*R-squared)*	*=2.4*	*prob=0.12*
Ramsey reset Test (1)(F-statistics)	*= 0.93*	*prob=0.33*
*White Heterosckedasticity Test(Obs*R-squared)*	*=5.58*	*prob=0.69*

As the results on the diagnostic tests depict , both the long run and short run equations have good statistical properties. There is no evidence of heterosckedasticity , the error terms are normally distributed as testified by the Jarque-Bera statistics where the null can not be rejected. There is also no specification problem as indicated by the Ramsey test.

The estimation of the price equation started by considering a monetary disequilibrium term which was calculated from the difference between actual money supply and the estimated money demand function. Incorporating this disequilibrium term produced a coefficient with an expected sign an low level of significance and so was dropped and replaced by the money supply variable. This rather improved the fitness of the model and so was maintained for further analysis.

The other factor hypothesized to have an effect in the path of inflation is the output gap. Both the long and short run results show that the output gap has a positive impact on inflationary developments in Ethiopia. As shown above, the estimated long run equation is around 0.49 implying that when actual output is less than potential by 10 percent, we would naturally expect prices to increase by about 4.9 percent.

Developing countries like Ethiopia are also subject to imported inflation given that they are small and very much open to the rest of the world. This paper makes use the import price index to see the effect of imported inflation. As expected, import prices have a positive and significant effect on the price level both in the short and long runs. The estimated long run coefficient is 0.25 i.e. if prices of all imported goods and services increase by 10 percent, we would expect domestic prices to show a rise of about 2.5 percent, *ceteris paribus*.

The results for the estimated short run dynamic equation of price also shows that all variables are found to be significant with expected signs. The insignificance of import price in the short run equation might tell us the slow transmission of world inflation to the domestic economy in the short run.

4.2.1.3. Import Demand

Table 4 C. The Johansen Cointegration Test for Import

Null hypothesis	Eigenvalues	λ_{max}	$\lambda_{max}(95\%)$	λ_{trace}	$\lambda_{trace}(95\%)$
$r = 0$	0.86	67.42**	33.5	108.5**	68.5
$r \leq 1$	0.59	30.97*	27.1	41.67	47.21
$r \leq 2$	0.19	7.21	21.0	10.14	29.68
$r \leq 3$	0.07	2.79	14.1	2.91	15.41
$r \leq 4$	0.003	0.12	3.8	0.12	3.76

According to the Johansen cointegration test, both the trace and maximal satistics reject the null hypothesis of no cointegrating vector. However, the maximal statistics could not reject the existence of two cointegrating vectors while that of the trace statistics convincingly points towards a single long run relationship among the variables of the import demand function. Furthermore, the eigenvalue associated with the first vector is certainly dominant

over the corresponding vectors, further strengthening the evidence of unique vector. Once the existence of long run relationship has been established the next step is to estimate the long run and short run dynamics of the model.

Long Run

$$\textit{log(IMI)} = -2.35 - 0.34^{*} \log(RER) - 0.43^{*} \log(PM/P)_{t-1} + 0.86^{*} \log(RY) + 0.30^{*} \log(EX(-1))$$

(t-values) (-1.12) (-3.17) (-5.83) (3.61) (3.66)

R-square	*=0.96*	
R-square Adjusted	*=0.95*	
Normality: Jarque_Bera	*= 1.00*	*prob=0.61*
*LM serial correlation test(1)(Obs*R-squared)*	*=7.8*	*prob=0.02*
Ramsey reset Test (1)(F-statistics)	*= 0.23*	*prob=0.63*
*White Heterosckedasticity Test(Obs*R-squared)*	*=8.01*	*prob=0.43*

Short Run

$$\Delta \log IMI = -0.006 - 0.29^{*}\Delta \log(PM/P) + 1.21^{*}\Delta \log RY - 0.465^{*}ECM_{t-1} - 0.023^{*}\Delta \log RER(-1) + 0.17^{*}\Delta \log IMI(-1)$$

(t-values) **(-0.35)** **(-3.03)** **(3.42)** **(-3.48)** **(-0.18)** **(1.08)**

R-square	*=0.54*	
R-square Adjusted	*=0.45*	
Normality: Jarque_Bera	*= 2.2*	*prob=0.32*
*LM serial correlation test(1)(Obs*R-squared)*	*=0.12*	*prob=0.72*
Ramsey reset Test (1)(F-statistics)	*= 2.3*	*prob=0.62*
*White Heterosckedasticity Test(Obs*R-squared)*	*=11.1*	*prob=0.52*

In the estimated long and short run import demand functions; there is no evidence of serial correlation, heterosckedasticity, and regression misspecification problems. Under the null hypothesis of a normal distribution, the Jarque-Bera statistic is not rejected for both long and short run version of the import equation.

Like many developing countries, which have experienced varying degrees of foreign exchange constraint in the past and present, the coefficient of export earnings variable tends to have a consistent influence on the demand for intermediate imports. As theoretically expected, the price elasticity is negative while that of income is positive. The short run price elasticity is far below its long run level, which is consistent with theoretical expectation.

The results of this study are similar to estimates of other studies. Estimates from Kenya using annual data over 1964-91 for instance, Mwega (1993) found a long-run income elasticity of 0.454, a price elasticity of -0.398, a lagged forex reserve elasticity of 0.157 and a foreign exchange receipts elasticity of 0.342. Similarly, Moran (1989) estimated import demand elasticities for twenty-one LDCs using pooled data over 1970-83. He found long-run price elasticities ranging from -0.3 to -0.1, income elasticities ranging from 0.2 to 0.4, lagged international reserve elasticities ranging between 0.5 to 0.8 and foreign exchange receipt elasticities around 0.1. The higher income elasticity of the present study might be due to the fact that the paper makes use of intermediate imports while all the above studies relied on aggregate imports of goods and services.

4.2.1.4. Export Supply

Table 4D. The Johansen Cointegration Test for Export

Null hypothesis	Eigenvalues	λ_{max}	$\lambda_{max}(95\%)$	λ_{trace}	$\lambda_{trace}(95\%)$
$r = 0$	0.59	30.95*	27.1	55.48**	47.21
$r \leq 1$	0.37	16.19	21.0	24.53	29.68
$r \leq 2$	0.15	5.79	14.1	8.34	15.41
$r \leq 3$	0.072	2.55	3.8	2.55	3.8

From the unit root tests reported in Annex 2 table D, all the variables entering the export supply function were found to be non-stationary with integration of order one i.e. the variables become stationary at first difference. This suggests that non-stationarity may not become a problem if it can be established that the variables are cointegrated. The cointegration analysis using the Johansen procedure, reported in table 4.4 suggests one cointegrating vector at 5% level of significance using both the trace and maximal eigenvector and trace statistic.

Long Run

$\log(EX) = -7.45 + 0.50*\log(RER) + 0.74*\log(PX/P) + 0.51*\log(RY) + 0.54*\log(EX)_{t-1}$
(t-values) (-2.69) (4.41) (2.22) (3.05) (3.05)

R-square	*=0.90*	
R-square Adjusted	*=0.89*	
Normality: Jarque_Bera	*= 4.49*	*prob=0.10*
*LM serial correlation test(1)(Obs*R-squared)*	*=0.98*	*prob=0.62*
Ramsey reset Test (1)(F-statistics)	*= 3.8*	*prob=0.15*
*White Heterosckedasticity Test(Obs*R-squared)*	*=9.4*	*prob=0.22*

Short Run

$\Delta \log(EX) = 0.023 + 0.46*\Delta \log(RER) + 0.14*\Delta \log(PX/P) + 0.26*\Delta \log(EX)_{t-1}$
(t-values) (1.30) (5.66) (1.82) (1.62)

$-0.70*ECM_{t-1}$
(-3.00)

R-square	=0.59	
R-square Adjusted	=0.53	
Normality: Jarque_Bera	*= 1.7*	*prob=0.19*
*LM serial correlation test(1)(Obs*R-squared)*	*=0.79*	*prob=0.37*
Ramsey reset Test (1)(F-statistics)	*= 0.48*	*prob=0.48*
*White Heterosckedasticity Test(Obs*R-squared)*	*=3.5*	*prob=0.74*

The long run results show a good fit of the data with an adjusted R-square of 70 percent. The diagnostic tests on normality, serial correlation, stability, and Heteroskedasticity are easily passed. The RER is significant at 1% level and has the a priori theoretically expected sign(a decline in RER indicating depreciation) % while the relative price variable is significant at only 10%. The short run elasticity of RER is around 0.46. This is relatively comparable with other studied for developing countries. For example, Sepheri(1992) estimated a coefficient of 0.39 for Tanazania while Jaeger(1992) estimated a coefficient of 0.26 for Ghana .

According to the estimated coefficients, a 100 percent appreciation of the RER would lead to about 46 percent decline in exports in the short run. At the same time, 100 percent increase in relative prices would boost exports by about 14 percent in the short run. The results from the short run estimates further illustrate that the error correcting term adjusts by about 70 percent towards equilibrium.

4.2.1.5. The Output Equation

Table 4 E. The Johansen Cointegration Test for Output

Null hypothesis	Eigenvalues	λ_{max}	$\lambda_{max}(95\%)$	λ_{trace}	$\lambda_{trace}(95\%)$
$r = 0$	0.74	45.82**	33.5	79.16**	68.5
$r \leq 1$	0.58	30.03*	27.1	40.08	47.21
$r \leq 2$	0.28	11.37	21.0	14.46	29.68
$r \leq 3$	0.14	5.28	14.1	4.75	15.41
$r \leq 4$	0.008	0.299	3.8	0.25	3.8

Johansen cointegration test suggests a rather mixed result. The maximal eigenvalue could not reject the existence of two conintegrating vectors while the trace statistics points to exactly one cointegrating vector. In such situations it is better to rely on the trace statistics since it is

argued that the trace statistics shows more robustness than the maximal eigenvalue (Harris, 1995). Both the trace and maximal eigenvector tests reject null hypothesis of zero in favor of one cointegrating vector. What is most important at this stage is the existence of a long-run relationship among the variables of interest.

Long Run

log (RYNA) = 2.83 + 0.41*log L(-2) + 0.20*logK(-1) + 0.06*log (IMI) + 0.21*log (DC)
(t-values) (15.51) (4.36) (5.18) (1.56) (6.73)

- 0.03*DPolitical[6]
(-1.29)

R-square	*=0.987*	
R-square Adjusted	*=0.985*	
Normality: Jarque_Bera	*= 0.70*	*prob=0.70*
*LM serial correlation test(1)(Obs*R-squared)*	*=0.97*	*prob=0.32*
Ramsey reset Test (1)(F-statistics)	*= 1.6*	*prob=0.19*
*White Heterosckedasticity Test(Obs*R-squared)*	*=6.5*	*prob=0.68*

Short Run

Δ log RYNA = 0.042 + 0.0618*Δ log K + 0.107Δ log IMI - 0.19*ECM (-1)**
(t-values) (7.78) (2.55) (2.33) (-1.99)

- 0.07*DPolitical
(-2.53)

R-square	*=0.74*	
R-square Adjusted	*=0.70*	
Normality: Jarque_Bera	*= 0.22*	*prob=0.89*
*LM serial correlation test(1)(Obs*R-squared)*	*=0.02*	*prob=0.88*
Ramsey reset Test (1)(F-statistics)	*= 3.7*	*prob=0.05*
*White Heterosckedasticity Test(Obs*R-squared)*	*=8.3*	*prob=0.40*

[6] Dpolitical is a dummy included to capture the effect of political upheavals and takes value of 1 in 1973/74 and 1990/91 and zero elsewhere.

A glance at the diagnostic tests demonstrates that in both the long and short run equations, there is no evidence of serial correlation (the LM test) i.e. errors in the equations are not serially correlated. There is no evidence of heterosckedasticy as revealed by the White test. According to the Ramsey reset test, there is no evidence of specification or omitted variables problem.

All the coefficients of the supply function have the right signs, even though the significance of the coefficients differs considerably. In developing countries like Ethiopia, the bulk of imports includes intermediate imports and raw materials, which are important factors of production. Results show that both capital and labor have a relatively important influence on non-agricultural output in the economy. An attempt to include a trend variable to account for technology produced unsatisfactory results and thus was dropped from the equation. A dummy variable , Dpolitical, was introduced to account for effects of periods of political upheavals and the estimated coefficient has a negative impact on the growth of non-agricultural output, though it does not have statistical significance in the long run equation.

The short run dynamics of the model shows more or less similar result with the coefficient of adjustment of 20 percent. The error correcting term has the expected negative sign and is significant at 5%.

CHAPTER FIVE

MODEL VALIDATION AND POLICY EXPERIMENTS

Model validation is the first test that any macroeconomic model needs to pass before being put to use. This preliminary test is necessary to determine whether the constructed system achieves an acceptable standard performance. In general, there are two main groups of model evaluation. The first step is checking the individual equations of the model i.e. examining if each estimated equation satisfies standard diagnostic tests such as coefficient of determination, normality of error terms, and autocorrelation. We have already dealt with such a procedure in Chapter Four of this paper. If we are satisfied with the statistical property of each equation of the model, we then move onto the second type of evaluation.

In the second category, the system as a whole is put to test to examine two important issues. The first is ascertaining the dynamic stability of the model i.e. checking if the system reverts back to equilibrium after an exogenous shock. The second issue is evaluating the ability of the model to replicate the actual historical path i.e. the tracking performance of the model. In what follows we will put our model to test to examine its dynamic stability and tracking performance.

5.1. Stability of The Model

The stability of a model is very essential when the model is used to analyze different features of the economy. Without establishing that a model is stable, any economic inference drawn from the model would lose meaning. The commonly used approach is to introduce a once and for all shock to the system and then studying the multiplier effects. For a stable model, the multiplier effects would die out after some time, leaving the shock to have only a temporary effect while the system returns to its original equilibrium.

For the purpose of exploring the stability of our model, a once and for all exogenous shock is given to the system for just one period. As such, the historical value of domestic credit in fiscal year 1970/71 is reduced by 10 percent while the actual values of the other exogenous variables are left intact. The results of this simulation are then compared with the simulation results of the base run. The results of this shock are shown in Figures 5.1.1 to 5.1.4, where the solid lines for each of the major macro variables represents the deviation of the shocked-run time path of the variables from the control run time path.

The initial impact of reduction in domestic credit is to reduce the level of price, intermediate imports, and non-agricultural output. But it leads to an increase in Net foreign asset position of the economy. Visual inspection suggests that the model returns to the original equilibrium with varying degrees of adjustment for each of the endogenous variables following once and for all exogenous disturbance. Therefore, we can conclude that the model is stable.

Fig.5.1.1. Price Response

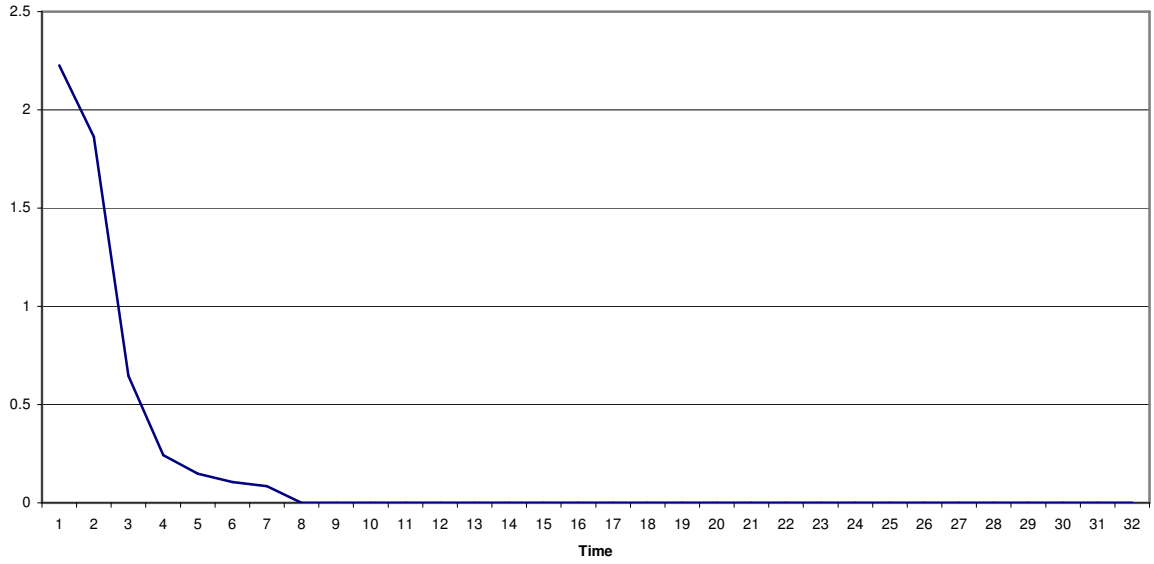


Fig 5.1.2. Non-Agricultural Output Response

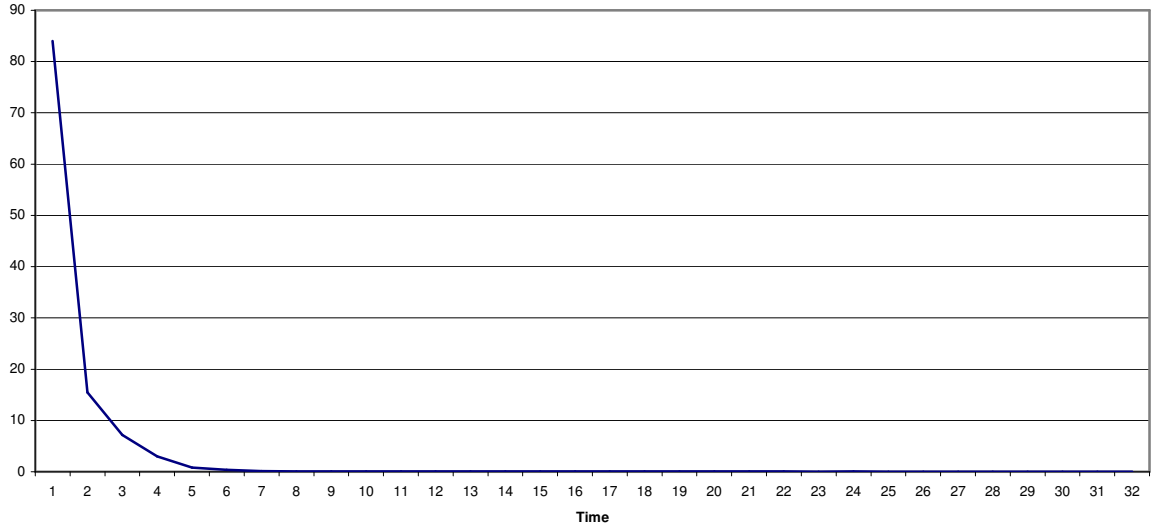


Fig. 5.1.3. Net Foreign Asset Response

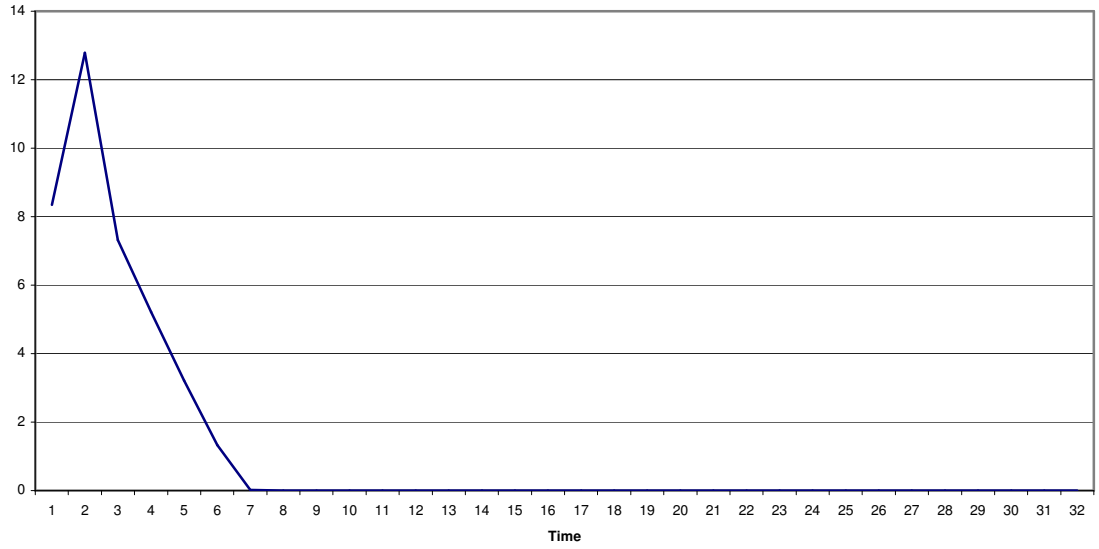
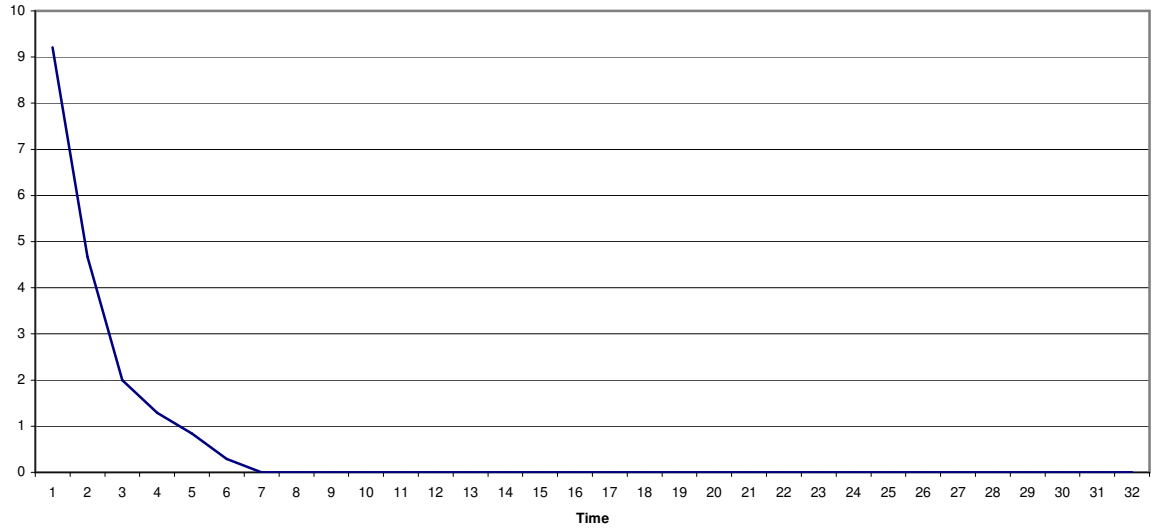


Fig 5.1.3. Intermediate Import Response



5.2. Tracking Performance of the Model

The ability of the system to track historical time paths of its endogenous variables, with-in sample tracking performance of the model, is regarded as the most important of all evaluation procedures. The point is that even if individual equations of the system have good statistical property, the system as a whole may perform badly giving poor replication of reality (Challen and Hagger, 1983).

Evaluation of tracking performance of the model begins with the control run solution of the endogenous variable generated by a dynamic simulation of the system. The control /base/ run values of the endogenous variables are then compared with the actual /historically observed/ values of the corresponding variables. At one extreme, if the control run values and the historical values of the endogenous variables coincide for every period in the sample, then the model is tracking perfectly. Therefore, the comparison between the control run solution and the corresponding historical values provides the basis for evaluating with-in sample tracking performance of the model.

There are different summary statistics to evaluate the tracking performance of a model. Root mean squared error, mean absolute error, mean absolute percentage error, root mean squared percentage error and Theil's inequality coefficient are among the most commonly used statistics. The first three statistics depend on the scale of the dependent variables and the remaining two statistics are unit free. In most cases unit free measures are preferred (Challen and Hagger, 1983).

The root mean squared percentage error (R.M.S.P.E.) for selected endogenous variables of the model are reported in table 5.2.1.

Table 5.2.1 Statistics Accuracy of the Model [7]

Variable	RMSPE		MPE	
	Static	Dynamic	Static	Dynamic
Non agricultural GDP	5.92	5.93	0.001	-0.002
Export	9.84	11.13	0.003	0.003
Intermediate Imports	2.36	4.63	-0.004	-0.008
Price	7.80	7.83	-0.007	-0.016
Net Foreign Assets	*31.2*	*61.5*	-0.164	-0.173

The results from the above table suggest that the RMSPE of the variables is less than 11 percent for most of the cases. However, the RMSPE value associated with net foreign assets are very high, even though the graphs suggest a relatively good tracking performance. According to Challen and Hagger(1983), the RMSPE may not always be a good measure especially if the values switch between positive and negative numbers.

In addition, figures 5.2.1 to 5.2.5 present the simulated along with the actual values of five variables. These variables are non-agricultural GDP, net foreign assets, intermediate imports, exports, and the consumer price index. It is clear that most of the major turning points of the selected key macroeconomic variables are picked up well for the period in consideration. Particularly, those of non-agricultural output, imports of intermediate goods, and the consumer price index are more or less traced adequately by the model; to a lesser degree, but

[7] The RMSPE and MPE are computed as follows:

$$R.M.S.P.E. = 100 \times \sqrt{\frac{1}{T}\sum_{T=1}^{T}\frac{\left(Y_T^{\,S} - Y_T^{\,A}\right)^2}{(Y_T^{A})^2}} \qquad \text{and} \quad M.P.E. = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{Y_T^{S} - Y_T^{A}}{Y_T^{A}}\right)$$

Where Y^S and Y^A represent simulated and actual values and T is the number of observations.

still reasonably well, the model shows its tracking performance for the exports and net foreign assets.

Figure 5.2.1. Exports

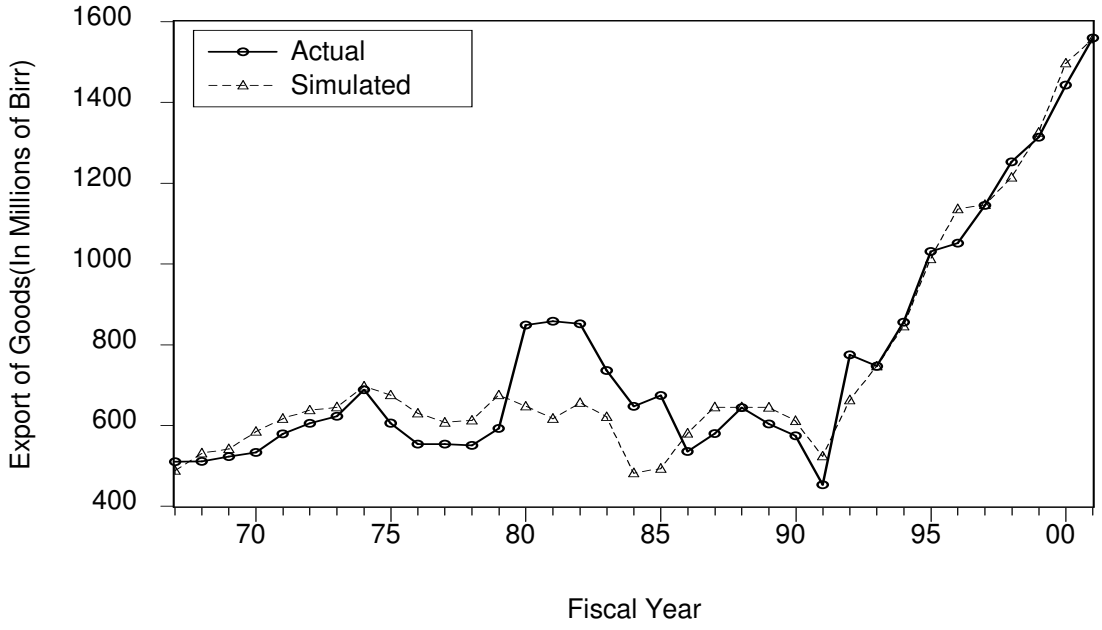


Figure 5.2.2. Imports of Intermediate goods

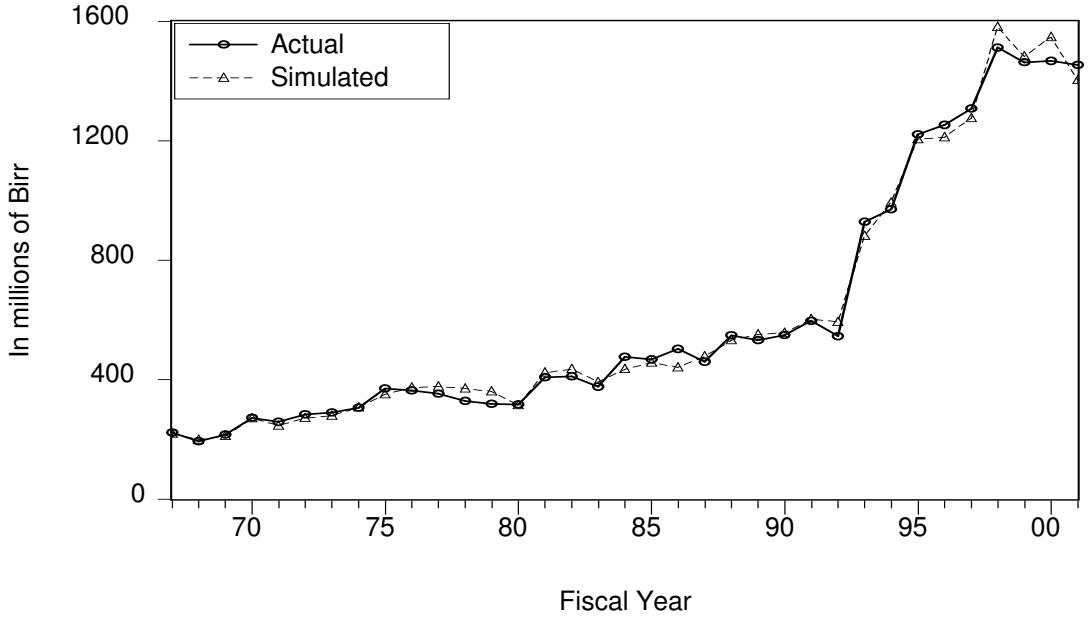


Figure 5.2.3. Net Foreing Assets

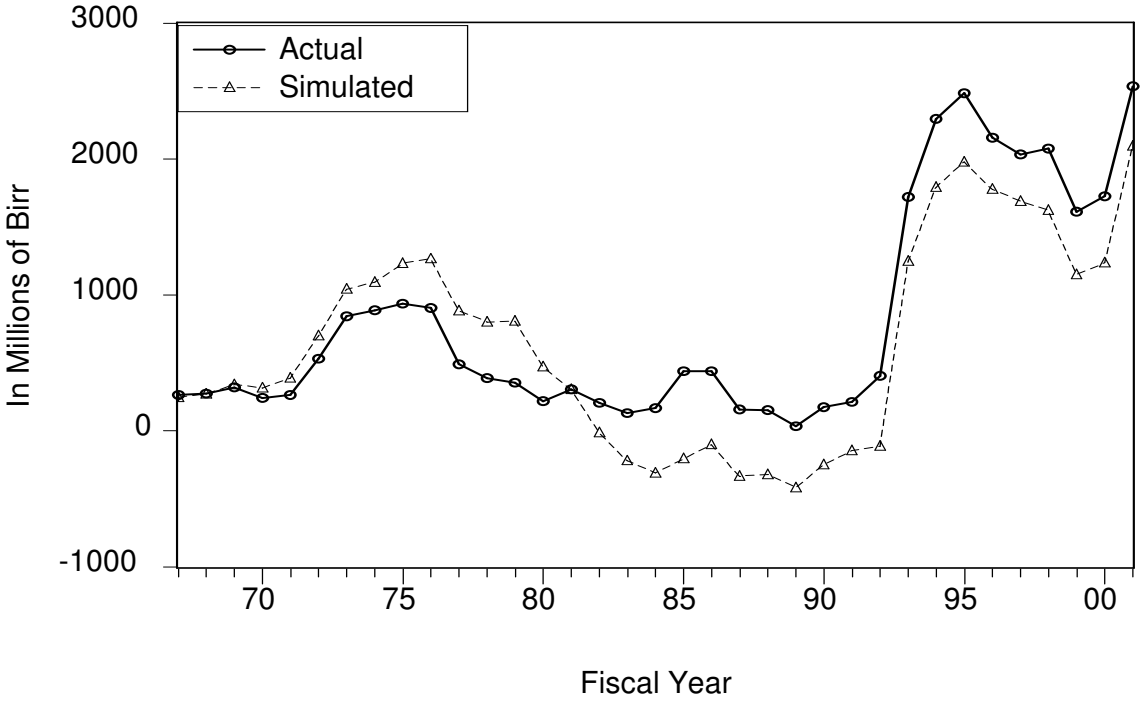


Figure 5.2.4. Non-Agricultural Output

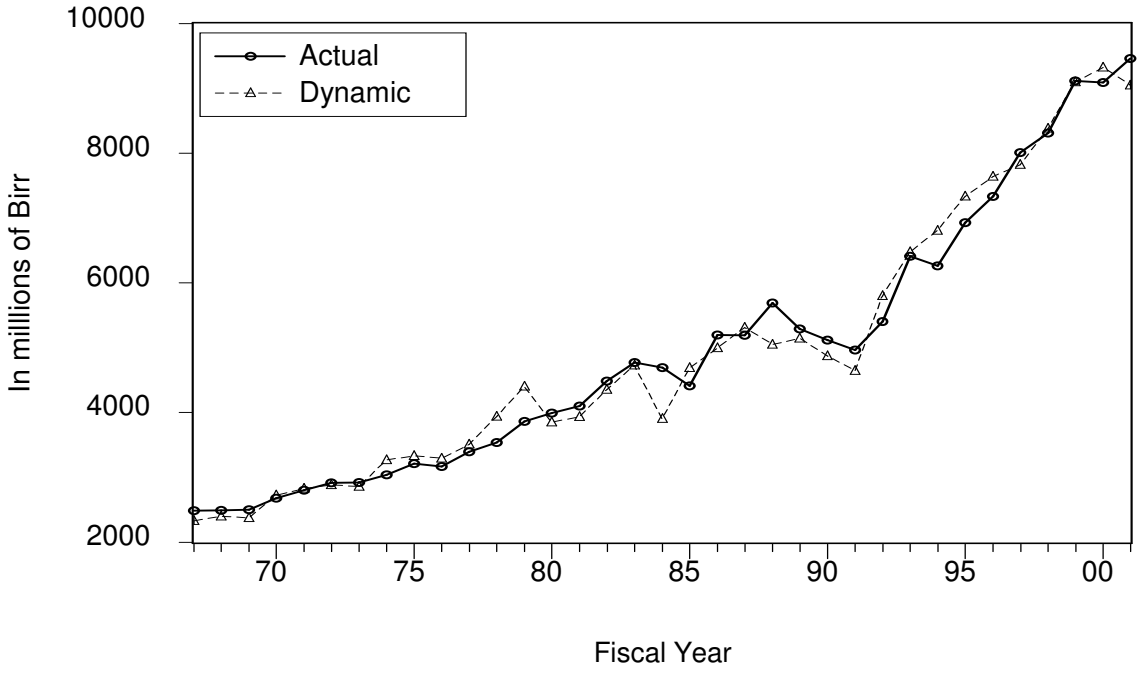
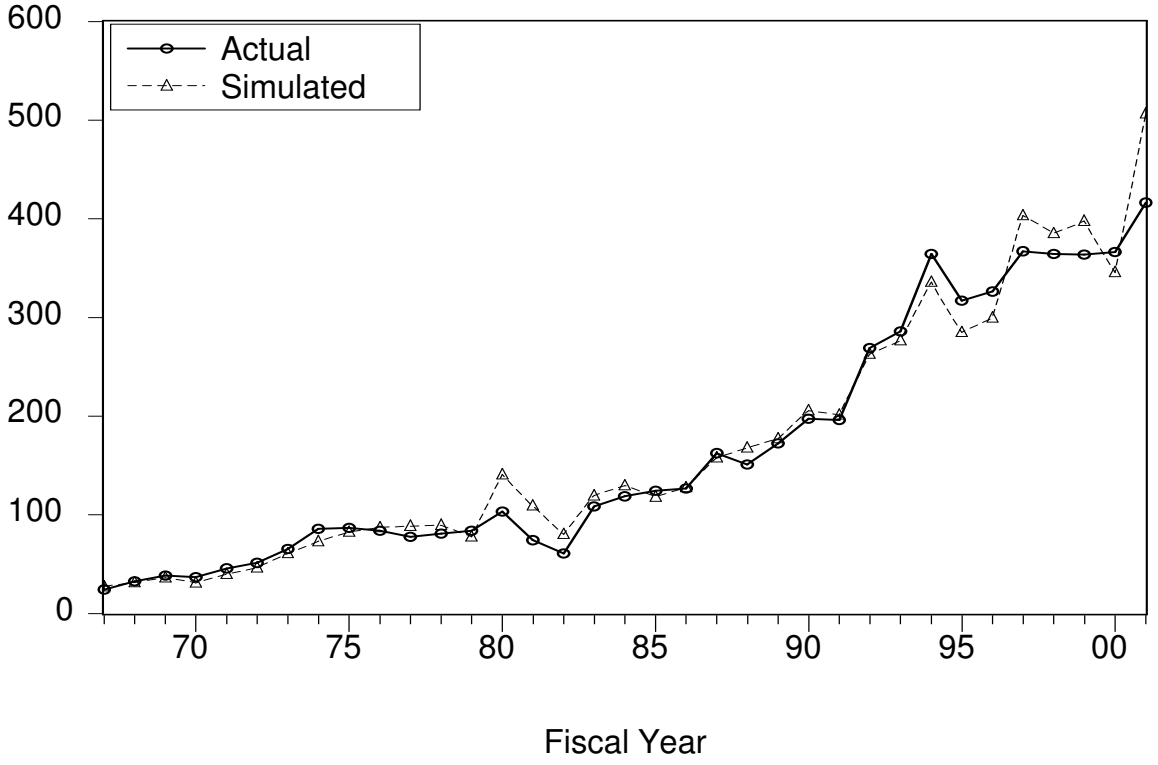


Figure 5.2.5. Consumer Price Index



On the other hand, Table 5.2.2 reports the Theil's inequality coefficient (TIC)[8] and its components. This statistics indicates the forecasting ability of the model. Theil's inequality is further decomposed in to three components. The bias and variance proportions show how far the mean of the forecast vary from the mean of the actual series and how large the variation

[8] Theil's inequality coefficient(TIC) is given as

$$\text{TIC}=\frac{\sqrt{\frac{1}{h+1}\sum_{t=s}^{s+h}(Y_t^S - Y^A{}_t)^2}}{\sqrt{\frac{1}{h+1}\sum Y^S{}_t^2}+\sqrt{\frac{1}{h+1}\sum_{t=s}^{s+h} Y^A{}_t^2}}$$

Where Y^A and Y^S are actual and forecasted values, respectively. S is forecast sample and h is the length of forecast sample. Theil's inequality coefficient can be decomposed into bias, variance and covariance proportions. components which helps us to evaluate the forecasting ability of each equation of the model.

of the forecast is from the variation of the actual series. The covariance proportion, on the other hand, measures the unsystematic forecast errors.

Table.5.2.2. Forecast Evaluation: Theil's Inequality Coefficient

Components	TIC	Bias	Variance	Covariance
Exports	0.10	0.009	0.029	0.961
Intermediate imports	0.04	0.003	0.009	0.988
Non Agricultural output	0.02	0.002	0.039	0.959
Price	0.05	0.006	0.016	0.978
Money demand	0.04	0.003	0.010	0.895

The figures in Table 5.2.2. show Theil's inequality coefficient less than ten percent. In all the cases reported the bias proportion is less than 5 percent. The variance proportion indicates that the model is doing a good job in replicating the variability in the historical data series. Except for real balances, the variance proportion is well below 5 percent. Table 5.2.2 further highlights that in more than 95 percent of the cases, the forecast error are captured by the covariance proportion and thus forecast error are unsystematic.

However, it should be noted that this model is not being evaluated in terms of outside-sample tracking performance. This is mainly due to the small number of observation and the implied loss of degrees of freedom for estimation if we are to reserve some data points for outside sample forecasting.

5.3. Policy Issues: Exchange Rate and Monetary Policy

In this section, we try to use the model to analyse the impact of two policy scenarios on the development of the endogenous variables of the model. For this purpose, two types of simulation exercise are presented in the following two sections.

5.3.1. Devaluation and Stabilization in Ethiopia

Devaluation of the exchange rate is one major but very controversial component of IMF type orthodox stabilization policy package. As has been reviewed in Chapter Three of the paper, there are arguments for and against devaluation in bringing about internal and external balance in developing countries. As part of the reform program, the exchange rate of the Birr was devalued in October 1992 from its level of 2.07 per USD to Birr 5 per USD. Studies have shown that the real exchange rate of the Birr was overvalued for much of the Derg regime (1974/75-1990/91) and thus considered the devaluation in 1992 as a timely policy. However, the fact remains that the external balance of the Ethiopian economy is still very much in deficit even after the significant level of devaluation.

Taking these facts into consideration, this section of the paper tries to answer the question "What would have been the performance of the Ethiopian economy, particularly the external sector, had there been no devaluation in 1992?" The result of such a policy scenario would provide us with a result for assessing the effectiveness of devaluation in mitigating the external balance problem of the economy.

For the purpose at hand, therefore, the value of the real exchange was kept at its level prior to the devaluation 1992. The results of the policy experiment that are reported in table 5.3.1 are based on the above assumption. According to the simulation results, had there been no devaluation in 1992, the initial impact would have been a 23 percent decline in exports, and a 40 percent increase in imports of intermediate goods.

Table 5.3.1. Effects of Exchange Rate Policy
(Deviation from base run – in percent)

	Non-agricultural Output	Trade Balance	Exports	Imports of Intermediate Goods	CPI
1992	2.2	-36.4	-23.5	40.0	-3.4
1993	1.1	-26.0	-37.9	17.7	-4.0
1994	0.7	-26.0	-46.6	10.9	-4.6
1995	0.4	-30.4	-52.1	6.2	-5.1
1996	-0.2	-29.9	-55.7	-3.1	-5.3
1997	-0.5	-27.2	-57.3	-7.0	-5.5
1998	-0.3	-21.6	-58.8	-4.4	-5.9
1999	-0.8	-19.8	-59.7	-12.2	-6.0
2000	-0.8	-22.1	-60.5	-14.6	-5.9
2001	-0.8	-23.0	-60.7	-15.6	-6.5
Average	***0.1***	***-26.2***	***-51.3***	***1.8***	***-5.2***

This would have led to worsening of the trade balance by about 36 percent compared to what actually happened. The increase in intermediate imports, however, would have led to an increase in production of the non-agricultural goods which would have shown a 2.2 percent gain. The increase in output would have contributed to reducing the output gap (or excess demand) in the economy leading to decline in general price level by about 3.4 percent.

As a result of decline in domestic prices, we would have expected an increase in exports as the relative price of exports to domestic price increases. However, this effect seem to have been counter balanced by the overvalued exchange rate leading to net decline in exports. The

decline in exports eventually leads to shortage of foreign exchange earnings which would limit the capacity to import. As a result of this, the initial increase in imports would be eroded in subsequent years. The other factor reinforcing the foreign exchange constraint is the increase in relative price of imports as domestic price level declines. These two effects together would have reduced imports of intermediate goods leading to eventual decline in non-agricultural output.

In sum, had there been no devaluation in 1992, there would have been a 50 percent decrease in exports and 2 percent increase in imports, on average. Had the exchange rate been allowed to appreciate, the trade balance of the economy would have deteriorated even further, on average by 26 percent over the decade under consideration. However, the overvalued exchange rate would have helped to boost production in the non-agricultural sector, as imports would have continued to become much cheaper than their post devaluation level. This should not, however, be over stretched as output of non agricultural sector increased, on average, by only 0.1 percent The increase in output would have reduced the output gap and thus reducing the inflationary situation.

5.3.2. Monetary Restraint and Stabilization in Ethiopia

Another important policy of the reform package is controlling the amount of domestic credit in the economy. This is based on the argument that domestic credit expansion increases money supply, which will feed into raising the general price level while at the same time credit expansion leads to worsening of the balance of payments. In fact according to the monetary approach to the balance of payments, domestic credit expansion leads to an equal

decline in the balance of payments (Net foreign asset position) assuming a stable demand for money. Taking these facts into consideration, this part of the policy experiment tries to see the response of the economy to sustained 10 percent domestic credit reduction during the simulation period 1992-2001. i.e. it tries to answer the question "What would have been the performance of the economy had there been sustained 10 percent credit contraction since 1992 ?".

The results of the second policy scenario are reported in table 5.3.2. The simulation results show that had there been sustained 10 percent credit contraction since 1992, there would have been a 2.4 percent improvement in the balance of payments of the economy (Net foreign asset position) .The contraction in domestic credit would have had a negative consequence on output of the non-agricultural sector, which would have led to decrease in total domestic production.

Table 5.3.2. Effects of Sustained 10 percent Domestic Credit Contraction (Deviation from base run – in percent)

	Non-Agricultural Output	Intermediate Imports	Net Foreign Asset	Output Gap	Price
1992	-3.1	-1.3	-6.9	6.7	-1.0
1993	-3.1	-0.8	0.0	7.5	-3.1
1994	-3.2	-3.1	1.3	8.7	-1.4
1995	-3.2	-2.4	2.1	16.2	2.0
1996	-3.1	-1.0	2.4	18.2	2.8
1997	-3.1	-0.8	2.6	10.0	0.2
1998	-3.2	-2.6	37.3	13.0	-0.2
1999	-3.2	-2.2	-6.5	17.3	1.4
2000	-3.1	-1.5	-6.7	27.3	5.3
2001	-3.0	0.1	-1.9	13.3	-0.7
Average	***-3.1***	***-1.5***	***2.4***	***13.8***	***0.5***

Such a case would have increased the excess demand leading to higher inflation in subsequent periods i.e. the initial price reduction due to contraction of domestic credit would have been counter balanced by the reduction in domestic production.

In general, had there been sustained 10 percent credit reduction since 1992, there would have been a 2.4 percent increase in net foreign asset (NFA), on average, and an average 3.1 percent decline in non-agricultural output. The decline in non-agricultural output would have led to reduction in imports of intermediate goods, on average, by 1.5 percent over the period under consideration. Furthermore, the decline in non-agricultural output would have led to decline in output of the economy leading to an increase in the output gap (excess demand), on average by 13.8 percent. Such an increase in excess demand would have eventually been reflected in an increase in price level. Accordingly, there are two forces working on the domestic price level. Initially, the price level declines as domestic credit and hence money supply decreases. This initial effect, however, seem to have been counterbalanced by the decline in output and hence the increase in excess demand. Accordingly, domestic price level would have increased, on average by, a marginal 0.5 percent.

CHAPTER SIX

CONCLUSIONS AND POLICY IMPLICATIONS

This study attempted to address stabilization issues in Ethiopia using monetary model. The specific objectives of the study were twofold. First to construct a model that incorporates the interaction among the monetary sector, the real sector and external sectors of the economy. Second to use the estimated behavioral equations of the model for simulation exercises to derive some implications for stabilization policy.

The model so developed has five major behavioral equations. On the supply side, total output in the economy is disaggregated into agriculture and non-agricultural sectors whereby the former was made exogenous. On the external side of the economy, the model specified an aggregated export function while imports were disaggregated into intermediate and consumer goods. Intermediate imports were made to be determined in the model while other components of imports were made exogenous. The monetary sector consisted of a behavioral equation for money demand while money supply is specified as an identity. Prices are also determined within the model.

The estimation of the model was done using cointegration technique. The results of the estimation indicate that most, if not all, of the coefficients are significant and have the theoretically expected signs.

Real income and real exchange rate along with the foreign exchange availability from (i.e. export earnings) were found to be important determinants of imports of intermediate goods. In the monetary sector, the main determinant of demand for money is real income while expected inflation and nominal interest rate played a rather insignificant role. Labor, capital, intermediate imports, and availability of domestic credit all have significant influence in the production of non-agricultural output. Export supply is inelastic to both relative prices and real exchange rate changes while the output gap , real exchange rate and money supply positively affected the price level.

The model as a whole was subject to various tests. Dynamic multiplier analysis showed that the model is stable in the sense that it returns to equilibrium following an exogenous shock to the system. Within sample tracking performance of the model revealed that the model tracks historical values of endogenous variables of the model very well with low R.M.S.P.E values for most of the endogenous variables. In terms of Theil's inequality coefficient and its decomposition, the model has the desirable property of low bias and variance proportion. The covariance proportion captured much of the forecast errors, and hence, errors were unsystematic. The bias proportion informs us how far the mean of the forecast is from the mean of the actual series. On the other hand, the variance proportion tells us how far the variation of the forecast is from the variation of the actual series. Following these preliminary tests, two dynamic counter factual simulations were conducted using the model.

The first scenario examined what the performance of the economy would have been if there was no devaluation in 1992. The results show that, with out devaluation the performance of the economy and especially that of the external sector would have deteriorated. In sum, had

there been no devaluation in 1992, there would have been a 50 percent decrease in exports and 2 percent increase in imports, on average. Had the exchange rate been maintained at its pre-reform level, the trade balance of the economy would have deteriorated even further, on average by 26 percent over the decade under consideration. However, the overvalued exchange rate would have helped to boost production in the non-agricultural sector, as imports would have continued to become much cheaper than their post devaluation level. This should not, however, be over stretched as output of non agricultural sector increased, on average, by only 0.1 percent The increase in output would have reduced the excess demand and thus reducing the inflationary situation.

The second policy experiment considered the effect of sustained credit contraction. The results, in general, show that had there been sustained 10 percent credit reduction since 1992; there would have been a 2.4 percent increase in net foreign asset (NFA), on average and an average 1.5 percent decline in intermediate imports. The decline in intermediate imports would have led to reduction in non-agricultural output, on average, by 3.1 percent over the period under consideration. Furthermore, the decline in non-agricultural output would have led to decline in output of the economy leading to an increase in the output gap (excess demand), on average by 13.8 percent. Such an increase in excess demand would have eventually been reflected in an increase in price level. Accordingly, there are two forces working on the domestic price level. Initially, the price level declines as domestic credit and hence money supply decreases. This initial effect, however, seem to have been counterbalanced by the decline in output and hence the increase in excess demand. Accordingly, domestic price level would have increased, on average by, a marginal 0.5 percent. In sum, the results of the domestic credit contraction are not that attractive since the

initial gains in reduced inflation would eventually be eroded as the economy starts to contract due to lack of credit.

Some policy implications could be drawn on the basis of the counterfactual simulations carried out so far. One could argue that in the face of overvalued exchange rate and huge trade balance deficit, it is unlikely that devaluation could have been avoided. Indeed, in the Ethiopian case, devaluation has proved to be a relatively effective policy tool for boosting exports and helping reduce the external imbalance i.e. the counterfactual policy experiment has shown that without the 1992 devaluation, the external balance of the economy would have deteriorated. This policy implication is clear from the results of the model. However, the fact remains that the external balance of the Ethiopian economy is still very much in deficit. This seems to indicate that devaluation alone may not be able to bring continued improvement in the external sector of the economy. Important structural changes have to be made regarding, for example, the export sector of the economy. A case in point is export diversification.

There is strong evidence that overvaluation of the real exchange rate contributed to Africa's poor economic performance. Ghura and Greens(1993) found that overvaluation was associated with lower levels of growth of real GDP percapita, lower levels of exports, lower levels of investment, and lower levels of saving.

If we consider the case in which there was no devaluation but huge currency inflow, the effects of the overvalued exchange rate would have been less severe. That is assuming that the currency inflow is not sterilized, the likely initial impact is to increase the net foreign

asset position of the economy. This would have affected money supply leading to increases in price. The rise in domestic price would affect the relative price of exports and imports as a result of which exports would increase while imports decline. This will further improve the trade balance.

Another important policy implication of the study is that the textbook and also IMF's view that devaluation is expansionary/inflationary and thus must be accompanied by such policies, as domestic credit restraint should be closely scrutinized. This point has been reinforced by the second policy experiment of the study where it was found that sustained domestic credit contraction could bring a reduction in out put without much improvement in the external balance of the economy.

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Annex 1.

Capacity Utilization Rate

The rate of capacity utilization is calculated as follows. First we regress real GDP (*RY*) constant factor cost) over time i.e.

$Log\ RY = \alpha + \beta Trend$----------*(1)*

The fitted value of this equation is mostly used as depicting the potential output level of an economy. However, Yohannes (2000) argues that the simple trend fitting in search of potential output is not easily applicable to developing countries where there are a lot of internal and external shocks leading to under utilization of capacity in most of the years. The alternative way of calculating potential output is to simply drift the fitted value of equation (1) by using the highest positive difference between the actual output and trend output in a particular year. Yohannes(2000) indicates that the year so chosen should be a normal year in the sense that there should no external or external shocks to the economy. For the purpose at hand the highest positive difference between actual and fitted values was obtained in the fiscal year 2001/02 and the value was about 0.14. We used this value to drift the fitted value of real GDP to obtain the potential output of the economy. Afterwards, the rate of capacity utilization is calculated as the ratio of actual to potential GDP. This principle is applied when we calculated for the rate of capacity utilization in the non-agricultural sector, which is needed for adjusting the labor force data.

Annex 2.

Time Series Property of The Data

Estimation of any macroeconomic relationship nowadays begins with consideration of time series property of the data. This means studying the behavior of the mean , variance and covariance of macrovarialbes over time and ascertaining whether variables are stationary i.e. constant mean and variance over time, or non-stationary. If data series are found to be non-stationary, most of the classical assumptions for econometric estimation are violated. Thus, regression of non-stationary variables could only spurious results.

There are quite a number of methods available to test for stationary of variables and the most commonly used are the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests. These methods are commonly used mainly due to ease of application. Accordingly, the number of times a variable needs to be differenced to become stationary is termed as the order of integration of the variable i.e. a variable is said to be integrated of order K if it becomes stationary after differencing it K times. By the same logic, variables which are stationary at levels are integrated of zero, I (0). In this study we use both DF and ADF testing procedures to identify the existence of a unit root and thus order of integration of variables.

The DF test relies on a simple AR(1) process and thus dumping all the possible autocorrelation problems on the error term while the ADF test starts from the assumption of an AR(P) process which will help avoid the possible misspecification problem associated with the DF test. The ADF testing procedure can be specified as:

$$\Delta Y_t = \phi + \alpha Y_{t-1} + \sum_{i=2}^{K} \gamma_i \Delta Y_{t-1} + \beta t + \varepsilon_t$$

The intercept term is introduced to capture drifts in the series while the time trend variable is there to account for existence of deterministic trends. Tables A to F of Annex 3 show the results of the DF and ADF tests.

After checking the order of integration of variables, the next step is to test for the existence of long run relationship among variables. This follows the argument that even if individual series are not stationary they could have long run linear relationship if they are cointegrated i.e. if they produce a series, which is of lower order of integration than the variables themselves. There are two procedures of testing for the existence of lower order of integration, say I(0), while the variables are I(1), then the two variables are cointegrated i.e. they move together and have long run relationship.

Though very innovative and very original, this approach has a major weakness that it cannot be applied if the equation or model has more than two variables i.e. the EG approach always assumes the existence of only one cointegaring vector. However, it is a fact that economic theory does not necessarily limit the number of long run relationship among variables in an equation or model.

In the Johansen Maximum Likelihood approach, the test for long run relationship among non stationary variables rests on the vector error correction mechanism. Consider a vector

$$Z_t = \beta_1 Z_{t-1} + \beta_2 Z_{t-2} + ... + \beta_k Z_{t-k} + U_t$$

Where Z_t is an *(n x 1)* matrix , β is an *(n x n)* matrix of parameters and $U_t \sim IN(0,\Omega)$. The Vector Error Correction Mechanism can be specified as :

$$\Delta Z_t = \Gamma_1 Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + ... + \Gamma_k \Delta Z_{t-k+1} + U_t$$

The estimated coefficients of $\boldsymbol{\Gamma}$ and $\boldsymbol{\Pi}$ in the above equation respectively represent short run adjustment and the long run information. If there is full rank i.e. $\boldsymbol{r = n}$, where $\boldsymbol{n}$ is the number of variables entering the cointegraion space, it means that the variables are stationary. If the rank of $\boldsymbol{\Pi}$ is zero, no stationary linear combination among the variables is ascertained. If, however, the rank is less than n i.e. reduced rank, it is possible to represent $\boldsymbol{\Pi}$ as $\boldsymbol{\alpha\beta'}$ where β is an *(n x n)* vector of long run parameters and the $\boldsymbol{\alpha}$ matrix represents the speed of adjustment to equilibrium.

The number of cointegrating vectors can then be identified using the λ-trace and λ-max statistics which are given as:

$$\lambda_{trace}(r) = -T(\sum_{i=r+1}^{n} \ln(1-\hat{\lambda})$$

$$\lambda_{\max}(r, r+1) = -T \ln(1-\lambda_{r+1})$$

Where $\lambda_{i=}$ Eigenvector

T= Number of Observations

The trace statistics tests whether there is at most one cointegrating relationship while the maximal statistic is used to test the null that there are $\boldsymbol{r}$-cointegrating vectors as against the

alternative hypothesis of $\boldsymbol{r}$ less than one. These two statistics are reported in the main body of the paper for each behavioral equation of the model.

Annex 3 –Results of Unit Root Tests

Table A- The Output Function

VARIABLE		DF			ADF					
		Without drift And trend	With drift	With drift And trend	Without drift And trend With lag		With drift With lag		With drift And trend	
					1	2	1	2	1	2
Log RYNA		4.07	0.06	-2.59	3.98	3.50	0.26	0.31	-2.25	-2.33
Log L		1.21	-1.55	-1.43	1.02	1.23	-1.56	-1.44	-2.09	-1.96
Log K		0.79	-0.97	-3.02	1.07	0.95	-0.36	-0.59	-2.35	-2.75
Log IMI		2.59	-0.48	-2.11	3.18	2.80	-0.09	-0.13	-1.56	-1.61
Log DC		2.54	-1.49	-3.26	2.42	3.81	-1.48	-1.73	-3.28	-2.21
Δlog RYNA		-4.55	-6.78	-6.73	-2.73	-2.32	-4.58	-4.53	-4.53	-4.52
Δ Log L		-4.37	-4.49	-4.60	-3.02	-2.48	-3.25	-2.72	-3.25	-2.65
Δ Log K		-7.33	-7.43	-7.52	-3.85	-3.81	-3.97	-4.00	-4.09	-4.29
Δ Log IMI		-6.22	-7.77	-7.64	-3.42	-2.06	-4.51	-4.39	-4.57	-3.72
Δ Log DC		-4.97	-6.02	-6.08	-4.30	-2.57	-6.77	-4.73	-6.99	-5.10
Critical Values	1%	**-2.62**	**-3.62**	**-4.23**	**-2.62**	**-2.62**	**-3.63**	**-3.63**	**-4.24**	**-4.24**
	5%	**-1.95**	**-2.94**	**-3.53**	**-1.95**	**-1.95**	**-2.94**	**-2.94**	**-3.54**	**-3.54**

Table B- The Price Equation

VARIABLE		DF			ADF					
		Without drift And trend	With drift	With drift And trend	Without drift And trend With lag		With drift With lag		With drift And trend	
					1	2	1	2	1	2
Log P		4.40	-1.40	-0.69	1.97	1.92	-1.41	-1.34	-1.64	-1.55
Log M		10.91	-.56	-2.61	4.85	3.88	-0.60	-0.62	-2.77	-2.37
Log PM		-0.11	-1.12	-1.33	-0.17	-0.14	-1.59	-2.27	-1.93	-1.63
Log OTG		0.26	-2.27	-2.16	0.32	0.52	-2.10	-1.67	-1.85	-0.69
Log RER		0.71	-0.66	-1.36	0.68	0.72	-0.79	-0.59	-1.34	-1.17
ΔlogP		-2.60	-3.62	-3.74	-2.13	-1.34	-3.25	-2.12	-3.33	-2.16
Δ LogM		-2.56	-6.58	-6.47	-1.53	-0.96	-5.22	-4.22	-5.18	-4.20
Δ Log PM		-3.55	-3.50	-3.45	-3.56	-2.94	-3.49	-2.89	-3.56	-2.89
Δ Log OTG		-6.41	-6.32	-6.44	-6.36	-4.31	-6.33	-4.31	-6.68	-4.73
Δ Log RER		-5.53	-5.54	-5.67	-4.17	-3.09	-4.15	-3.15	-4.34	-3.38
Critical Values	1%	**-2.62**	**-3.62**	**-4.23**	**-2.62**	**-2.62**	**-3.63**	**-3.63**	**-4.24**	**-4.24**
	5%	**-1.95**	**-2.94**	**-3.53**	**-1.95**	**-1.95**	**-2.94**	**-2.94**	**-3.54**	**-3.54**

Table C Export Supply

VARIABLE		DF			ADF					
		Without drift and trend	With drift	With drift and trend	Without drift and trend with lag		With drift with lag		With drift and trend	
					1	2	1	2	1	2
log EX		1.30	-0.88	-2.02	1.28	1.08	-0.85	-0.98	-2.06	-2.43
log RER		0.71	-0.66	-1.36	0.68	0.72	-0.79	-0.59	-1.34	-1.17
log (PX/P)		0.57	-0.37	-1.41	-0.15	-0.19	-0.79	-0.73	-1.82	-1.76
log RY		3.20	0.35	-1.86	2.74	4.10	0.36	1.11	-2.05	-0.68
Δ log EX		-5.48	-5.73	-5.65	-3.39	-3.33	-3.67	-3.71	-3.56	-3.65
Δ log RER		-5.53	-5.54	-5.67	-4.17	-3.09	-4.15	-3.15	-4.34	-3.38
Δ log (PX/P)		-3.89	-4.19	-4.07	-3.13	-2.33	-3.48	-2.91	-3.32	-2.38
Δ log RY		-4.43	-5.58	-5.61	-4.17	-2.88	-6.51	-3.28	-6.71	-3.46
Critical Values	1%	**-2.62**	**-3.62**	**-4.23**	**-2.62**	**-2.62**	**-3.63**	**-3.63**	**-4.24**	**-4.24**
	5%	**-1.95**	**-2.94**	**-3.53**	**-1.95**	**-1.95**	**-2.94**	**-2.94**	**-3.54**	**-3.54**

Table D Money Demand Function

VARIABLE		DF			ADF					
		Without drift and trend	With drift	With drift and trend	Without drift and trend with lag		With drift with lag		With drift and trend	
					1	2	1	2	1	2
Log(M/P)		5.12	-1.09	-2.45	3.92	3.87	-1.20	-1.40	-2.30	-1.82
Log NIR		-0.74	-1.42	-1.12	-0.81	-0.76	-2.28	-2.27	-2.05	-2.06
Log π		-2.00	-3.56	-3.70	-1.87	-1.36	-3.21	-2.15	-3.28	-2.19
log RY		3.20	0.35	-1.86	2.74	4.10	0.36	1.11	-2.05	-0.68
Δ Log(M/P)		-4.22	-6.62	-6.64	-2.69	-1.56	-5.39	-3.93	-5.53	-4.14
Δ Log NIR		-4.19	-4.88	-5.18	-3.09	-2.14	-3.05	-2.12	-3.5	-2.36
Δ Log π		-7.22	-7.11	-7.12	-6.82	-3.77	-6.77	-3.74	-6.81	-3.82
Δ Log RY		-4.43	-5.58	-5.61	-4.17	-2.88	-6.51	-3.28	-6.71	-3.46
Critical Values	1%	**-2.62**	**-3.62**	**-4.23**	**-2.62**	**-2.62**	**-3.63**	**-3.63**	**-4.24**	**-4.24**
	5%	**-1.95**	**-2.94**	**-3.53**	**-1.95**	**-1.95**	**-2.94**	**-2.94**	**-3.54**	**-3.54**

Table F Import Demand

VARIABLE		DF			ADF					
		Without drift and trend	With drift	With drift and trend	Without drift and trend with lag		With drift with lag		With drift and trend	
					1	2	1	2	1	2
Log IMI		2.59	-0.48	-2.11	3.18	2.80	-.09	-0.13	-1.56	-1.61
Log RY		3.20	0.35	-1.86	2.74	4.10	0.36	1.11	-2.05	-0.68
Log (PM/P)		1.04	-0.31	-1.55	-0.14	0.15	-0.96	-0.68	-2.20	-1.97
Log RER		0.71	-0.66	-1.36	0.68	0.72	-0.79	-0.59	-1.34	-1.17
Log NFA		0.83	-0.84	-1.63	0.79	0.67	-0.87	-1.07	-1.72	-1.97
Log EX		1.30	-0.88	-2.02	1.28	1.08	-0.85	-0.98	-2.06	-2.43
Δ Log IMI		-6.22	-7.77	-7.64	-3.42	-2.06	-4.51	-4.39	-4.57	-3.72
Δ Log RY		-4.43	-5.58	-5.61	-4.17	-2.88	-6.51	-3.28	-6.71	-3.46
Δ Log (PM/P)		-3.26	-3.52	-3.83	-3.09	-2.36	-3.45	-2.69	-3.89	-2.96
Δ Log RER		-5.53	-5.54	-5.67	-4.17	-3.09	-4.15	-3.15	-4.34	-3.38
Δ Log NFA		-5.40	-5.49	-5.46	-3.40	-2.91	-351	-3.09	-3.51	-3.04
Δ Log EX		-5.48	-5.73	-5.65	-3.39	-3.33	-3.67	-3.71	-3.56	-3.65
Critical Values	1%	**-2.62**	**-3.62**	**-4.23**	**-2.62**	**-2.62**	**-3.63**	**-3.63**	**-4.24**	**-4.24**
	5%	**-1.95**	**-2.94**	**-3.53**	**-1.95**	**-1.95**	**-2.94**	**-2.94**	**-3.54**	**-3.54**