MODELLING MONETARY AND FISCAL POLICY IN ETHIOPIA: A Macroeconometric Approach

Thesis submitted in accordance with the requirements of Liverpool John Moores University for the degree of Doctor of Philosophy

By

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May 1998

I dedicate this thesis to:

- *my beloved mother,* ***Letebrehan Abrehe****, who selflessly dedicated her life to her children and successfully guided my life during the testing times of the Ethio-Eritrean war,*

- *my daughter* ***Eritrea****, for enduring my absence at the time when she needed me most, and for sending pictures, letters and songs of encouragement that eased my guilt and kept me going,*

and

- *all martyrs and innocent victims of the Ethio-Eritrean war and those who work for peace and economic cooperation in the Horn of Africa.*

Acknowledgements

I would like to express my deep appreciation to my supervisors Professor Ken Holden and Professor John Thompson for their time and expertise that made the completion of this thesis possible. Professor Ken Holden read my drafts with pin-point punctuality and accuracy. His patience, critical observation, and editorial skills were vital. Professor John Thompson's probing questions were very stimulating and helped in shaping my ideas and in improving the structure of the final thesis. Thank you both.

My dearest sister Zewdi and the sincere family-friend Fr. Lucca Barzano shared my passion for knowledge and supported me throughout my postgraduate years. Fr. Lucca arranged a scholarship from Oeuvre St. Justin of Fribourg, Switzerland, which funded the early years of my studies. Given the lack of support from other sources, the combined effort of Zewdi, Fr. Lucca Barzano, and Oeuvre St. Justin was very crucial and I thank them from the bottom of my heart.

My dear parents Mehari Berhane and Letebrehan Abrehe, my sisters Zewdi Mehari, Medhin Mehari, Wdasie Mehari, Akberet Mehari, together with their families, took the responsibility of looking after my family-related businesses. This arrangement was facilitated as a result of the loving, mature and responsible character of Almaz Tsegai and the generous support from Medhanye, Tesfaldet, Eden, Semere, Saba, Senait, Meseret, Gebrehiwet, Selamawit, Wegahta, Lewam, Yosief, Mehreteab, Debai, Awet, other Mehari-family members, Mehreteab (Gobie) and my dear friend Gebregziabher Gebremedhin. Thanks to you all!

My heartfelt thanks goes to my wife Mehret for her patience, encouragement and self-sacrificing help; and to my children: Eritrea, Neyet, Samuel, and Shanet who were affected by the different stages of this research and thus have the right to share the celebration of its successful completion. My research period would have been dull and lonely, had it not been for the sparkling life and sweet voices of my children and the love of my wife. Thank you very much.

Professor Brian Hillier has been a good friend of mine throughout my stay in England and was instrumental in my coming to the Liverpool Business School. I also owe much to Austin Seal and John Couchman for editorial help. I would also like to thank friends and colleagues: Professor Steve Tombs, Davd Whyte, Manus Conaghan, Michael Atingi-ego, Said Mohammed Tariq, Gianluigi Giorgioni, Jason Laws, James Eden, Tony Hall, and the academic and Administrative staff of the Liverpool Business School for enriching my academic and social life. I am also very grateful to the friendship and support of the Kingsnorth family (Steven, Denise, David, Ruth, and Peter). The guidance and support of Monsignor Peter Cookson is also very much appreciated.

Persistence prevails when all else fails! Like any long-term commitment, this research project has gone through its fair share of ups and downs. The most distressing period was waiting for my viva, and the happiest moment was, of course, at its completion. I would like to thank all who supported me in the process.

Tesfamariam Mehari
May 1998

Abstract

This thesis evaluates the effectiveness of monetary and fiscal policies in Ethiopia using annual data of the years 1964-1993. The objective is to see if the Ethiopian economy can withstand the constraints resulting from surrendering instruments of economic policy in favour of a co-ordinated approach conducted on a regional level in the Horn of Africa. The literature on macroeconomic modelling is reviewed with particular emphasis on its application to the Ethiopian economy where a small modern sector coexists with a large subsistence economy and a significant informal trade and financial sector. The structure of the Ethiopian economy is profiled in terms of the modernization process of pre-1974, the socialist experiment of 1974-91, and the post-1991 'free' market reforms.

The second part of the thesis focuses on the specification and estimation of a macroeconomic model of the Ethiopian economy. The model is comprehensive, in which the link between the real and financial sectors and the implications of the large informal economy for macroeconomic policy are theoretically argued and empirically tested. The relationship between long-run equilibrium and its short-run dynamics is estimated using the cointegration and the error correction mechanism (ECM) techniques. After examining the goodness-of-fit of the macro-model, simulations are carried out to see the effects of policy instruments and exogenous shocks.

The results in general suggest that the monetary and fiscal policies of Ethiopia can be effectively conducted under the disciplines of market forces. Interest rate deregulation, where the government bonds are sold at market rates, is less inflationary and serves to raise real income. The maintenance of an artificially overvalued exchange rate and credit rationing that characterized the era of financial repression are shown to have a negative impact on output. Money financing of the budget deficit is highly inflationary while an increase in the premium on the informal exchange rate results in a decline in real output. On the basis of these results policy recommendations are proposed and the use of a similar research methodology is suggested for research on the post-1991 data of Ethiopia and the other potential members of the proposed free-trade area of the Horn of Africa

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CHAPTER ONE

INTRODUCTION

This thesis examines the structure of the Ethiopian economy with the intention of evaluating its fitness to function within the constraints of regional economic and monetary union *if and when* the existing regional institutions of the Common Market of East and Southern Africa (COMESA), the Inter-Governmental Authority on Development (IGAD) and the Ethio-Eritrean co-operation agreements mature to such a higher level of integration.

As part of the pan-African ideals, economic integration has been at the forefront of academic and political debate in post-colonial Africa. In terms of strengthening existing unions and stabilizing new ones, however, Africa achieved very little in the pre-1990s period, and the question which follows from such anunimpressive record is '*why should regional economic integration succeed in the post-1990s*?' Mehari (1999) presents a detailed discussion on the multitude of events which took place in the Horn of Africa, and further afield in Africa and Western Europe during the first half of the 1990s that justify the establishment of strong economic and monetary unions in Africa, and particularly in the Horn of Africa. This study will, therefore, focus the discussion on the Ethiopian economy, and her importance in the Horn of Africa, and will provide a macroeconometric model that will serve to analyze the possible effects of economic and monetary union on her monetary and fiscal policy *if and when* she joins. The following points make the likelihood of such a scheme more credible.

1.1 The prospect for Ethiopia's membership of a regional economic integration scheme

The current Ethiopian government's attitude towards regional economic integration is positive and consistent with events in Africa and the resurgence of trading blocs in the world market. These events can be summarized into three as follows.

FIRST: in May 1991 Mengistu Hailemariam, the Ethiopian dictator who presided over most of the 30-year Ethio-Eritrean war, was ousted from power. This opened the way for the establishment of new governments in both Eritrea and Ethiopia with unprecedented political will towards regional economic integration. The following points reflect the optimism and cooperative mood of the time.

I. Soon after the defeat of the Ethiopian Derg's Army, the Eritrean leader, Isaias Afeworki, stressed the need for regional co-operation and the importance of a cordial relationship with Ethiopia saying, "*Ethiopia is the first in our list, whether politicians here like it or not, because of geography and cultural ties, mutual security and economic interests*" (Parmelee, 1991)[1].

II. This was formally reciprocated on July 12, 1993, when the Ethiopian foreign minister Seyoum Mesfin said, "*It is now becoming increasingly obvious that closer co-operation among countries and their economic integration is not one option among many that states have to ensure a better life for their respective people. It is the only option they have*". (Review of African Political Economy, no. 59, 1994, p. 92).

III. Such exchange of political good-will also caught the imagination of the intelligentsia and in 1994 a book was published in which the "Horn of African Free Trade Area (HAFTA)" was proposed (see Kidane 1994).

IV. The will to co-operate seems to accord with the practical measures on the ground, albeit slowly. The Inter-Governmental Authority on Development (IGAD) has extended its role towards becoming a regional institution for economic co-operation between Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, and Uganda. Eritrea continued to use the Ethiopian Birr until November 1997 and, as the current voices against dollarization of Ethio-Eritrean trade indicate, Eritrea's national currency is expected to be closely linked to the Ethiopian Birr. Ethiopia has free access to Eritrean seaports and both countries run a number of joint projects.

SECONDLY: after three decades of protectionism and financial repression, the post-cold-war leaders of Africa seem to have accepted regional economic grouping of their fragmented economies as a viable alternative development strategy. Almost all countries have accepted the structural adjustment program (SAP) of the IMF and none of the ruling regimes identifies itself as 'communist'. Continental institutions like the African Development Bank (ADB) are actively campaigning in favour of monetary union and African leaders endorsed the principle in the Abuja Declaration of 1991 (AED January 3,1994, p. 3). Leaders of international institutions, such as the World Bank's president James Wolfensohn, have also endorsed economic integration as the best strategy for attracting private investment (including the 34%

[1]This was quoted by Okbazghi Yohaness in Review of African Political Economy, no. 57, p. 24, from Jennifer

of the continent's wealth deposited abroad) and for reducing Africa's marginalization in global trade and investment (PANA report, January 27, 1998).

THIRDLY: post-war developments in Western Europe have proved that political will can transform a war-torn continent into the biggest single market in the world. The organization that started as the European Coal and Steel Community (ECSC) in 1951 has now reached a level where it is poised to have a single currency and a common central bank.

1.2 The importance of political will and economic efficiency

It is true that political commitments are vital in any integrationist project because monetary integration has important political implications. In fact, the few economic and monetary union experiments Africa has experienced are products of colonial politics[2]. However, political commitments should be seen as a necessary but not sufficient condition for monetary union. Once a country joins a monetary union, the direct control of national monetary authorities over monetary instruments (e.g., seigniorage, interest rates and exchange rates) will be surrendered to a supranational institution which implements them in a co-ordinated approach at union level. In other words, economic and monetary union represent a radical change in the formulation and implementation of economic policies, and no such arrangement can be sustained in the long run unless it improves the economic welfare of citizens through added efficiency to the economic system.

In this study we are dealing with Ethiopia, a country which has the potential for, but no experience of, membership of a monetary union. *If and when* such opportunity arises therefore, the decision on whether or not to join is likely to be based on the theoretical arguments for monetary union and the empirical evidence on the relative effectiveness of national monetary policy. Even in the case where national monetary authorities are shown to have had a poor performance, monetary union is one (and by no means the only) option for reforming the institutions of policy-making and implementation. These will be the guiding principles in the analysis and conclusions of this thesis.

Parmelee's article in the Washington Post, 8 August 1991.

[2]The CFA countries are all former French colonies, while the East African Common Market and the Rand Monetary Area were by and large associated with British colonialism. The fate of the European single currency is also likely to be decided by politicians, and history seems to support those who associate a single European currency with a Federal Europe. To mention only two of many, the dollar in the USA and the rouble in former USSR were introduced after the formal political union of the states and republics respectively.

1.3 Methodology and outline of the study

Historical analysis of the Ethiopian political economy, theoretical arguments on the informal sector and on macroeconomic modelling, and a policy simulation exercise using a macroeconometric model will be used to examine the adaptability of the Ethiopian economy to the changes in the policy-making regime that are likely to arise if Ethiopia joins a regional monetary integration scheme. Part One of the discussion starts from a profile of the Ethiopian political economy during the sample period, proceeds to analyzing the macroeconomic implications of the informal economy and the dual structure of a developing economy, and reviews macroeconomic modelling. Part Two specifies and estimates a macroeconomic model for the Ethiopian economy, and conducts policy simulations using instruments that are relevant to any future regional monetary union. The use of a similar approach in the evaluation of other economies in the Horn of Africa will be suggested as a proposal for future research.

The main body of the thesis is organized in eight chapters and the concluding remarks are given in chapter ten. Chapter two profiles the Ethiopian economy in the post-1960's period. It is shown that the economy grew steadily until the drought and political upheavals which followed the 1973 oil-shock. The 1974-91 reign of the 'socialist government' was a period of massive growth of government expenditure and steady decline in economic growth; while the post-1991 period is a period of reforms towards a free-market system.

Ethiopia is a member of COMESA and there are various initiatives to establish economic and monetary unions in the region. In the chapter, therefore, monetary union is considered as a possible scenario where Ethiopia plays a central role due to the relatively large size of her economy, her diplomatic network and the post-1991 exemplary relationship between Eritrea and Ethiopia.[3] Thus, the policy simulations in chapter nine are carried out to test the implications of such changes in the policy regimes on the monetary and fiscal policy of Ethiopia.

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[3] In order to maintain the focus on evaluating the effectiveness of monetary and fiscal policy in Ethiopia, however, the chapter does not give a detailed discussion on the cost-benefit analysis of economic and monetary union in Africa. However, Mehari (1999) argues the case for regional economic and monetary union in terms of the need for post-war reconstruction, economies of scale and the importance of collective bargaining in the international market. The rationale for monetary union relies on issues related to the credibility of common monetary policy and as a natural progression of the will to integrate. Economic interdependence, political history, demographic and cultural ties and the need for peaceful coexistence are also emphasized as possible reasons behind the new mood for economic integration in the region.

In chapter three the discussion is focused on the large rural subsistence economy and the informal sector as the distinctive structures of contemporary economies of Ethiopia (and indeed of sub-Saharan Africa) which most studies tend to ignore, or to mention without adequate articulation and empirical investigation. It is shown that the dual structure of the economy leads to the concentration of economic, social and political facilities in a few urban centres, thereby excluding the large subsistence economy from markets and infrastructures that are crucial for the transfer of technology and for full participation in the decision-making processes of the nation. Secondly, the persistent coexistence of the informal market alongside its official counterpart is seen as a symptom of the ineffectiveness of national economic policies and, to some extent, as evidence of interdependence of neighbouring economies. The implications of such structural duality and persistence of the informal sector for macroeconomic modelling and for policies on industrialization and international trade are discussed in detail.

Chapter four reviews the literature on macroeconomic modelling. A macroeconometric classification is provided to show the 'Schools of Economic Thought' on which each of the models bases its theoretical underpinnings and the econometric procedures applied in estimating their equations. It is also shown that the theoretical purity of these models has been diluted in the evolution of macroeconomic modelling and, thus, contemporary models are mainly hybrids of different 'Schools of Economic Thought' and econometric procedures. The applications of macroeconomic modelling in less developed countries (LDCs) have also followed similar evolution as their counterparts in the developed world. They attempt to incorporate the supply-side constraint and market-clearing concepts of the neo-classical school within a Keynesian IS-LM framework; and there are also some models which try to combine input-output analysis on the supply-side with demand-side equations estimated using dynamic (time-series) econometrics. It is also shown that macroeconomic modelling in Ethiopia is still at its early stage, and after a review of the existing models, suggestions are made on how a more comprehensive macroeconometric model can be built. The gap in the literature is identified in order to highlight the points on which this study intends to contribute. The chapter concludes by emphasizing the importance of understanding the structure of the economies, institutions and policy regimes that influence the behaviour of agents in LDCs and their incorporation (adaptation) in the macro-model.

The second part of the thesis focuses on an econometric analysis of the Ethiopian economy. In addition to the importance of Ethiopia and the Ethiopian economy in the region, this focus is chosen because of the availability of relatively good-quality data. Chapter five specifies the theoretical model of the real and monetary sectors of the Ethiopian economy. It is an IS-LM model (whose adoption is justified in chapter four), and has separate behavioural functions for private consumption, private investment, imports, exports and the demand for broad money. Prices are modelled in such a way that they respond to disequilibrium in both the real and monetary sectors. The model is modified in recognition of the coexistence of informal and formal sectors discussed in chapter three. The dual structure of the economy is catered for by modelling expected inflation adaptively while using rational expectations for returns on foreign assets. The supply side of the economy is to some extent accommodated in the investment, import and FER functions.

The sources and time-series properties of the data used in the estimation of the model are discussed in chapter six. Most of the data are taken from official publications while some are derived. The derivation procedure and its theoretical basis are included in detail. The full list of the data used in the estimation of the model is presented at the end of the chapter in order to facilitate scrutiny of the accuracy of the results.

The estimation procedure and its diagnostic tests are discussed in chapter seven. The theory of cointegration and the error correction mechanism are used to determine the static and dynamic relationships between the variables in each behavioural equation. The final result is accepted after it is evaluated on the basis of the underlying economic theory and statistical diagnostic tests.

In chapter eight the individual estimated equations are combined into a macroeconomic model and analyzed as a system. To facilitate the discussion the equations are listed and their interaction is shown in a flow-chart. The accuracy of the macro-model is then evaluated by comparing the time-path of the actual values with their simulated counterparts.

After accepting the model as being representative of the Ethiopian economy, chapter nine takes the argument back to the issue of monetary union. The effectiveness of monetary and fiscal policy in influencing real variables is examined by subjecting the model to five policy-induced and two exogenous shocks. The results of these shocks in the immediate post-shock period and over the long run are presented and discussed. These results are used in chapter ten to present the overall conclusion of the thesis, propose policy recommendations and suggest areas for further research.

CHAPTER TWO

PROFILE OF THE ETHIOPIAN ECONOMY

The macroeconomic model that will be estimated in this study is based on 1964-93 data. This period extends through the optimism of the 1960s, the stagnation of the 1970s to 1980s, and the reform towards free market of the 1990s. In order to provide background information and help put the findings of the study into proper context, this chapter will profile the Ethiopian political economy. Section 2.1 presents the general features of the Ethiopian economy, followed by a brief history of Ethiopian political economy in section 2.2. Section 2.3 discusses the behaviour of some key economic variables during the sample period. Section 2.4 presents Ethiopia as a regional power in the Horn of Africa with the potential to anchor mutually beneficial regional cooperation schemes, and section 2.5 concludes the chapter.

Figure 2- 1: Map of the Horn of Africa

2.1 General features of the Ethiopian economy

In spite of an early start in the modernization process, Ethiopia still has one of the poorest and least-developed economies, with the economic gains of modernization limited to only a few areas. Per-capita income is still around $120 and 64% of the population lives below the absolute poverty line. Life expectancy is 45 years, and out of the population of around 55 million only 46% have access to health services, and 19% to safe water. Adult literacy rate is 66%, with primary and secondary school enrolment rates of 38% and 30% respectively. Nowadays, all the marks of underdevelopment (i.e., weak infrastructure, low agricultural productivity, dependence on coffee exports, narrow and import-dependent industrial base, small and fragmented domestic market) characterize the Ethiopian economy (Abegaz 1994).

Details of external debt are not published but World Bank estimates show that it rose sharply in the 1980s reaching 57% of GNP in 1988, with 40% of export earnings going to servicing debt obligation. By 1992 external debt reached $4.4 billion ($88 per head compared to $392 per head in sub-Saharan Africa) with half of bilateral debt owed to the former Eastern Bloc. Nonetheless, per-capita foreign aid to Ethiopia is one of the lowest, i.e., $9.9 per head in 1984 compared with $25.5 for low-income sub-Saharan countries (see EIU 1994/95, BBC April 7, 1998, and ANS February 26, 1998).

As a result of the post-1974 socialist policy, more than 90% of large-scale industry (and less than 10% of agriculture) is state-run. This may change as the current government is expected to privatize some of the state industries (World Factbook 1994). Output of the agricultural sector is composed of field crops (40%), livestock (40%) and cash crops (20%). The inefficiency of this sector is clearly seen from the fact that it employs more than 80% of the labour force, while its contribution to GDP is limited to around 45%. Migration from rural to urban areas is high although the overwhelming urban majority is only marginally better-off than the rural population.

The impact of the stagnation of the formal sector on the expansion of informal economic activities is also worth noting. In the post-1974 period the service sector expanded to constitute an output share equivalent to that of agriculture in terms of value added. On the basis of the history of Western industrialization this may seem a healthy development because as an economy progresses the share of the service sector is expected to increase. In the Ethiopian case, however, as indeed in most of sub-Saharan Africa, such development is symptomatic of the failure of the productive sector to absorb the labour force. Employment capacity of the formal sector declined as growth in agriculture and industry lagged behind the growth of the labour force (see Figure 2.3). This has created a marginalized labour force whose only means of survival is to participate in the mushrooming petty private service and informal trade activities (Abegaz 1994).

2.2 Ethiopian political and economic history in brief

After decades of cross-border conflict and civil war, normality was restored in 1991. In spite of the food crisis in some drought-prone regions and the loss of the Red Sea coast to Eritrea, the restoration of peace and the post-1991 reforms managed to reverse the trend of economic decline and stagnation. A brief account of the major events which shaped the Ethiopian political and economic scene will be discussed in this section.

2.2.1 Brief political history of Ethiopia

Also known as Punt and Abyssinia, Ethiopia's earliest recorded history dates from the second millennium BC. With Axum as its main centre, the civilization accepted Christianity as the State Religion in the fourth century. One of the most enduring legacies of this civilization is the Ge'ez language which dates back to the first century BC and still serves as the liturgical language of the Ethiopian Coptic church. The distinct Ge'ez writing-system used in Classical Ethiopic literature still serves the country's governmental, educational and domestic business activities. The Muslim conquest which introduced Islam mainly to the lowland regions, cut off the country's communication with northern civilizations until the 19th century.

In the 19th century's European scramble for Africa, Ethiopia maintained her independence by winning successive battles including the famous Ethio-Italian battle of Adowa in 1896. After four decades, Benito Mussolini's army succeeded in ousting the Ethiopia Emperor in 1935/6. The defeat of Italy by the British in 1941 restored Haile-Selassie to the throne. Soon Ethiopia demanded sovereignty over Eritrea claiming it as an integral part of Ethiopia until its colonization by the Italians in 1890. In 1952 the UN decided to federate Eritrea and Ethiopia, but in 1962 the King declared the federal arrangement null and void, and annexed Eritrea as the 14th province of his empire, thereby igniting the 30-year Ethio-Eritrean war. As a result of his failure to solve the Ethio-Eritrean conflict, and the economic hardships that followed the major crop failure in Wello province and the 1973 oil-shock, the King lost popular support and was overthrown in 1974.

The new government pressed for a military solution to the Eritrean problem and its dictatorial policy plunged the country into civil war. The conflict culminated in the defeat of the Ethiopian Army in 1991 and, following a UN-supervised referendum, to the establishment of the independent state of Eritrea in 1993. Thus, in spite of its ancient history, the present political borders of Ethiopia are to a large extent the result of European colonialism.

2.2.2 Brief economic history of Ethiopia

The process of modernization in Ethiopia started in the 1930s with the introduction of modern labour and capital markets, and central government bureaucracy. Since then the economy has experienced two major shocks following the change of governments in 1974 and 1991. Thus, modern Ethiopian economic history can be divided into three parts, during which economic policy went full circle: i.e., the period of industrialization based on 'free-market' principles; its replacement by socialist policy in the mid-1970s; and the re-introduction of free-market reforms in the early 1990s.

2.2.2.1 Pre-1970 policy

Like most LDCs, Ethiopia entered the post-world-war era with a large subsistence sector and very weak industrial base, while her institutions lacked the degree of flexibility required for adjustment and modernization. As exporter of few primary products, she joined the ranks of price-takers in the international market. These internal and external factors therefore played a key role in arresting the country's economic growth.

The 1960s were in general a period of stability, optimism and promises of rapid industrialization by the ruling elite. However, it soon became clear that the promise of development could not be fulfilled, given the over-dependence of the economy on a few primary exports and on foreign economic patronage. Powerlessness in the face of international markets became more evident when the 1973 oil-shock triggered the economic deceleration from which most of sub-Saharan Africa did not recover for more than a decade.

2.2.2.2 Post-1974 socialist experiment

The Ethiopian people's reaction to such economic difficulties was expressed by a popular revolution which replaced the King by a 'Marxist' military government, inward-looking policies and civil wars. The 1970-90 period, therefore, was an era of political instability, excessive government intervention and economic stagnation.

The 1974 Ethiopian revolution introduced state socialism with a rudimentary system of central planning. This coupled with the effects of the 1973 oil-shock and the wars with Somalia, Eritrea and other rebel groups, constituted an important watershed in Ethiopian economic progress (see Table 2.1 and Figure 2.2). Real GDP (at 1990 prices) which had been steadily growing from Birr 163.23 million in 1968 to Birr 189.49 million in 1974, suddenly dropped to Birr 179.6 million in 1975 followed by a steady decline to Birr 90.05 million in 1992. Government expenditure grew steadily from Birr 21.44 million in 1968 to Birr 43.79 million in 1990 at the expense of the private sector. The squeeze was particularly harsh on private investment and exports, which fell from Birr 18.6 million and Birr 16.98 million in 1968 to a mere Birr 1.76 million and Birr 6.93 million in 1992 respectively. Private consumption accounted for around 77% of GDP. Although population grew steadly during the sample period, private consumption fell from Birr 144 million in 1974 to Birr 78 million in 1992. Imports fluctuated between Birr 17 to 30 million with an average of Birr 23 million for the full sample period.

In the monetary sector, real money (M2) increased in spite of the decline in real output. With the exception the years of major political upheavals (i.e., 1976-78 and 1991) real M2 increased steadily from Birr 23.62 million in 1968 to Birr 80.58 million in 1992. Close observation of the composition of M2 reveals that the proportion of bank deposits increased at the expense of holdings of cash. The average ratio of cash to M2 fell from 55.98% in 1964-69 to 46.93% in 1970-79 and 39.29% in 1980-89 (see section 2.3.7).

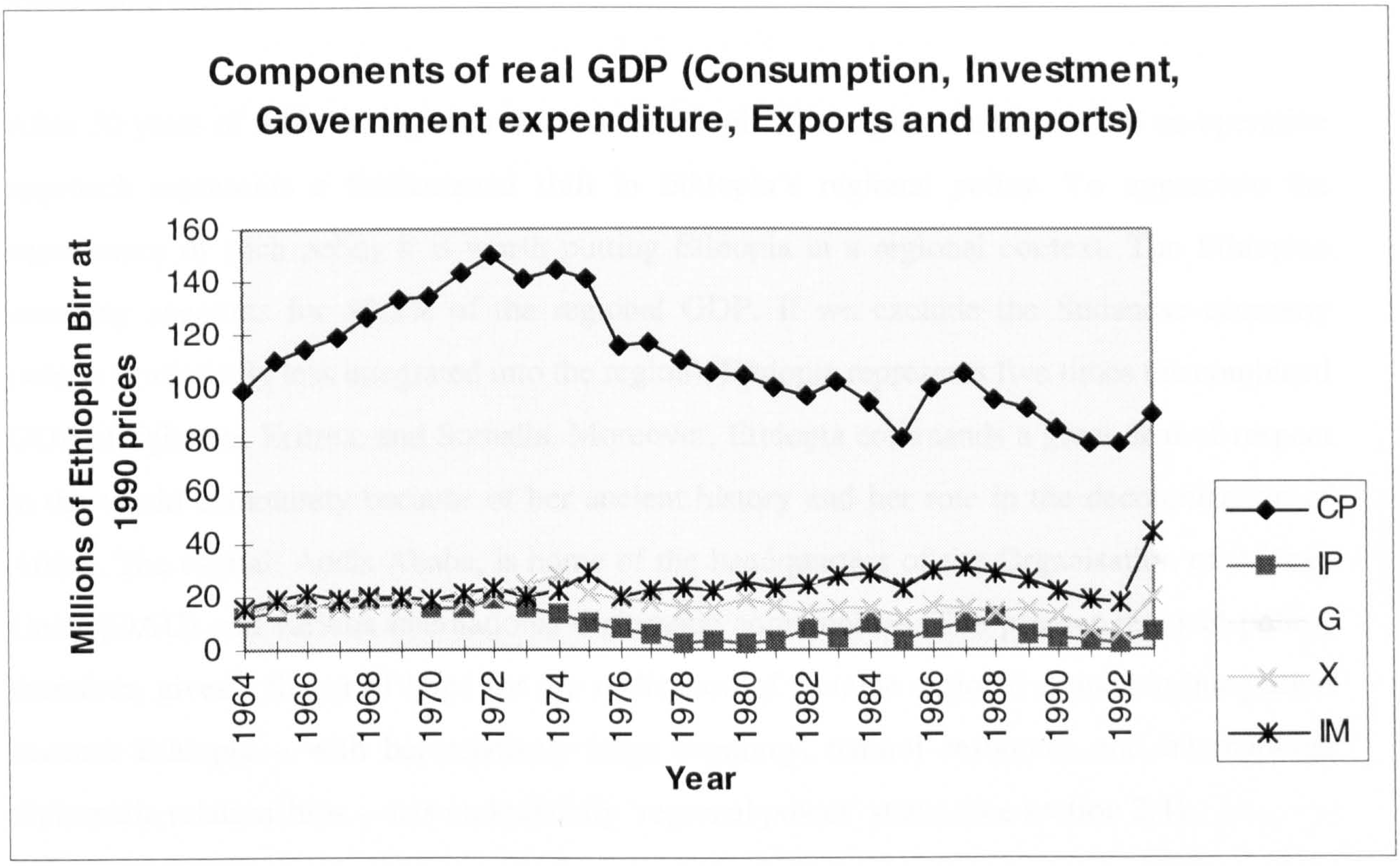
Although real money as a percentage of GDP increased by an average of 38.95% for the full sample period, the corresponding average inflation was 8.46%. Even this inflation does not seem to be policy-induced because in spite of the steady growth of 22.46% in government expenditure, inflation remained low. In 12 out of the 17 years reign of the 'socialist government', inflation remained in single figures and at times even negative. In this respect it is worth noting that the government was actively intervening in the market to stabilize prices, and its ability to do so was enhanced by the nationalization of the commanding heights of the real and financial sectors. The sharpest increase in the CPI (i.e. from 100 to 150) was recorded during 1991-92 and this corresponds with the rise in the cash economy to 46% and the beginning of adjustments towards a free-market system (see section 2.3.6).

Table 2- 1: Components of GDP, Money and Price (1968-92)

	Millions of Ethiopian Birr at 1990 prices					
	Average 1968-92	1968	1974	1975	1990	1992
Private consumption	110.77	126.34	144.85	141.47	84.16	78.04
Private investment	8.82	18.60	13.72	10.34	4.57	1.76
Government (Total)	30.63	21.44	25.02	34.63	43.79	20.77
Imports	16.69	16.98	28.26	21.79	13.91	6.93
Exports	23.73	20.13	22.35	28.63	22.13	17.45
GDP	143.17	163.23	189.49	179.60	124.3	90.05
Money supply (M2)	51.09	23.62	42.53	46.45	88.37	80.58
Prices (CPI, 1990=100%)	64.11	23.50	29.30	31.30	100.00	150.00

Source Calculated from IMF, *International Financial Statistics,* 1994.

Figure 2- 2: Components of GDP



2.2.2.3 *Post-1991 policy of liberalization and regional economic integration*

The 1990s have been characterized by economic reforms geared towards a free-market system and regional economic integration. Government monopoly on key production and financial sectors has been eased by allowing private-sector operators and a semi-market-determined exchange rate system. Nowadays, Ethiopia is a member of the Common Market for East and Southern Africa (COMESA) which is expected to progress to a customs union by the year 2004 (see AED, September, 22, 1997). Ethiopia is also a key member of the Inter-

Governmental Authority on and Development (IGAD) and there are calls for the establishment of a Horn of Africa Free Trade Area (see Kidane 1994).

Post-1993 Ethiopia recognizes Eritrea as a sovereign neighbouring state and, as discussed in chapter one, she is pressing for regional economic integration among the five sovereign countries namely: Djibouti, Eritrea, Ethiopia, Somalia and Sudan. Historically these countries shared kingdoms whose boundaries and political centres varied over time, whilst their present interdependence is based mainly on shared natural resources (such as rivers and sea-ports) and the significant movements of people caused by frequent environmental and political problems.[1] Consequently, their economic and political destiny remain inextricably linked for the foreseeable future.

After 30 years of futile attempts to dominate the region through violence, such a co-operative approach represents a fundamental shift in Ethiopia's regional policy. To appreciate the significance of such policy it is worth putting Ethiopia in a regional context. The Ethiopian economy accounts for 42.3% of the regional GDP. If we exclude the Sudanese economy (which is relatively less integrated into the region), Ethiopia represents five times the combined GDP of Djibouti, Eritrea, and Somalia. Moreover, Ethiopia commands a great deal of respect in the world community because of her ancient history and her role in the decolonization of Africa. The capital, Addis Ababa, is home of the headquarters of the Organisation of African Unity (OAU) and various international diplomatic communities. The present regional policy, therefore, gives a flicker of hope for the realization of genuine regional economic integration because Ethiopia – with her relatively large economy, natural resources and international diplomatic relationships – has undoubtedly 'regional power' status (see section 2.4).

Since the macroeconomic model that will be estimated in this study is based on 1964-93 data, it extends through all three phases of post-1960 Ethiopian economic history. The model builds on the prevailing policy on regional economic integration. However, political willingness on its own cannot deliver a sustainable economic union unless there are fundamental economic interdependencies and mutual benefits to warrant such an arrangement, as well as the

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[1]In the past three decades up to 500,000 Eritreans and 600,000 Ethiopians have moved to the Sudan and are living there mainly as refugees, and hundreds of thousands of Eritreans have settled in Ethiopia. More recently there has been a large migration to Ethiopia from the conflict zones of Somalia and southern Sudan.

Ethiopian economy having the potential strength, discipline and credibility to anchor such project. To this effect, the relevant policy simulations that test the monetary and fiscal credibility of the Ethiopian economy will be carried out in chapter nine. The next section discusses the behaviour of some key variables in the model during the sample period.

2.3 Historical account of some key economic variables.

Having briefly profiled the Ethiopian economy, we will now examine some key indicators of the structure and performance of the economy. In line with Ethiopia's policy on regional economic integration, we will discuss economic variables related to inflation, government revenue and exchange rate stability (see De Grauwe 1992). The informal economy is also covered because of its effect on these variables and thereby on the overall effectiveness of monetary policy. External trade is discussed as an indicator of the degree of interdependence of the Ethiopian economy with its neighbours and the global market. The growth of real GDP will also be examined as a major determinant of living standards.

2.3.1 Growth of real output

The Ethiopian economy steadily grew throughout the pre-revolution period. As can be seen from figures 2.3 and 2.4 the first negative sign appeared in 1973, which coincided with an international oil price-shock. In September 1974 the King was formally ousted from power after which socialist economic policy emerged in the form of nationalization of the commanding heights of the economy, promotion of co-operatives mainly in the agricultural sector, and the introduction of national planning to coordinate pricing and resource allocation in line with national objectives. The result was a sharp decline in real output during the 1975-92 period. However, it is worth mentioning that the socialist experiment was conducted in an atmosphere of uninterrupted political violence, civil war, Ethio-Somali war, Ethio-Eritrean war, and environmental crisis such as the 1984-85 famine. For almost all the post-1974 period, growth of real output remained below growth of population, thereby reducing per-capita income (see Figure 2.4). The new government which took over in May 1991 initiated reforms to the economy, and policies such as devaluing the official exchange rate in 1992 (see Table 9.9, page 304) seem to have reversed the downward trend in 1993.

Figure 2- 3: Real output

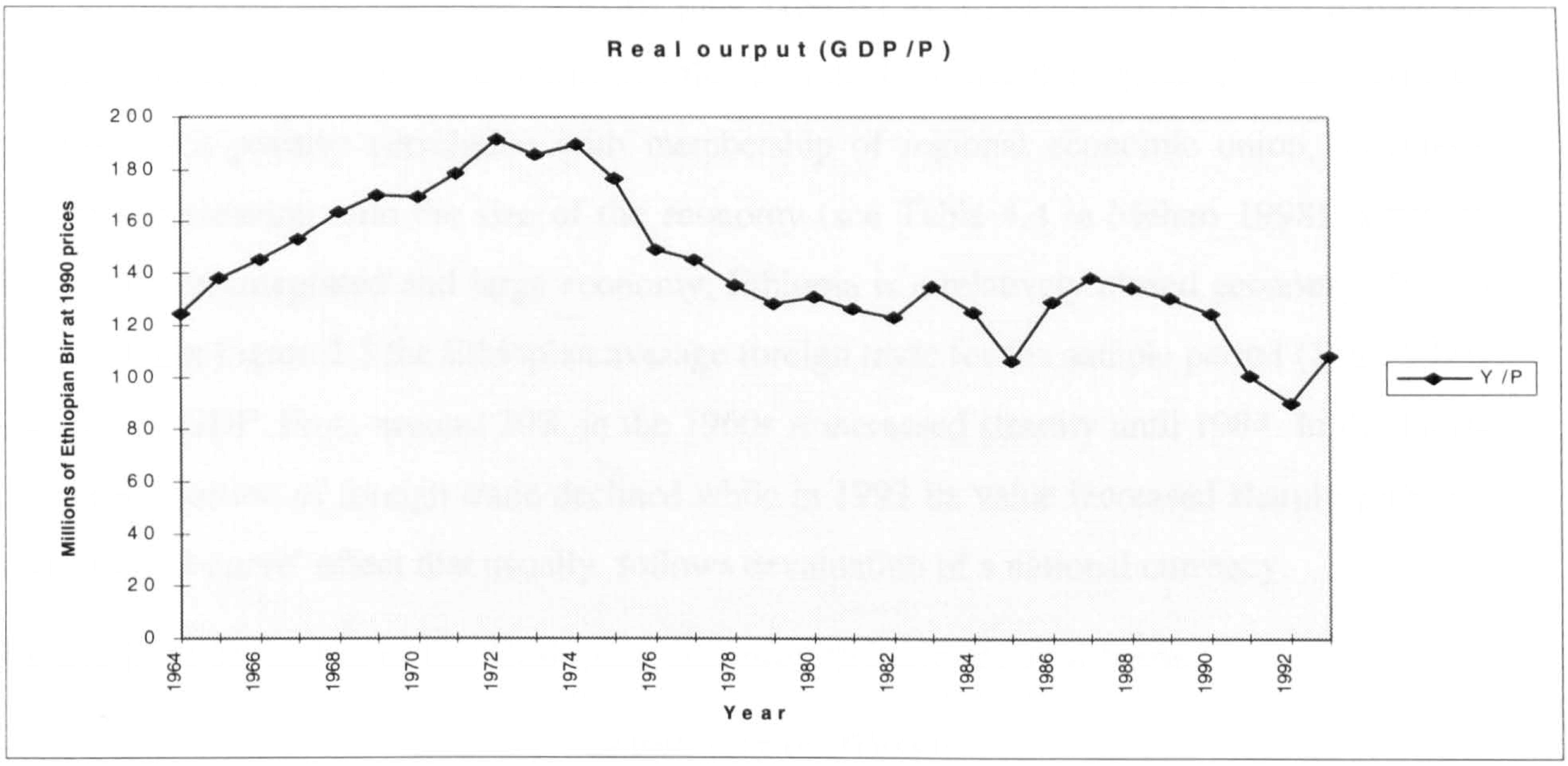
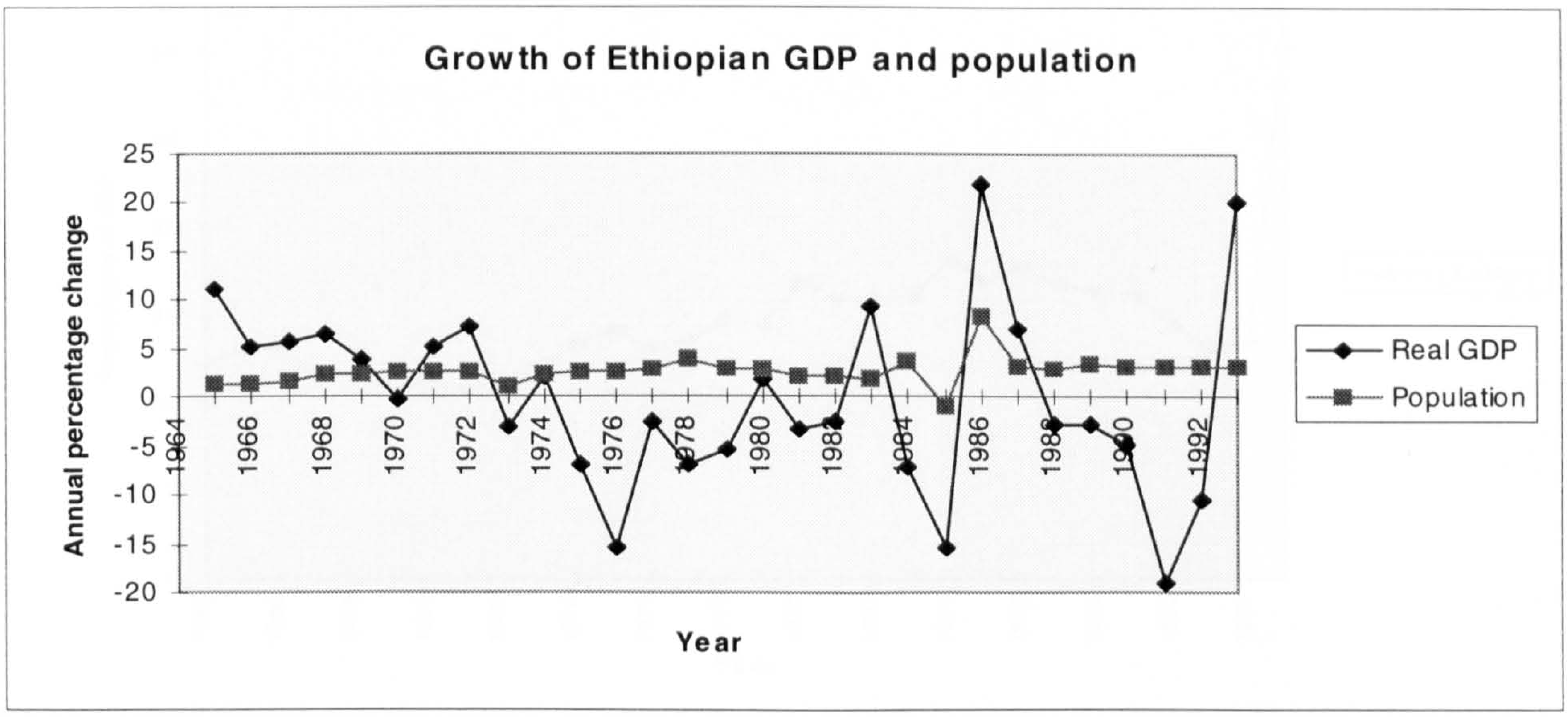


Figure 2- 4: Growth of output and population



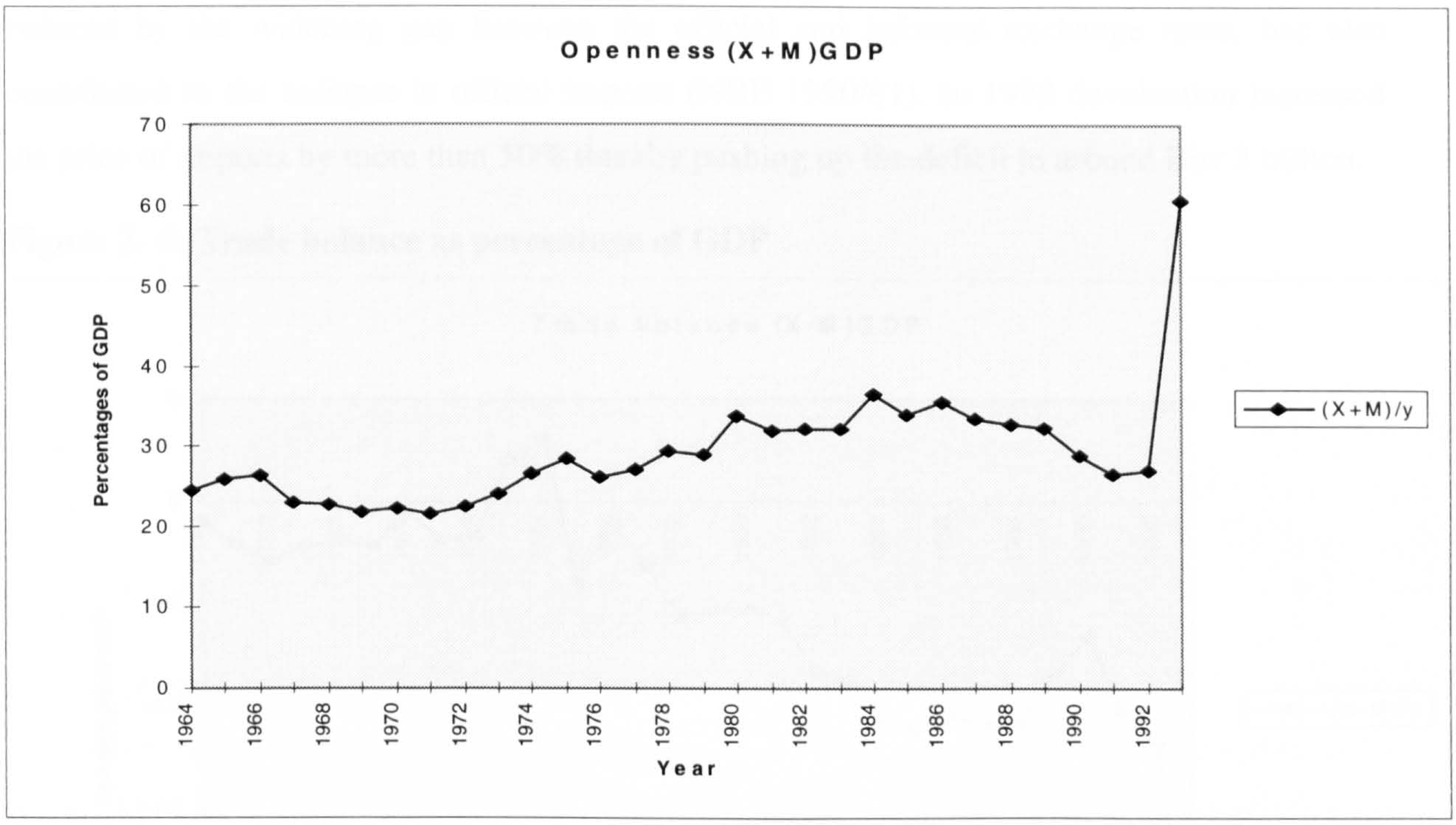
2.3.2 Trade in Africa: openness, direction, and performance

The degree of openness of the domestic economy determines the effectiveness of key policy instruments such as exchange rate in kick-starting economic growth and the susceptibility of the domestic economy to shocks in the international market. In order to evaluate Ethiopia's interdependence with the outside world we now consider the degree of openness, the direction of regional trade and the trade performance.

2.3.2.1 Openness

The ratio of total external trade (imports plus exports) as a percentage of GDP, is used to measure the economy's openness to international trade. In Africa the degree of openness tends to have (i) a positive correlation with membership of regional economic union, and (ii) a negative correlation with the size of the economy (see Table 4.4 in Mehari 1998). Thus, as relatively non-integrated and large economy, Ethiopia is a relatively closed economy. As can be seen from Figure 2.5 the Ethiopian average foreign trade for the sample period (1964-93) is 29.35% of GDP. From around 20% in the 1960s it increased steadily until 1984. In the 1985-92 the proportion of foreign trade declined while in 1993 its value increased sharply probably due to the 'J-curve' effect that usually follows devaluation of a national currency.

Figure 2- 5: Openness of the Ethiopian economy to international trade

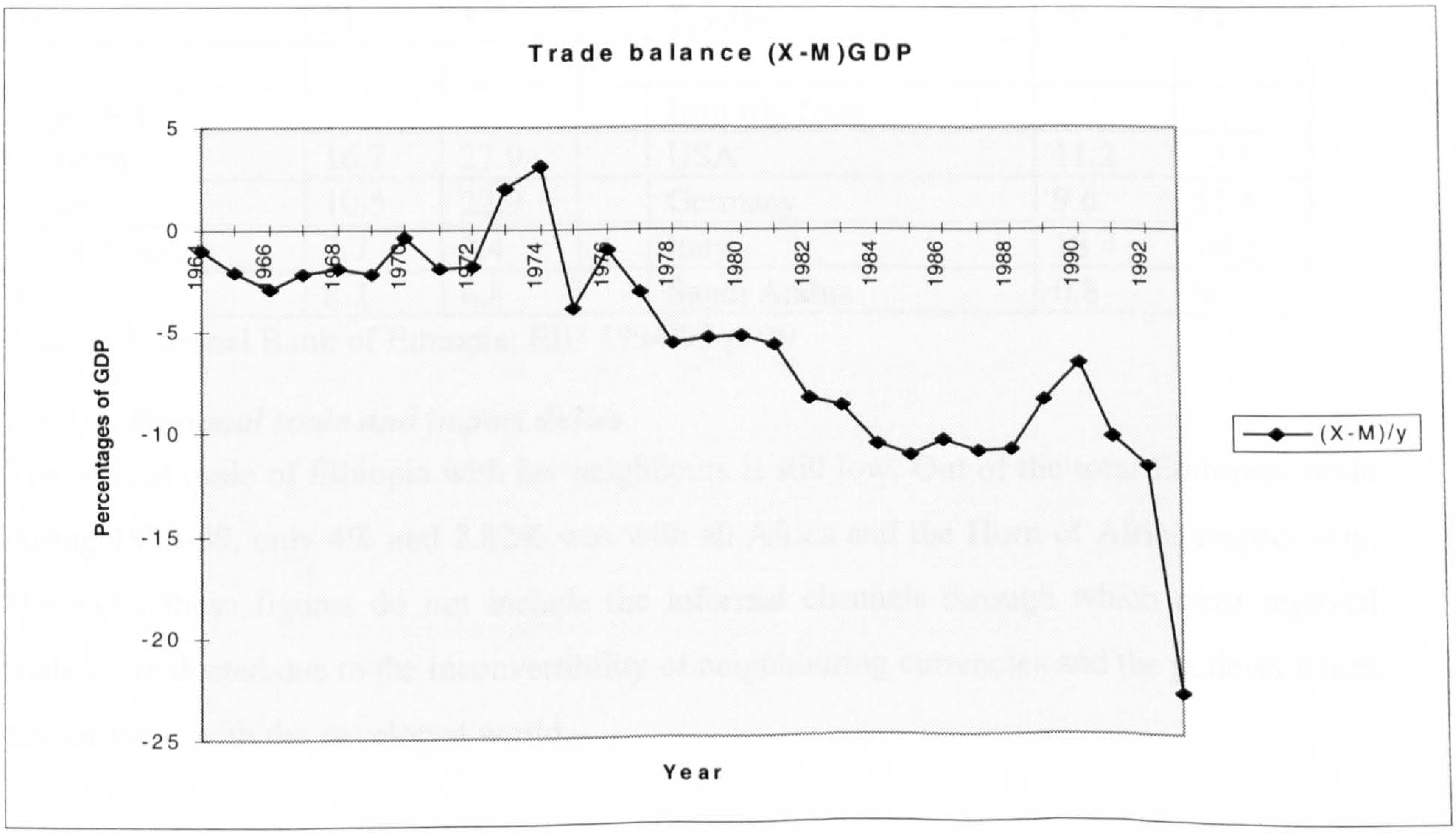


2.3.2.2 Trade performance

The ratio of trade balance (exports minus imports, i.e., net exports), as a percentage of GDP, is used to measure the economy's performance in international trade. The result presented in Figure 2.6, shows that Ethiopia had sustained trade deficits for many years. In fact 1973 and 1974 are the only years where positive trade balance is recorded. In the pre-1974 period the deficit was stable around 4% of GDP. The post-revolution trade deficit, however, increased to about 13% in 1992 and further to 23% in 1993.

Export earnings grew steadily in the pre-revolution period followed by stagnation and sharp falls for most of the post-revolution periods. The 1986 and 1989 up-turns shown in Figure 2.6 are cases of increasing exports, but those of 1976, 1989 and 1990 are cases of decline in exports partially offset by decline in imports. The huge deficit of 1985 is caused by drought that reduced production of exportables by 25%. Note that this coincided with the sharp fall in output that led to the 1985 famine (see Figure 2.3). In 1986 the export earnings increased mainly because of the boom in coffee prices in the world commodity market, but this was followed by a down-turn in 1987 mainly because of the diversion of transport facilities to food distribution in famine-stricken regions. At the climax and in the immediate aftermath of the war (i.e., 1991-92) exports collapsed and the deficit reported in Figure 2.6 would have been worse had it not been for the dip in imports. Increase in smuggling of exportables, mainly induced by the widening gap between the official and informal exchange rates, has also contributed to the collapse in official imports (NBE 1990/91). In 1993 devaluation increased the price of imports by more than 50% thereby pushing up the deficit to around Birr 3 billion.

Figure 2- 6: Trade balance as percentage of GDP



2.3.2.3 Type and direction of trade

Ethiopian exports are highly dependent on a few primary products and on Western markets (see Table 2.2). Coffee accounts for about 60% of total exports. Other exportables include leather and leather products, live animals, petroleum products, pulses, gold, oilseeds, sugar and molasses, qat, fruit and vegetables, gold, and canned and frozen meat. The main imports are capital items, intermediate goods, crude petroleum and food.

The volume of trade between Ethiopia and her trade partners fluctuated over time in line with domestic and global political economy. Trade with the communist bloc increased during the post-revolution era, and at times trade with the USSR exceeded that with the USA. On balance, however, the USA, Italy, Germany, Japan and the UK, which respectively shared 17.67%, 11.33%, 11.14%, 9.35%, and 5.88% of Ethiopia's foreign trade during the sample period, can be described as her major trade partners (see Tables 6.2-3 in chapter six)

Table 2- 2: Main commodities traded and direction of trade (million Birr)

Exports	1987/8	1991/2		Imports	1987/8	1991/2
Coffee	349	168		Machinery include aircraft	328	314
Hides and Skins	133	59		Motor vehicles	339	177
Petroleum products	38	19		Petroleum products	62	101
Fruit & vegetables	12	6		Crude petroleum	163	92
Qat	21	5		Textile	58	74
Exports to				**Imports from**		
Germany	16.7	27.9		USA	11.2	13.1
Japan	10.5	22.9		Germany	9.6	11.4
Saudi Arabia	7.7	8.4		Italy	18.4	10.2
Italy	8.2	6.8		Saudi Arabia	0.8	9.9

Source: National Bank of Ethiopia; EIU 1994/95 p. 29

2.3.2.4 Regional trade and import duties

The official trade of Ethiopia with her neighbours is still low. Out of the total Ethiopian trade during 1973-89, only 4% and 2.82% was with all Africa and the Horn of Africa respectively. However, these figures do not include the informal channels through which most regional trade is conducted due to the inconvertibility of neighbouring currencies and the policies which favour trade with the developed world.

If import duties are a measure of protectionism, then the Ethiopian economy is fairly protected with an average of 15.82% import duties during 1972-94 accounting for 20.09% of the overall tax revenue. However, we have already discussed Ethiopia's membership of several regional free-trade areas in Africa and the possibility of economic integration in the Horn of Africa. As such integration projects mature, the first casualty is likely to be tax on cross-border trade because it is incompatible with the principle of free trade. The smaller the degree of dependence of a country on trade tax, therefore, the greater the ability of the economy to adjust to shocks that occur during the integration process.

2.3.3 Public finance

Table 2.3 shows the main budgetary variables of the last government. Public finance was dominated by the effects of war and to a lesser extent the drought for most of the post 1970 period. In 1988/89 for example, defence expenditure accounted for more than 50% of current expenditure. Tax revenue increased by an average of 8% per year in the 1980-88 period. But this was not enough to finance the war and government had to resort to the transfer of profits from public enterprises and to the collection of extraordinary war/drought contributions. As a result the proportion of revenue derived from tax fell from 83% in 1980 to 72% in 1988 (see EIU 1994/5).

Figure 2.7 shows that direct tax revenue (as percentage of GDP) rose sharply from around 10% in 1973 to 20% in 1988. The decline in tax revenue after 1988 coincides with the turning-point in the Ethio-Eritrean war after which the government lost key economic centres and the administrative tax-collection machinery of the state was shaken.

The change of government, therefore, enabled reorientation of post-1992 public finance, confirming the fact that the major and sustained diversion of resources away from development projects came from the war. The main features of the post-1992 budgets include: shift of resources from the military to health and education, substantial increase in capital budgets, and increase in regional control over expenditure. Collection of tax revenue has also improved with the normalization in the state machinery (see Figure 2.7).

Figure 2- 7: Revenue from income tax rate as percentage of GDP

Table 2- 3: Government revenue and expenditure (millions of Birr)

	1987/88	1988/9	1989/90	1990/91
Total revenue	3,467.2	3,732.6	3,115.2	2,647.1
Tax revenue	2,394.1	2,761.0	2,278.2	2,065.7
Income and profit tax	1,041.8	1,396.2	972.9	760.1
Rural land use tax	47.4	45.2	35.9	28.9
Domestic indirect tax	719.9	784.9	765.8	754.0
Tax on international trade	585.0	534.7	503.6	522.7
Non-tax revenue	1,073.1	971.6	837.0	581.4
Total expenditure	4,881.4	5,206.1	5,190.6	4,636.3
Current expenditure	3,422.4	3,406.4	3,735.7	3,419.2
General services/Defence	1,714.9	2,077.2	2,414.9	2,078.3
Economic services	190.9	202.6	207.5	202.7
Social services	601.9	625.8	633.3	628.2
Pension payments	129.5	139.6	157.3	154.2
Interest and charges	244.7	255.4	228.3	264.6
Miscellaneous	73.8	105.8	94.4	91.2
External assistance	466.8	NA	NA	NA
Capital expenditure	1,459.0	1,799.7	1,454.9	1,217.1
Economic development	1,235.7	1341.2	1,108.3	941.9
Social development	202.0	169.7	75.4	57.2
Others	21.3	41.9	21.2	18.0
Unallocated	NA	246.9	250.0	200.0
Over all budgetary balance	**-778.2**	**-1,128.3**	**-1,814.3**	**-1,769.9**
External borrowing (net)	401.9	615.4	458.0	346.6
Domestic financing	376.3	512.9	1,356.7	1,423.3
Banking system	356.0	451.0	1,295.5	1,230.5

Source: NBE (National Bank of Ethiopia) annual report 1990/91

2.3.4 Credit restrictions and their impact on private investment

As can be seen from Table 2.3, the Ethiopian government's fiscal operation was characterized by a high and rising budget deficit which reached 14.5% of GDP in 1991. A large portion of this deficit was financed from external borrowing, with the USSR covering almost all military and oil financing. As foreign sources dried up in the late 1980's however, domestic financing (mainly credit from the banking system) took over, accounting for more than 80% in 1990/91.

The shift of resources led to a decline in the share of the bank credit extended to the private sector. Figure 2.8 presents the private sector's share in total domestic credit and investment. It clearly shows the impact of financial repression which quantitatively rations credit to the public sector. The share of the private sector in domestic credit, which accounted for over 70% in 1964-74, fell sharply during 1975-86 and stabilized below 10% thereafter.

The share of private investment followed a similar pattern. Starved of domestic credit, private investment was exceeded by public investment in 1976 and remained so throughout the rest of the sample period (see Figure 2.9). From a share of more than 75% of total investment, it took a sharp dip to around 15% in 1975-86. In 1987-93 private investment fluctuated between 20% and 50% mainly because of the fluctuations in public investment following the intensification of the war.

Figure 2- 8: The share of credit extended to the private sector and private investment

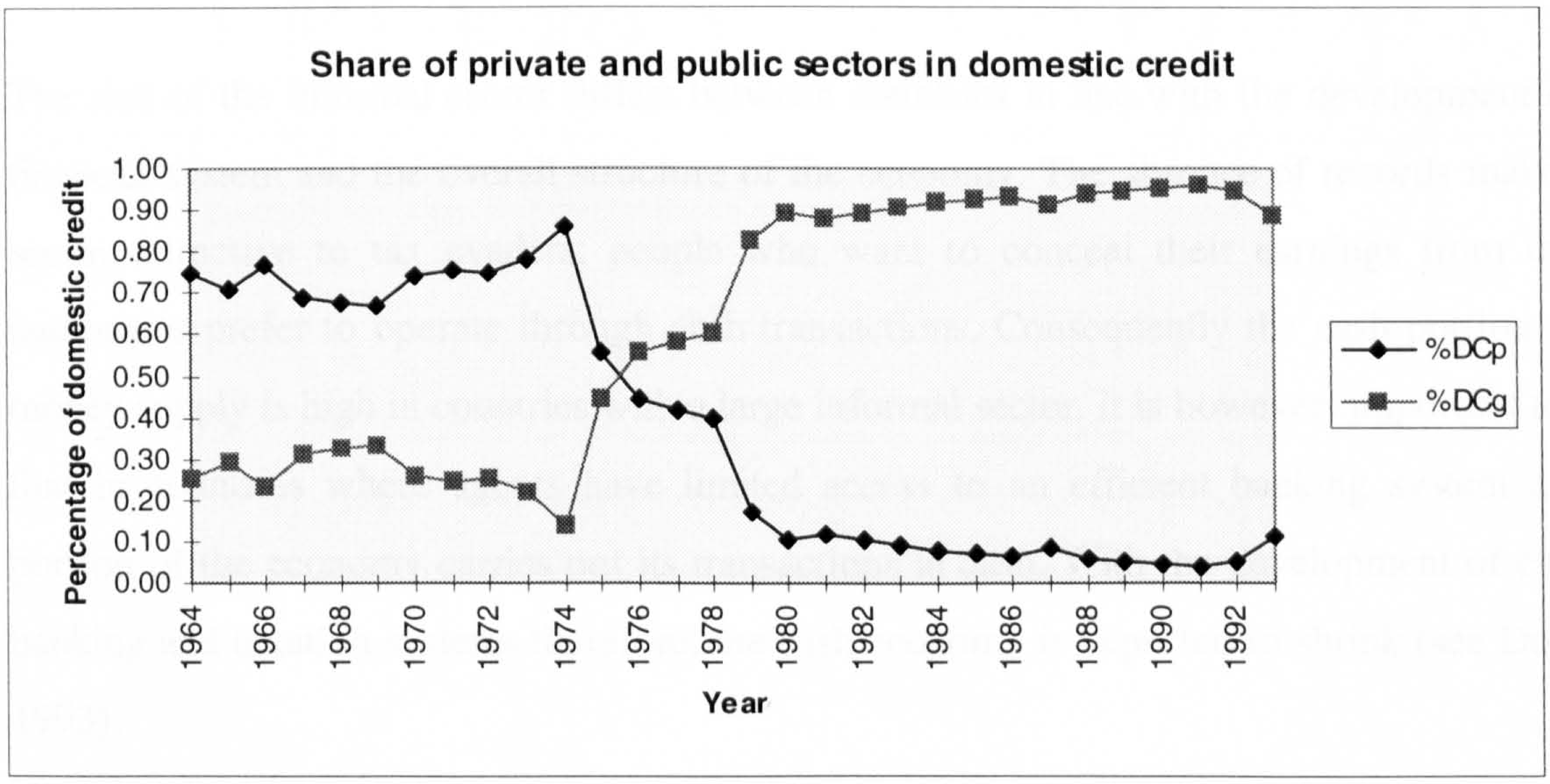
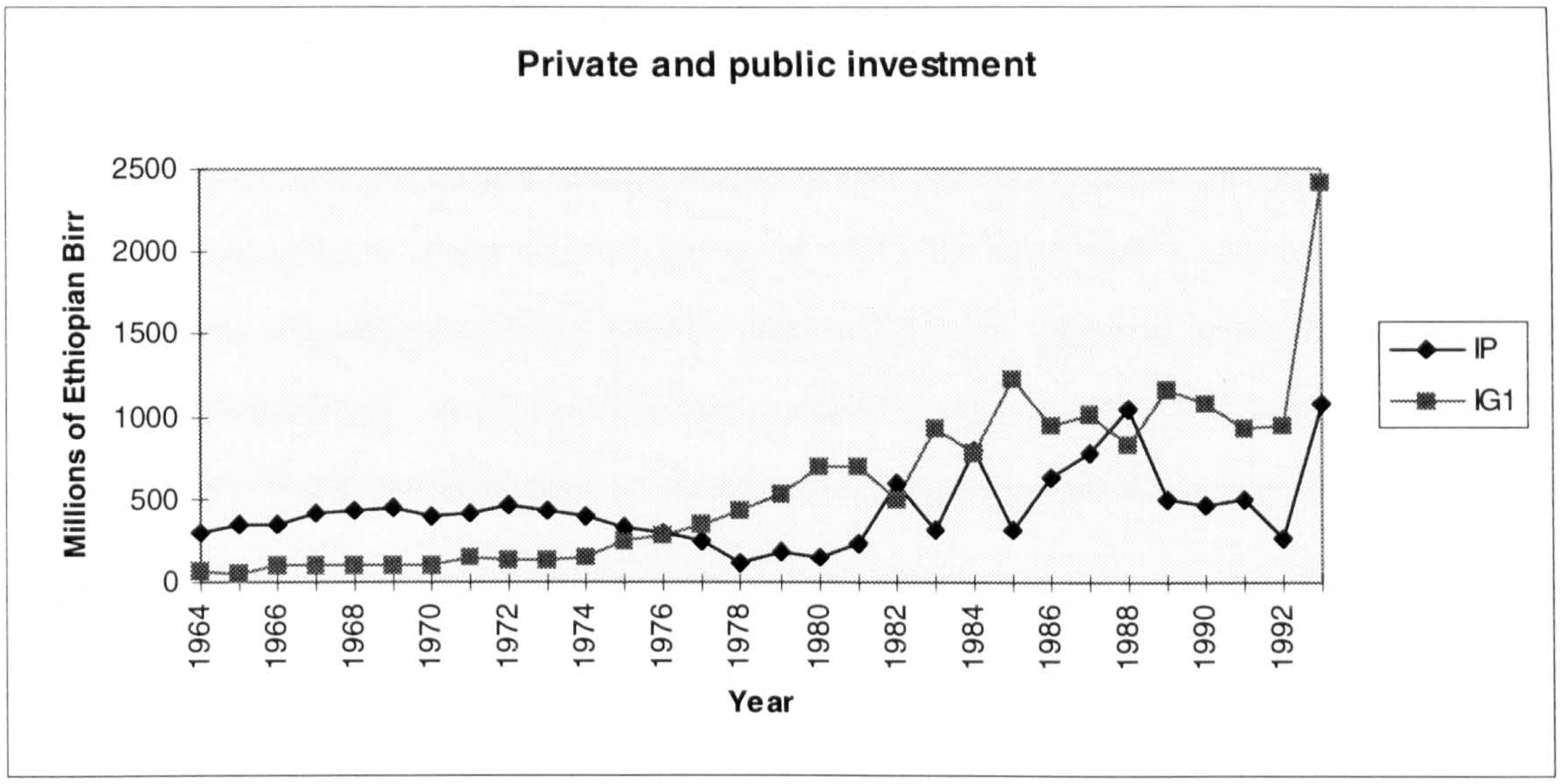


Figure 2- 9: Private and public investment



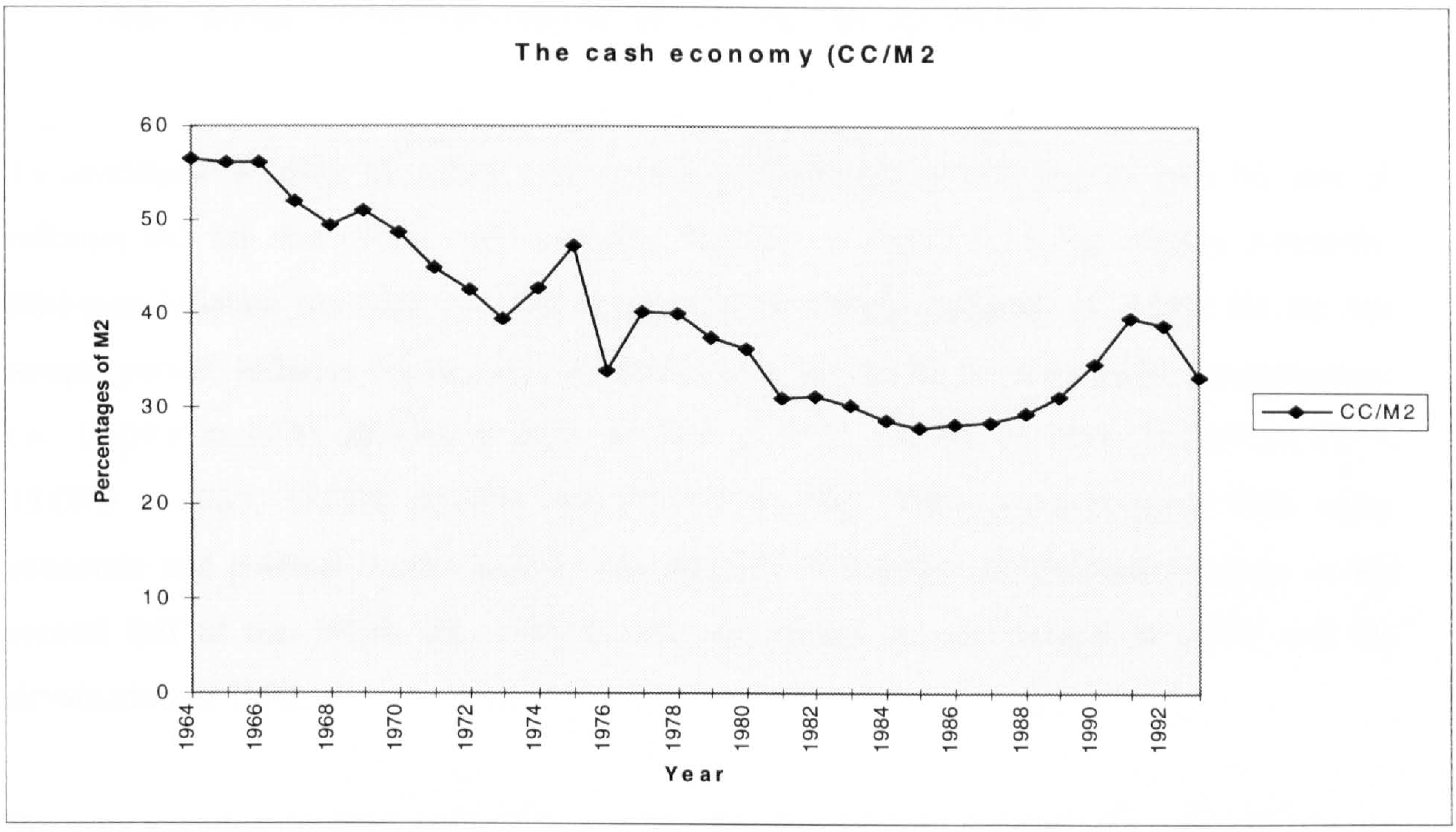
2.3.5 The cash economy

We have seen that the private sector was increasingly squeezed out of the official supply of credit in order to finance the increase in public sector expenditure and some private projects favoured by the authorities. As discussed in chapter three, such policy of financial repression increases the demand for credit in the informal sector thereby increasing the informal rate of interest. Given the administratively-set low nominal rates of interests in the banking system, private depositors can be attracted by the higher informal rate of interest, thereby increasing the informal financial sector.

The size of the informal sector differs between countries in line with the development of the financial system and the overall structure of the economy. The absence of records makes this sector attractive to tax evaders: people who want to conceal their earnings from the tax authorities prefer to operate through cash transactions. Consequently the cash portion of the money supply is high in countries with a large informal sector. It is however, important to note that in countries where agents have limited access to an efficient banking system a large portion of the economy carries out its transactions in cash. With the development of efficient banking and taxation systems therefore, the cash economy is expected to shrink (see Dongala, 1993).

The ratio of currency outside the banking system to broad money presented in Figure 2.10 is taken as a rough measure of the informal economy. It shows that the Ethiopian cash economy declined throughout 1964-73, 1977-86, and 1991-92. These were periods of relative stability in the economic and political situation which helped the penetration by banks into remote rural areas. The expansions of the cash economy in 1974-75 and 1986-91 coincided with periods of intensification of political conflict which culminated in the toppling of the King and his military successor respectively. In addition to the economic disruption, such political crises damaged the credibility of government policy, thereby boosting informal trade and financial activity.

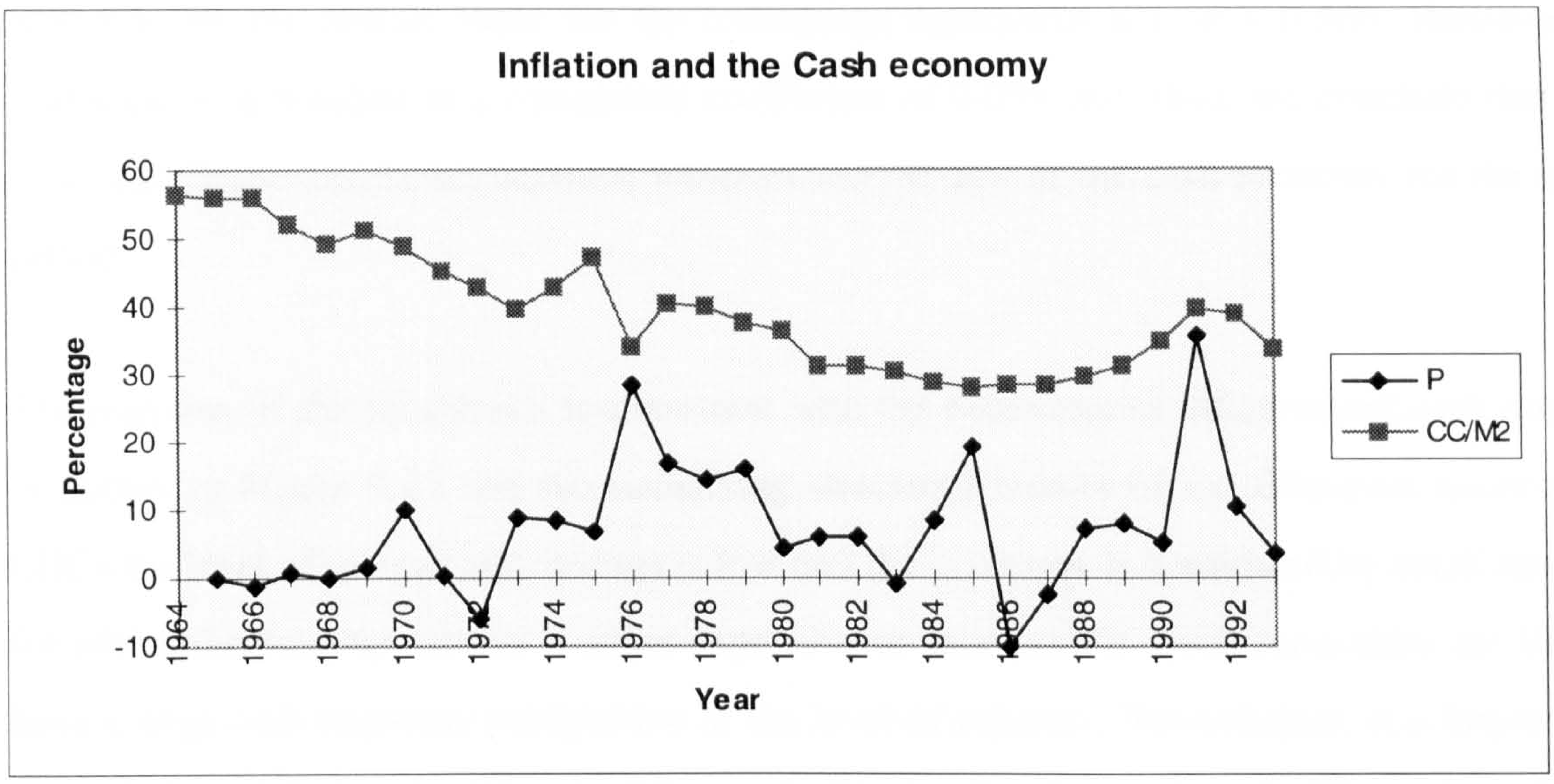
Figure 2- 10: Cash economy (Currency in circulation as percentage of broad money)



2.3.6 The cash economy and inflation

Recent developments in the literature on the informal sector argue that, owing to the clandestine nature of informal businesses, the cost of collecting taxes from them is usually high (see Canzoneri and Rogers 1990). This forces countries with a large informal sector to increase their dependence on seigniorage revenue (inflation tax). Consequently, the optimal level of taxation is directly proportional to the size of the cash economy.

Figure 2- 11: Inflation and the cash economy



To investigate whether this claim corresponds to the reality of Ethiopia we plot the rate of inflation and the size of the cash economy together in Figure 2.13. By African standards, Ethiopian inflation has been low and stable with an average inflation of 7.35% for the full sample period. Inflation reached double figures in 8 out of the 30 years under consideration: i.e., 10.04% in 1970, 28.43% in 1976, 16.67% in 1977, 14.29% in 1978, 16.04% in 1979, 19.08% in 1985, 35.07% in 1991, and 10.54% in 1992. These years coincide with major economic and political shocks such as the adoption of socialist development strategy in the second half of the 1970s, the 1985 famine, the change of government in 1991, and the devaluation of 1992.

We now examine the data for evidence of the positive relationship between inflation and the size of the cash economy as proposed in Canzoneri and Rogers (1990). As discussed above, the argument is based on the fact that the informal economy is predominantly a cash economy. Furthermore the optimal-taxation hypothesis suggests the use of an inflation tax in order to distribute the burden of taxation fairly throughout the economy. If this is the case, then, one can expect countries with larger cash economies to have a higher rate of inflation.

To examine this we calculated the cash-inflation correlation coefficient. The hypothesis that the correlation is zero can be tested by the use of t-test with $t= r\sqrt{(n-2)} / \sqrt{(1-r^2)}$ where r is the correlation coefficient and n is the number of observations. The critical values of t are one-tailed since the alternative to the correlation being zero is that it is positive. For the period

1964-93, n = 30 and the 5% critical value of t is $t_c = 1.701$. Putting this into the formula for t, with n = 30, the critical value for the correlation coefficient is $r_c = +\ 0.306$. However, the Ethiopian data resulted in a correlation coefficient of 0.058 and, thus, we conclude that there is no significant correlation between inflation and the size of the cash economy for the sample period.

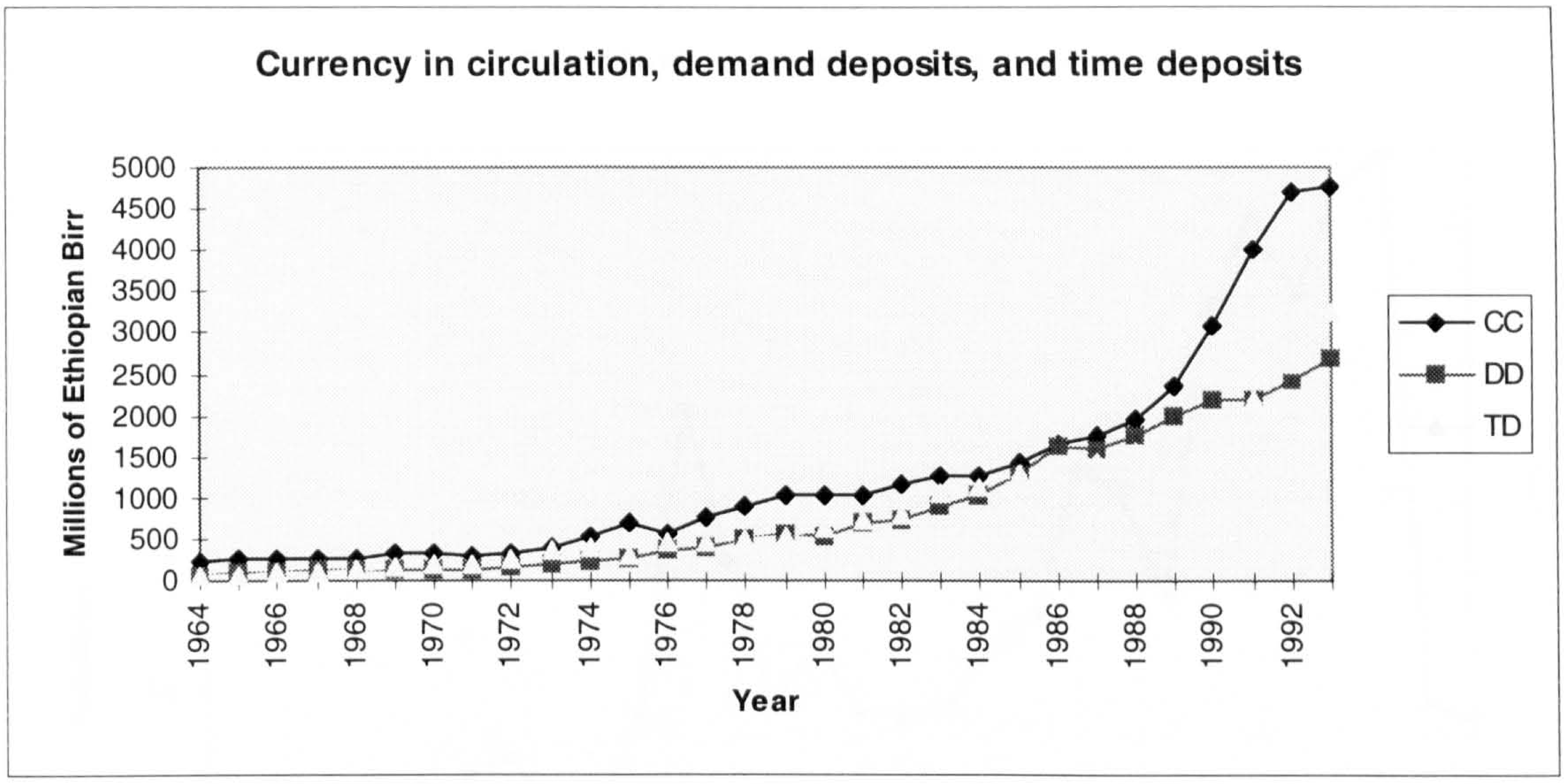
The rejection of the hypothesis is consistent with the behaviour of inflation and cash economy as shown in Figure 2.11 and the underlying structural factors of the Ethiopian economy. In LDCs the level of income and savings is low and the economy is dominated by small operators for whom the banking service is either expensive or inaccessible. Such economies are likely to have a large cash economy irrespective of the level of inflation. Nevertheless, it is important to note that correlation is not causation and the conclusions must, therefore, be taken as preliminary and need further scrutiny for validation.

2.3.7 Money banking and interest rates

The central bank (the National Bank of Ethiopia) was set up in 1964. In 1975 the new government nationalized all financial institutions, including private banks and insurance companies. As a result the Commercial Bank of Ethiopia monopolized the provision of banking services while all insurance companies were consolidated in to a single state corporation.

In spite of the fluctuations of inflation and of overall economic activity during the sample period, interest rates were administratively fixed at 6% deposit rate and 8.5% lending rate. All three components of M2 grew steadily during the sample period (see Figure 2.12). Deposits grew faster to constitute more than 65% in the 1980, but the trend seemed to shift in favour of currency in circulation in the early 1990s. On the asset side of the Central Bank balance sheet, however, the impact of financial repression is very clear. The restriction of credit to the private sector led to the predominance of claims on central government in the portfolio of the Bank's assets (see section 2.3.4). In September 1993 the National Bank of Ethiopia was granted greater autonomy. The new government also decided that the existing financial institutions should remain in state ownership, but allowed for the establishment of private banks.

Figure 2- 12: Components of M2



2.3.8 Parallel foreign exchange market

As discussed in chapter three, the informal market for foreign exchange is clearly symptomatic of the ineffectiveness of national economic policy. Financial repression and an inconvertible currency are important factors in the emergence and persistence of such markets. The demand for foreign currency in the informal market arises because of government policy that channels foreign exchange towards the public sector (and a few private enterprises selected as priority sectors) at a rate below the market clearing rate. The willingness of agents to purchase foreign exchange above the market-rate attracts suppliers and thereby the informal premium persists as long as financial repression continues in the official exchange rate policy.

In Ethiopia the rate of exchange (Birr per US dollar) was administratively fixed at 2.5 in 1964-70, at 2.3 in 1971-72, and 2.07 in 1973-91. As a result the internal and external shocks that hit the economy had to be reflected in the informal exchange rate, thereby increasing the premium (see figures 2.13 and 2.14). The premium was particularly high at times of major political upheavals reaching 155% in 1975 and 247% in 1991. The premium was reduced to 45% following the devaluation of the currency to Birr 5 per dollar in October 1992. In an attempt to reduce the gap between official and informal rates, the authorities introduced a system of fortnightly foreign exchange auctions in May 1993.

Figure 2- 13: Premium on informal rate of exchange

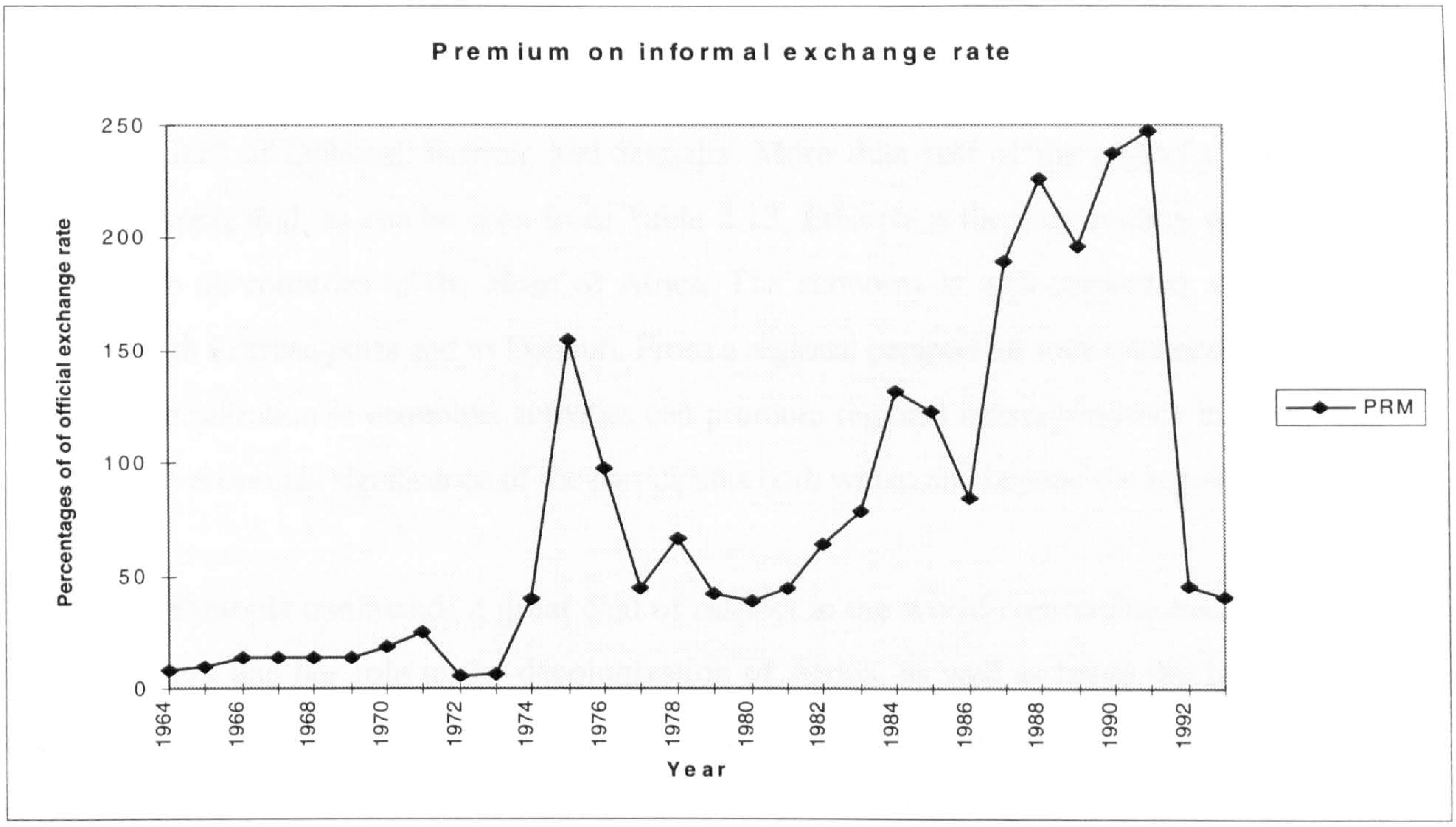
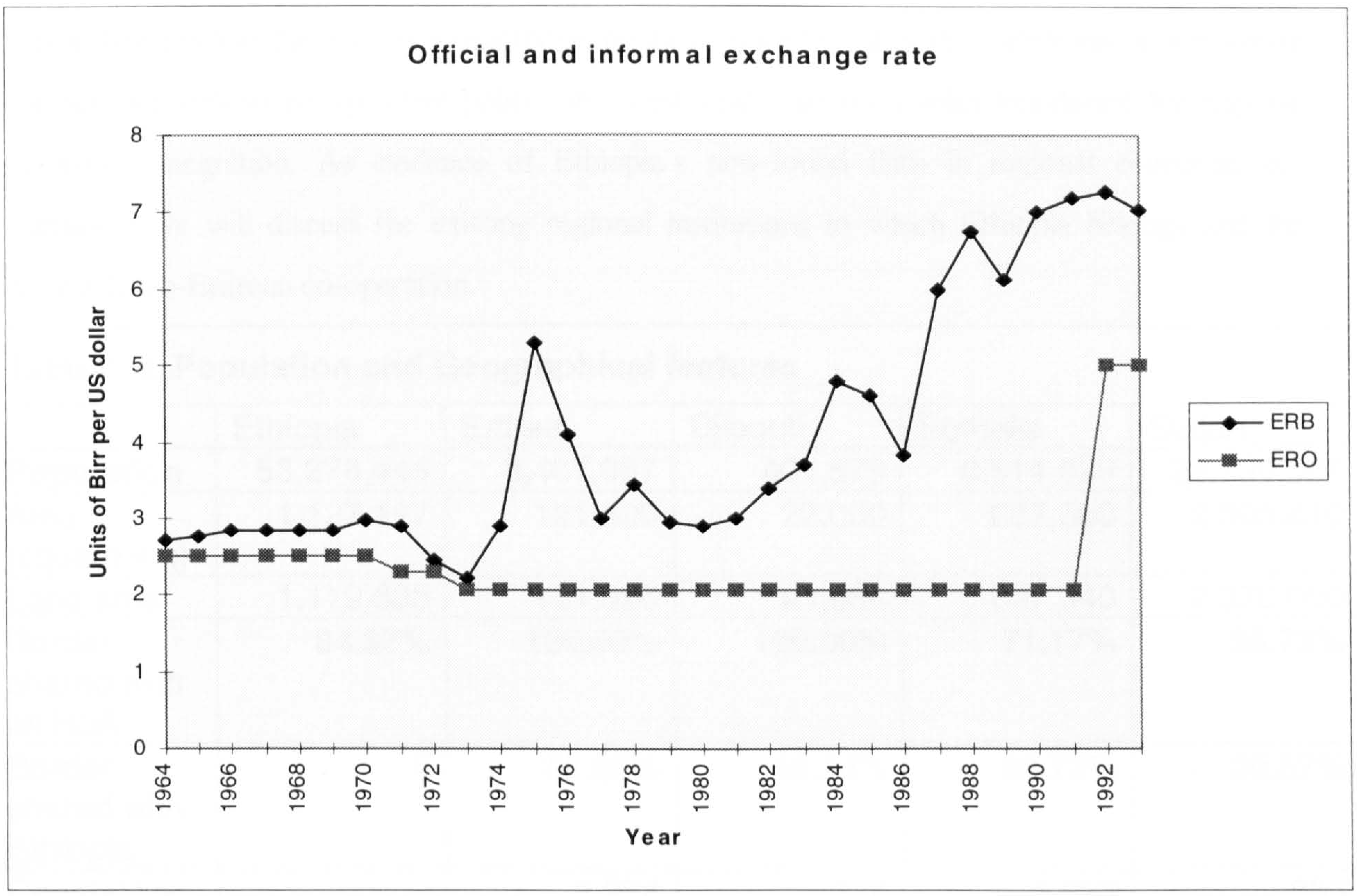


Figure 2- 14: Official and informal rate of exchange



2.4 Ethiopia: A regional power

The Ethiopian economy accounts for 42.3% of the regional GDP. If we exclude the Sudanese economy (which is relatively less integrated into the region), Ethiopia represents five times the combined GDP of Djibouti, Eritrea, and Somalia. More than half of the region's population lives in Ethiopia and, as can be seen from Table 2.13, Ethiopia is the only country which shares borders with all countries of the Horn of Africa. The economy is well-connected and has free access to both Eritrean ports and to Djibouti. From a regional perspective such connections and the resultant specialization in economic activities can promote regional interdependence in a way that enhances the economic significance of the participants both within and beyond the region.

Moreover, Ethiopia commands a great deal of respect in the world community because of her ancient history and her role in the decolonization of Africa, as well as being the home of the headquarters of the OAU and various national and international diplomatic communities. With considerable natural resources, population size, international attractiveness and market potential, Ethiopia has all the makings to become an epicentre for regional transformation in the Horn of Africa. Inasmuch as the country's hegemonic politics plunged most of the region into a devastating conflict, her shift to co-operative politics in recent years can lay a solid foundation for regional economic integration. As evidence of Ethiopia's new-found faith in regional economic co-operation, we will discuss the existing regional institutions to which Ethiopia belongs and the current Ethio-Eritrean co-operation.

Table 2- 4: Population and Geographical features

	Ethiopia	Eritrea	Djibouti	Somalia	Sudan
Population	53,278,446	3,467,087	401,579	6,514,629	28,730,381
Area (square km)	1,127,127	121,320	22,000	637,660	2,505,810
Land area	1,119,683	121,320	21,980	627,340	2,376,000
Border shared with all HoA	**84.37%**	**100.00%**	**100.00%**	**71.17%**	**28.73%**
Border shared with Ethiopia	0	**55.95%**	**66.34%**	**68.72%**	**20.87%**
Coastal line (km)		2,234	314	3,025	853
Territorial sea		nm 12	nm 12	nm 200	nm 12

Source: World FactBook (1994)

2.4.1 The Ethio-Eritrean Cooperation

Italy colonized Eritrea in 1890 and held sway until her defeat in the Second World War. Unlike other Italian colonies (namely Libya and Somalia which got their independence), the UN decided to federate Eritrea with Ethiopia in 1952. In 1962 Ethiopia declared the federal structure null and void and integrated Eritrea as her 14th province. This resulted in the 30-year Ethio-Eritrean war.[2]

Despite the political mistakes in the Ethio-Eritrean linkage in 1952-62, it provided the potential for horizontal integration where the relatively stronger industrial base and skilled manpower in Eritrea could benefit northern Ethiopia through the spread effect and Eritreans benefited from the then almost untouched wide Ethiopian market. There was also an enormous opportunity for vertical integration in which the coastal areas specialize in manufacturing and energy-related activities while the southern and central parts of Ethiopia concentrate on building modern agro-commercial apparatuses, instead of unnecessary duplication in production and competing for the same market in homogeneous goods and services.

The final outcome of the conflict was a referendum which resulted in an independent Eritrean state established on May 24, 1993 and a friendly government in Ethiopia. Eritrean independence seems to have given a window of opportunity for both countries to develop mutually beneficial economic relationships.[3] There is also a high expectation that this bilateral economic cooperation might lead to some form of economic union in the region.

In the current Ethio-Eritrean relationship, therefore, both governments seem to be determined to make up for the lost opportunities of regional economic co-operation. On September 27, 1993 Eritrea and Ethiopia signed a 25-point comprehensive cooperative agreement which, among others things allowed the continuation of Eritrean ports as free ports for Ethiopian trade, and the use of the Ethiopian currency (Birr) as legal tender in Eritrea. Despite the current political

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[2]The beginning of the war and its length can be attributed to both the cold-war politics and the pan-African consensus in favour of the territorial integrity of colonial boundaries. It led to "civil wars" of the so-called "demand for lost land or lost people" in post-colonial Africa, devastated the economies and claimed more than 2 million lives. Eritrea alone lost around 100 thousands of its citizens. Eritrea and Ethiopia were reduced from surplus-food exporters in the 1950's to being dependent on food aid.

[3]The Eritrean referendum challenged the conventional wisdom of 'opposing the principle of self-determination in order to avoid endless secessionist wars' which dominated the post-independence African political debate. It was proved to be wrong by the peace and co-operation which followed the Eritrean referendum. It set a precedent for Africa that **regional peace and economic union** can be achieved through the application of the "principle of self-determination".

problems of the region many observers expect the possibility of similar agreements with other countries of the Horn of Africa. One way of establishing genuine regional economic integration is by strengthening the existing regional institutions. This is discussed below.

2.4.2 Existing regional institutions

The countries of the Horn of Africa all belong to the Common Market for East and Southern Africa (COMESA) which was established in 1995 as a further stage of integration in the former preferential trade area (PTA) of Eastern and Southern African countries. Its progress so far has been limited to tariff negotiations and the establishment of a regional credit bank and clearing houses in regional trade. However, given the ideological convergence of its members towards market forces and the increasing role of collective bargaining in international trade, COMESA can be expected move faster along the route of integration.[4]

The Inter-Governmental Authority on Development (IGAD), later renamed is another common institution in the Horn of Africa. IGAD is a regional organization covering Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda. It was launched in January 1986 to coordinate efforts for development and drought control in these countries. It is playing an important role in the economic and political life of the region. Another regional institution, the Horn of Africa Free Trade Area (HAFTA), was proposed by a group of academics in 1994 to embrace the five countries of the region (Djibouti, Eritrea, Ethiopia, Somalia, and Sudan) but its implementation is yet to be seen. If and when such a project materializes its impact on issues like exchange rate policies is likely to be the mere formalization of the existing pseudo-monetary union.

The exchange rate has not generally been used as a policy instrument with respect to regional currencies by countries of the Horn of Africa. Like most of post-colonial Africa these countries responded to the undisputed dominance of the USA in the world economy and pegged their currencies to the US dollar, thereby maintaining a fixed parity rate between the national currencies of the region. Although at the beginning such a peg might be attributed to

[4] The PTA was the largest economic grouping in Africa and when all potential members sign the treaty, COMESA can be expected to include: Angola, Malawi, Mozambique, Zambia, Zimbabwe, Botswana, Lesotho, Namibia, South Africa, Swaziland, Comoros, Madagascar, Mauritius, Seychelles, Tanzania, Kenya, Uganda, Rwanda, Burundi, Zaire, Djibouti, Eritrea, Ethiopia, Somalia, Sudan. For a discussion on social, political and economic diversity of these countries see Mwase (1993)

the requirements of the Bretton Woods arrangement, the regional parity continued thereafter by a proportional change in their dollar parity. Using the parity against the Ethiopian Birr (Table 2.14) one can see that a fixed parity was maintained with Djibouti, Somalia and Sudan for most of the periods 1964-91, 1964-81, and 1964-77 respectively. The Sudanese pound and Ethiopian Birr were moving in the form of an adjustable peg to each other with only 8 adjustments in 25 years until the floatation of the former in 1991. The Somali shilling devalued against the Birr only once in 1971 until it floated in 1982. From this one can say that these countries were in a pseudo-monetary union which could have been translated into a genuine monetary union by allowing full convertibility and regulation by a common authority.

Table 2- 5: Devaluations against the Ethiopian Birr

Year	Djibouti	Kenya	Somalia	Sudan
64				
65	0.00%	0.00%	0.00%	0.00%
66	0.00%	0.00%	0.00%	0.00%
67	0.00%	0.00%	0.00%	0.00%
68	0.00%	0.00%	0.00%	0.00%
69	0.00%	0.00%	0.00%	0.00%
70	0.00%	0.00%	0.00%	0.00%
71	0.12%	8.70%	7.16%	8.70%
72	0.00%	0.00%	0.00%	0.00%
73	0.00%	7.33%	0.00%	11.11%
74	0.00%	3.52%	0.00%	0.00%
75	0.00%	15.64%	0.00%	0.00%
76	0.00%	0.61%	0.00%	0.00%
77	0.00%	-4.37%	0.00%	0.00%
78	0.00%	-6.83%	0.00%	14.86%
79	0.00%	-1.03%	0.00%	25.00%
80	0.00%	3.29%	0.00%	0.00%
81	0.00%	35.90%	0.00%	80.02%
82	0.00%	23.71%	141.30%	44.44%
83	0.00%	8.42%	15.79%	0.00%
84	0.00%	14.39%	47.73%	0.00%
85	0.00%	3.19%	63.46%	92.30%
86	0.00%	-1.49%	112.90%	0.00%
87	0.00%	2.95%	10.50%	80.02%
88	0.00%	12.62%	170.00%	0.00%
89	0.00%	16.14%	244.30%	0.00%
90	0.00%	11.49%		0.00%
91	0.00%	16.57%		233.10%
92	-58.60%	-46.60%		273.20%
93	0.00%	88.21%		60.87%

2.5 Concluding remarks

In this chapter we have tried to profile the Ethiopian economy during the three chapters of its post-world war history. The take-off and 'can-do' spirit of the 1960s was dashed when a combination of factors (such as the King's failure to accept land reform, the Wello Famine, the oil shock and the Ethio-Eritrean war) led to the 1974 socialist revolution. The military junta that came to power presided over a period of steady economic decline, the 1976 Ethio-Somali war, internal civil war, the 1984 famine, intensification of the Ethio-Eritrean war, the 1989 attempted coup, and it was finally defeated by its opponents in May 1991. In the third period the new government is reforming the economy towards free-market systems and regional economic integration. The previous section compared Ethiopia to the neighbouring countries in the Horn of Africa. It showed that Ethiopia is by far the largest economy in the region and is reasonably well-connected to her neighbours. Thus, a realistic assessment of the region's geopolitical structure suggests that any economic integration scheme in the region is likely to have Ethiopia at its core and the Ethio-Eritrean special relationship as its inspiration.

However, in implementing the process of economic integration among sovereign nations it is most important to be careful not to make it a "winners and losers game". The main objective of this study is, therefore, to contribute to this project by analyzing the effectiveness of monetary and fiscal policy in the Ethiopian economy using a macroeconomic model. Ideally, it would be better to have a macro-model of both countries and examine how they behave when exposed to exogenous and policy-induced shocks. However, there is not sufficient data on the Eritrean economy and since Eritrea was a part of (and is still well integrated to) the Ethiopian economy, we expect our model to represent the general features of the Eritrean economy as well.

Before proceeding to the model, however, it is worth examining aspects of developing economies such as Ethiopia that are usually overlooked in macroeconomic modelling. We have seen that the Ethiopian modernization started in the 1930s but its progress was very slow and its benefits limited to a few, mainly urban, enclaves. These areas include mainly Addis, Diredawa and Bahir-Dar where the provision of health, education, clean water, electricity, transport and communication are concentrated. The result has been a dual economic structure where the overwhelming rural majority is marginalized from the nation's political and economic power coexisting alongside a well-informed small modern enclave that interacts more with the world market than with the large domestic subsistence sector. Secondly, it has also been shown that the employment opportunity of the modern sector failed to cope with the labour migration, and the policy of war and financial repression pushed many private businesses towards the informal market. The next chapter will discuss the implication of the informal sector and dualism on macroeconomic modelling and policy. The discussion will then focus on reviewing the literature on macroeconomic modelling in chapter four followed by the specification of the macroeconomic model in chapter five. The model will then be estimated and used for policy simulations in chapters six to nine.

CHAPTER THREE

POLICY IMPLICATIONS OF THE INFORMAL SECTOR AND STRUCTURAL DUALITY

The term 'informal sector' refers to economic activities that are conducted outside the government's regulation. These activities do not appear in official records and serious empirical investigation of the area is very rare. This has resulted in various misleading conclusions about the structure and interdependencies of African economies. For example, the fact that African countries have low recorded trade among themselves (see section 2.3.2.4) has been used by proponents of the *structural dependency argument*[1] to emphasize the lack of complimentarity of the economies. This view is challenged by the fact of the existence of a large informal sector through which goods and capital move between neighbouring countries in Africa. Regarding the effectiveness of economic policy, a large informal sector can be seen as a confirmation of the fictitiousness of national monetary autonomy exercised by small African economies in the face of the ever-increasing interdependence of the world economy at a global level.

Structural duality, on the other hand refers to the country's internal lack of interdependence between the large traditional sector and the small enclave of modern industry and commerce. Such fragmentation of the economy has denied the traditional sector access to technology and other educational, social and economic infrastructure on one hand, and has consequently reduced the size of the domestic market which the modern sector badly needs for its take-off and expansion. Furthermore, as discussed in chapter two, such dichotomy in the economy has implications for the way agents process information and form expectations and, hence, for their responsiveness to government policy.

The discussion on the dual structure of the economy (i.e., the coexistence of a large traditional and a small modern enclave) is the basis for the application of adaptive and rational expectations in the model (see section 5.1). Expected inflation and expected devaluations are used in the model to generate real expected returns on domestic and foreign financial assets and thereby play an important role in the real and monetary sectors of the model. The

[1] This argument attributes the failure of regional economic integration schemes in Africa to the lack of complementarity among African economies. It says "Africa produces what it does not consume, and consumes what it does not produce" [see Thomas (1974) quoted in Mwase (1993, p.24)].This view is disputed by those who attribute the failure witnessed in the past to the lack of political commitment among African leaders.

discussion on the informal sector and the Mackinnon-Shaw thesis on financial repression (which attributes the informal sector mainly to the restrictions of financial repression on private economic activities) is also an integral part of the model because some variables owe their inclusion in the model to the discussion on the informal sector and financial repression. These include: the proxy for informal interest rate (CRp), the returns on foreign assets (if); premium on informal exchange rate (PRM), volatility of informal rate of exchange (VERB); and proxy for the government's creditworthiness (TBR) which is expected to determine the rate at which government borrows under a financial liberalization scenario.

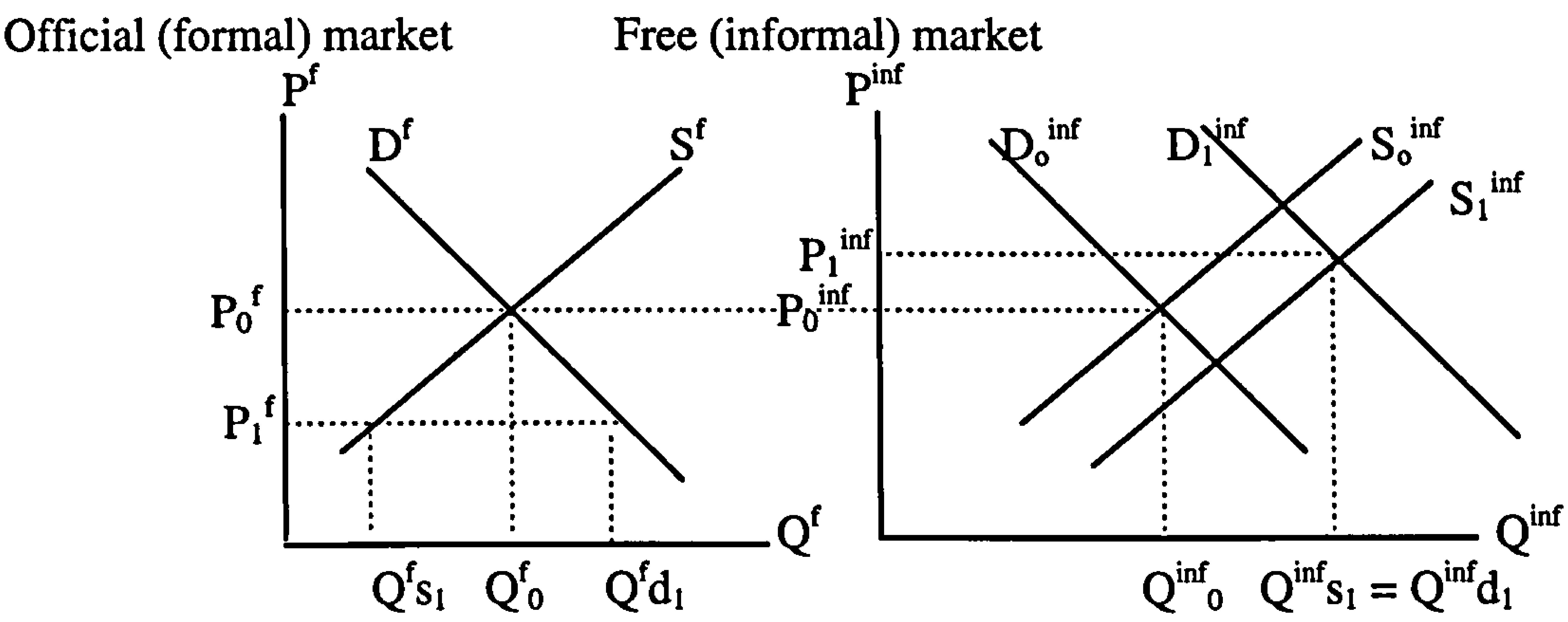
Thus, the arguments developed in this chapter play key roles in the model presented in chapters five to nine. To this effect, section 3.1 discusses the scope of informal economic activities and the main causes for their continuing existence alongside the official sector. Section 3.2 deals with the channels of transmission through which the informal sector influences the effectiveness of policy instruments. The main references are: Agénor and Haque (1996), Montiel et al. (1993), Dongala (1993), and the financial liberalization literature due to the McKinnon-Shaw hypothesis.

3.1 Informal trade and finance

The primary reason for the existence of the informal sector is the distortion of official prices from market prices leading to excess demand in the official market for goods and finances (see figure 3.2). In an effort to encourage 'priority sectors' by supplying credit and foreign currency at subsidized prices, governments in developing countries have frequently resorted to the imposition of ceilings on interest rates and foreign exchange within the banking system. As the official supply of credit and foreign currency is unable to cope with the excessive demand for cheap 'official products', quantity-rationing becomes a common practice. This creates a demand for credit and foreign currency in the informal market and raises the rate of return on informal financial assets, followed by an additional supply of informal finance. By increasing the premium on informal assets, therefore, financial repression encourages the shift of finance out of the formal sector.[2]

[2]The African Development Bank uses the growth in the currency in circulation to measure such shifts of finance towards the informal sector (Dongala 1993). This is because cash is the dominant form of transaction in the informal sector and any shift of finance from the formal to informal activities is likely to be conducted by withdrawing cash from the banking system at the expense of bank deposits (demand- and time-deposits) thereby changing the composition of money supply in favor of cash in circulation.

Figure 3- 1: Excess demand and informal market premium



Given the demand curve (D), supply curve (S) and quantity of transactions (Q), the differential between official and informal prices (P_1^f - P_1^{inf}) is a measure of financial repression.[3] In the official credit market this repression serves to tax depositors by the equivalent of (P_1^f - P_1^{inf}) times the total deposits in order to subsidize borrowers by an equivalent of (P_1^f - P_1^{inf}) times the total loans extended by the banking system. Similarly an implicit tax of (P_1^f - P_1^{inf}) times the total foreign currency inflow from exporters of products, labour and capital is collected in order to subsidize foreign goods and assets imported through the official exchange market.

Following Montiel et al. (1993 p. 88) we call (P_1^f - P_1^{inf}) the *repression index.* For an algebraic demonstration let D^P, i_{dB}, μ, L^P and i_{LB} respectively represent private sector deposits held in the banks, interest rate on bank deposits, reserve requirement, bank loans extended to the private sector and interest rate on bank loans. The zero profit condition can be presented as

$i_{dB}(D^P) = i_{LB}\,(L^P)$ 3.1

Assuming that banks hold no excess reserves other than those required by law (i.e., μD^P), we have the maximum loan that banks can extend to the private sector as

$L^P = (1-\mu)\,D^P$ 3.2

[3](P_1^f - P_1^{inf}) refers to interest rate differential in the credit market and exchange rate differential in the foreign currency market.

By substituting 3.2 in 3.1 we can get the equilibrium rate of interest in the banking system as

$i_{dB} = (1-\mu)i_{LB}$ 3.3

Given i_{dM} and i_{LM} to respectively represent the deposit and lending rates in the informal market, then the market-clearing condition under a zero-profit condition is

$i_{dM} = (1-\mu)i_{LM}$ 3.4

However, informal financial institutions operate outside the legal framework and consequently the reserve ratio can be zero. Thus, equation 3.4 becomes

$i_{dM} = i_{LM}$ 3.5

In a financially-repressed economy banks deliberately keep their rates below the market-clearing rates, thereby taxing depositors in order to subsidize their borrowers in the public sector and priority sectors (see section 2.3.4 and figure 2.14). The net repression tax on the private sector depends on the net private deposits held in the banking system. This can be calculated from equation 3.4 and 3.5 as follows.

Repression tax $= (i_{dM} - i_{dB})\, D^P$

$= [i_{LM} - (1-\mu)i_{LB}]D^P$ 3.6

Repression subsidy $= (i_{LM} - i_{LB})\, L^P$ 3.7

Net repression tax $= [i_{LM} - (1-\mu)i_{LB}]D^P - (i_{LM} - i_{BM})\, L^P$

$= i_{LM}\,(D^P - L^P)$

$= i_{LM}\,[D^P - (1-\mu)D^P]$

$= i_{LM}\,\mu D^P$ 3.8

The net effect of financial repression on income and wealth, therefore, depends on whether a particular economic agent is a net debtor or net purchaser of foreign currency from the banking system. As can be seen from figure 2.8, the private sector is a net loser under financial repression because the public sector is relatively big and tends to be a net debtor to the banking system and net purchaser of foreign currency to finance its persistent deficit. Since the public sector is given priority access to official finance at a subsidized rate, financial repression implies an implicit tax on private deposits held in the banking system, official exports and capital inflows through official channels.[4] Consequently, a significant portion of the private sector - dominated by self-employed people and small enterprises organized at family business level - is pushed towards the informal market. In section 9.13 it is shown that such policy of financial repression has a negative effect on economic growth.

The informal sector has traditionally been associated with the rural farming communities where cash exchange outside official channels is the norm rather than the exception.[5] As the employer of up to 80% of the population, the rural economy is by far the dominant sector of production activity in the informal economy. Recent trends, however, show that a significant portion of the urban economy has been engulfed by the informal sector. A survey by the World Bank (1989) has recognized the widespread existence of informal-sector operators in both the rural and urban areas of LDCs. These are defined as including members of "traditionally entrepreneurial ethnic groups, school-leavers, workers re-deployed from public service or private firms, public-sector employees seeking to supplement their official incomes, international migrants (temporary or permanent) or refugees living close to their country of origin"[6].

3.1.1 Informal trade

As we shall see in chapter four, official records understate the size of inter-African trade due to the effect of the informal sector. This sector covers a wide variety of production and exchange. With the exception of heavy industrial goods, virtually all kinds of tradable items are exchanged in the informal sector. Cash transactions are the main form of exchange, while barter exchange is also widely used in times of macroeconomic instability and during periods of expected devaluation of

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[4]Central banks are usually used as channels of credit to the public sector from the reserves of the commercial banks deposited in the central banks. An increase in the reserve requirement ratio reduces the commercial banks' ability to supply credit to the private sector.

[5]Barter exchange and subsistence production are also widespread in the rural economies of LDCs.

[6] Such association of a profession to an ethnic group is common in many LDCs. For example, trade in Ethiopia has long been associated with the Gurage people. Owing to the dominance of commerce by the Jebeli (Arabs who migrated from Yemen), many Eritreans tended to use the word 'enda-Jebeli' to describe grocery stores. Refugees who settled in neighbouring countries and tribes divided by borders drawn during the colonial era are also active in cross-border informal trade in the Horn of Africa.

the official rate of exchange. Many authors and notably Dongala (1993) give a more detailed description of the scope and structure of informal trade in Africa and consequently the discussion in this section will be brief.

The service sector of the informal market is generated from the goods trade. The main services include transportation facilities and information networks. *Transportion facilities* include the preparation of travel documents, the securing of the safety of trade-routes, and the actual transporting of people and freight by pack-animals, cars and so on. *Information networks* act as the economic intelligence unit of the sector which provides information on commodity prices, exchange-rate fluctuations, and other economic conditions at home and abroad. By linking labourers to local and international job opportunities - thereby influencing labour migration, by signalling regional differentials of commodity prices, interest rates, and exchange rates, these networks play a vital role in the allocation of the resources of the informal sector.

Figure 3- 2: Scope of informal trade

			Country X	
		Domestic currency	Goods	Services
	Domestic currency	Parallel market for **foreign exchange**	Export of goods **(cash transaction)**	Export of services **(cash transaction)**
Country Y	Goods	Import of goods **(cash transaction)**	**(Barter)** Goods for goods	**(Barter)** Goods for services
	Services	Import of services **(cash transaction)**	**(Barter)** services for goods	**(Barter)** services for service

Source: Dongala (1993)

A business which shifts to the informal sector survives in the 'free market' by the *competitiveness* achieved from deregulation, tax evasion, flexibility and efficient networking in the informal market. International exporters, for example, tend to shift to the informal sector due to high tax bills and the administratively-set low exchange rate for their foreign currency earnings. In the informal market they will be able to maximize their revenue by evading taxes and exchanging their foreign currency earnings in the parallel market where the rate is higher than the official exchange rate offered by the banks. There are also informal importers who serve as a cheap and reliable source of imports for residents. This activity tends to be tolerated by the authorities. Importers see an overvalued domestic currency as an advantage because it means cheaper foreign currency. Their shift towards the informal sector should therefore be explained by the high import taxes and by the rationing-out of 'non-priority importers' resulting in their exclusion from the official foreign exchange reserves.

Convertibility of national currencies (as indicated in figure 3.3) is another advantage: informal trade does not suffer from the chronic shortage of the medium of exchange commonly seen in formal trade, such difficulties being avoided by means of the parallel exchange market for all relevant currencies which is operated by numerous well-known dealers.[7] Even barter, which is almost non-existent in formal transactions, is widely used in small-scale and numerous informal transactions.

3.1.2 Informal finance

Informal financial institutions, represented by the multitude of parallel foreign-exchange shops and informal saving institutions, constitute another vital component of the informal market (for more detailed analysis see Agénor and Haque 1996). The financial resources mobilized in the informal sector originate from (a) domestic banks in the form of cash payments made by citizens in exchange for products supplied by the informal sector, (b) the informal sector's own savings, held in informal credit institutions; (c) proceeds from informal exports; (d) unrequited informal inflow of capital from abroad, mainly as transfers of migrant workers' earnings and the repatriation of national capital which was accumulated abroad.

By linking the informal sector to both the official domestic economy and the international market, informal financial institutions play an important role in the effectiveness of macroeconomic policy. Unlike its heavily-regulated official counterpart, market forces are fully operational in the informal sector with free entry and exit. The movement of asset prices is flexible and forward-looking (see section 5.1.2), while taxes are virtually zero.[8]

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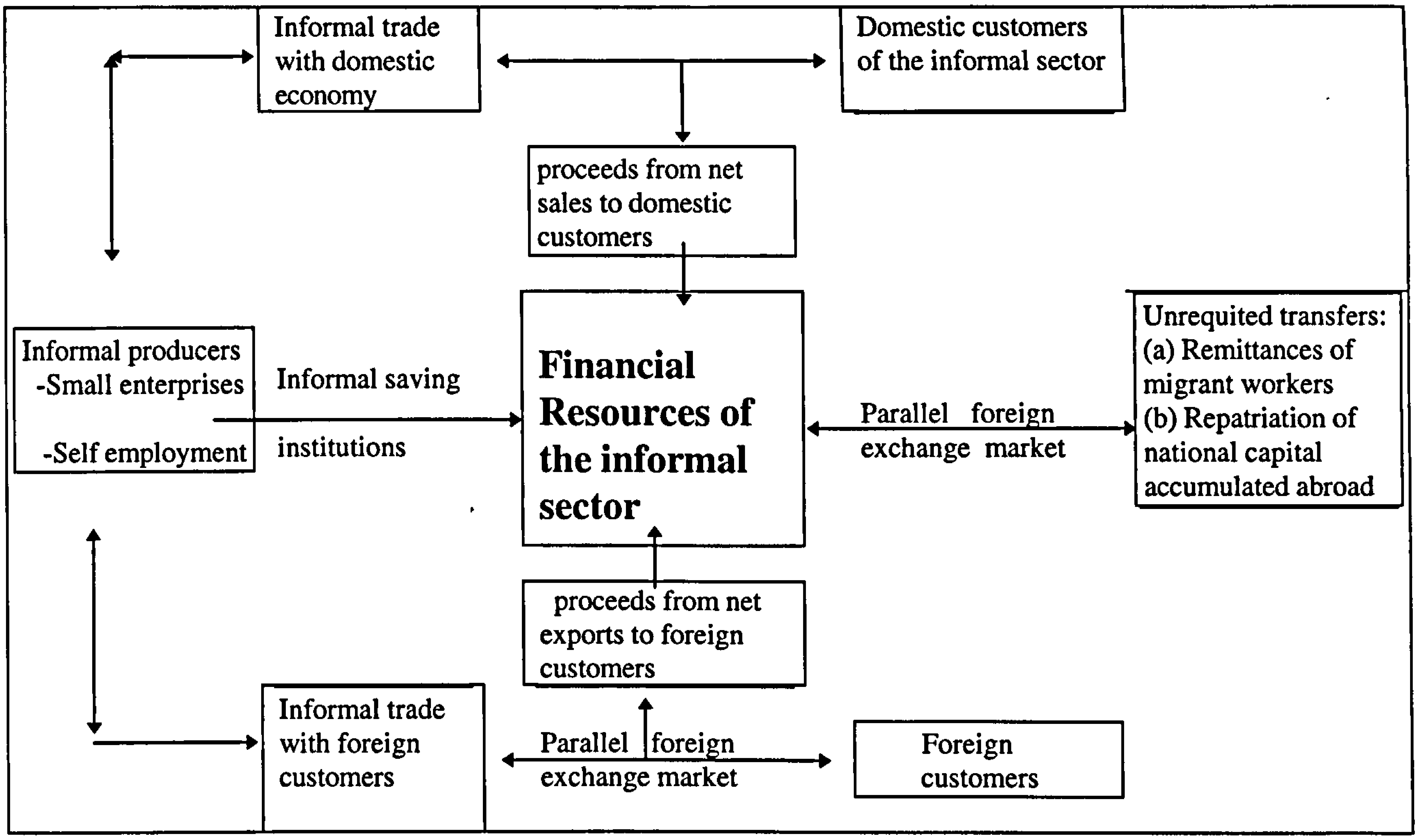
[7] Note that a major factor impeding trade in the formal sector is the inconvertibility among African currencies because it necessitates the use of hard currencies and/or the mediation of financial institutions of the developed world.

[8] Although payment of bribes is a possibility, informal imports and exports generally evade taxes and official regulations on international trade. Once they cross the border, however, informal imports join other products of the formal sector on the shelves of 'legal shops' in the domestic market of destination, and thus pay rents and related fees.

Figure 3- 3: Informal finance and the linkage between formal and informal sector activities



Source: Inspiration from Agénor and Haque (1996) and Dongala (1993)

3.1.3 Determinants of the informal interest rate and the parallel exchange rate

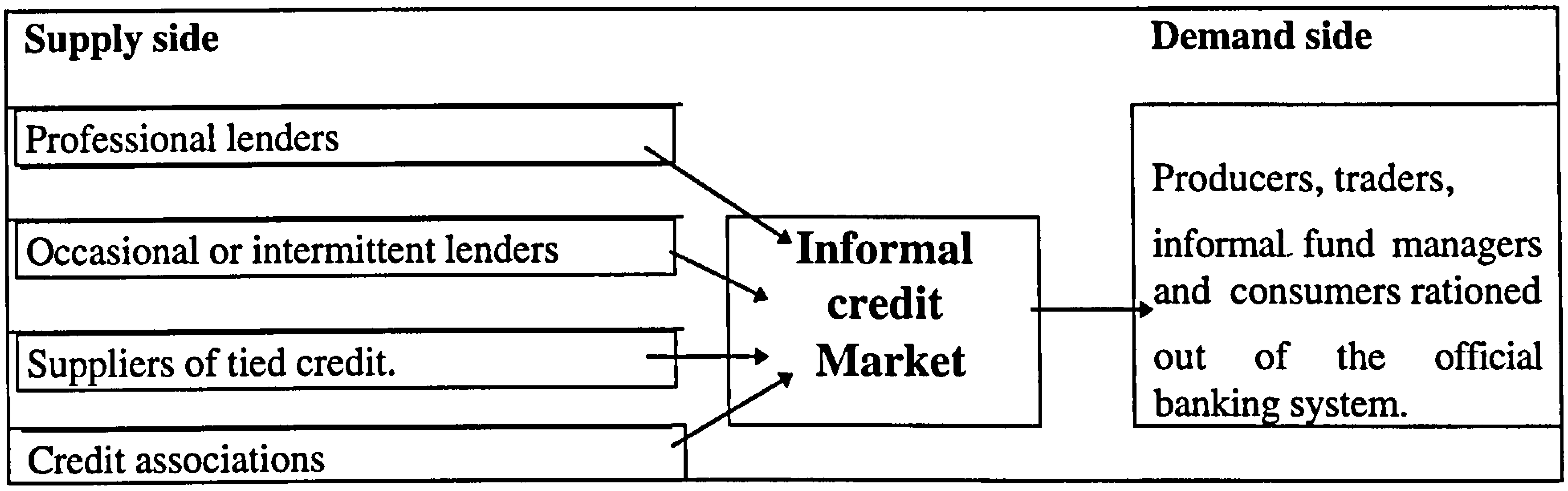
The limited menu of assets available to the private sector and the absence of a market-determined rate are key features in the structure of the official financial systems of LDCs. Agents make a clear distinction between bank deposits and financial assets offered by informal credit institutions. In a financially-repressed economy, therefore, the asset menu is limited to domestic currency, foreign currency, informal loans, bank deposits and physical assets.[9] By making possible an active substitution between these assets and thereby enhancing the reallocation of resources towards their more productive use, informal financial institutions play an important role in the functioning of the economy.

Asset prices in the informal market are determined by the forces of demand and supply. Demand for informal credit and foreign exchange depends on the degree of financial repression and the size of firms rationed-out of the official sector. On the supply side the size

[9]Physical assets include consumer durables (such as gold and furniture), land and physical capital purchased by agents mainly as hedges against inflation. They are relatively less liquid and less active in the production process. Any liberalization program which enables their replacement by a more productive asset would therefore be a net boost to economic growth.

of credit and foreign currency attracted to the informal sector is directly related to the premium on the informal interest rate and the parallel rate of exchange respectively, i.e., private agents take a rational decision to break the law and mobilize their financial resources through informal channels only if the profit involved is attractive enough to compensate the risk. Thus, credit and foreign currency are relatively expensive in the informal sector (see fig 3.2). In the model this is accomodated by premium on informal exchange rate and a credit restraint variable (see section 6.1)

Figure 3- 4: Informal credit market

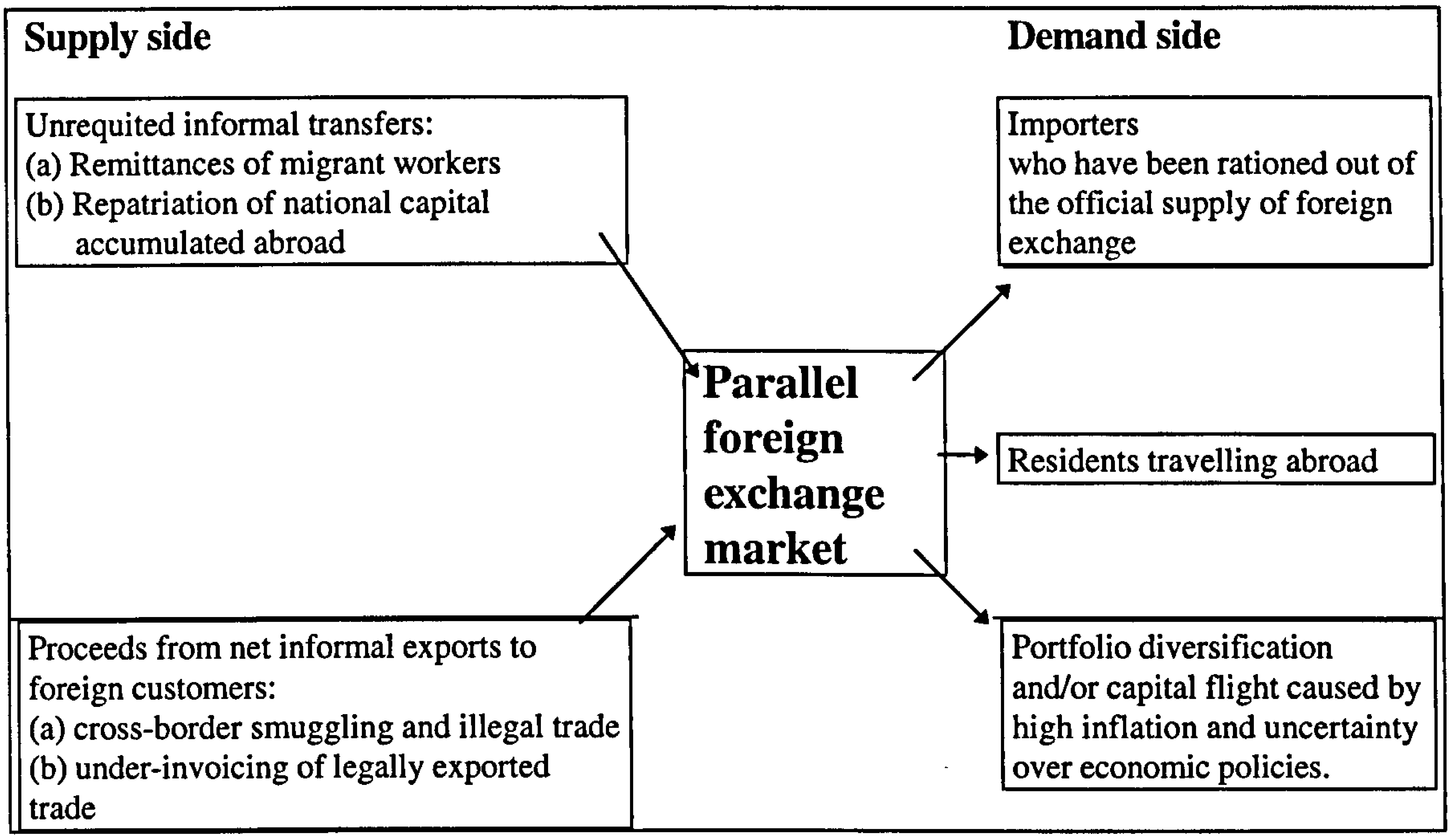


Source: Inspiration from Agénor, and Haque (1996)

There are also good economic reasons for the market-determined rate of interest to be higher than that applicable to financial assets in the world market. By international standards, LDCs suffer from a scarcity of capital, high inflation, volatile parallel exchange rate and political instability, which increase the risk premium associated with assets denominated in domestic currency. With sufficient capital mobility (via the informal financial markets) this risk premium is expected to be reflected in a high informal rate of interest. Therefore, both domestic money market conditions and arbitrage relationships with international markets reinforce each other in increasing the informal rate of interest (see Montiel et al. 1993).

Similarly as can be seen from figure 2.1.4, the parallel rate of exchange is higher than its official counterpart in the long run with significant short-run fluctuations in response to economic and political uncertainties.[10] Chronic deficits in the balance of payments and government budgets are among the important variables which have a positive correlation with the parallel market premium. The effect of the balance of payments works through its negative impact on the official supply of foreign currency, while higher government expenditure (fiscal deficit) implies a higher demand for foreign currency. The latter implies more rationing of private firms out of the banking system because the demand for foreign currency of government institutions must first be satisfied.

Figure 3- 5: Parallel market for foreign exchange (supply and demand)



Source: Inspiration from Agénor and Haque (1996)

Secondly, balance of payments and fiscal deficits reinforce each other to fuel inflation expectations and thereby trigger capital flight and/or portfolio diversification. In other words, a balance of payments deficit implies a decline in government revenue from the implicit tax collected from exporters (of products, labour and capital) who convert their foreign exchange earnings at the official rate, i.e., below the market rate. Given the reluctance to reduce public expenditure seen in most governments of LDCs, private agents will attach a higher weight to the likelihood that the government might compensate for spending power by inflating the

[10]Such rapid reaction to future events is symptomatic of the forward-looking nature of movements in asset prices (see Agénor and Haque 1996).

economy, i.e., by collecting seigniorage revenue. Consequently the high demand for foreign currency increases the premium on the parallel exchange rate.[11]

In the long run, however, structural factors such as the degree of repression (which includes the level of official rates, rationing of credit, the range of activities subjected to high taxation and related restrictions, the effectiveness of authorities in enforcing trade laws) are the most important determinants of the premium on informal financial assets. The market sets the rates by equating the supply and demand for credit and foreign currency reflecting private agents' equilibrium portfolio allocations and unreported current account balances.[12]

Unlike the official sector, where the rate of return is administratively fixed, earnings from holding informal financial assets are endogenous, i.e., they are linked to the real income derived from their productive use and their expected price.[13] This creates an important link between the financial and real sectors which any modelling and policy analysis for a financially-repressed economy must take into account. The next section will discuss the variables which link the formal and informal sectors and their implications for macroeconomic policy.

3.2 The linkages with the formal sector and the channels of transmission

The informal sector has a strong linkage with the formal economy in the sense that the former owes its existence to the failures of the latter. In other words, the failure of the formal sector in facilitating efficient public service and successful private enterprise is an important factor in pushing people towards the informal economy. Economic agents who join the informal sector are, therefore, assumed to have made a rational decision, given the gloomy economic opportunities in the formal sector. Secondly, coexistence of these two markets within a given economic system implies that they continue to influence each other systematically through variables related to the government budget, the balance of payments, money supply, income and wealth, prices and output.[14] The channels of transmission and their implications for policy will be discussed below.

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[11]There is a vicious circle in this case because a high premium on the parallel exchange rate encourages more exports and capital inflow through the informal market leading to a further deterioration of the official balance of payment.

[12]See Agénor et and Haque (1996) p. 89

[13]Changes in asset prices are a function of their current demand based on their expected performance relative to other assets at home and abroad.

[14]See Agénor and Haque 1996 and Dongala 1993.

3.2.1 Channels of transmission

Informal financial markets have an important influence on the transmission and the overall effectiveness of macroeconomic policy in a financially-repressed market (see Agénor and Haque 1996, p. 93-4). Importers and borrowers who have been rationed-out of the official banking system are required to buy foreign currency and loans at a higher rate in the informal market. Under a direct mark-up pricing system, therefore, the informal market premium is likely to have a direct *price effect* on smuggled imports and goods produced in the informal sector. Given the price level (P), informal exchange rate (E_b) and informal interest rate (I_b) the price effect can be expressed as

$P = p(E_b^{+}, I_b^{+})$ 3.9

On the *supply side* the informal sector has a mixed effect. The informal interest premium increases the financial cost of informal products, thereby discouraging production inasmuch as firms face financial constraints prior to the sale of their output. Informal exporters are, however, encouraged to increase supply because the parallel exchange premium increases their producer price. The net real (supply side) effect of the informal market premium, therefore, depends on the relative strength of the financial cost of inputs associated with the informal rate of interest and the parallel exchange rate vis-à-vis the boost in export earnings from sales at the parallel exchange rate. This effect on the level of output (Q) can be expressed as

$Q = q(E_b^{\pm}, I_b^{+})$ 3.10

The informal market premium has a negative effect on the *balance of payments* because it induces exporters, migrant workers and agents with capital accumulated abroad to abandon the banking system in favour of informal channels.[15] Although this shift improves the balance of informal current and capital accounts, it deteriorates the officially recorded balance of payments (BP).

$BP = f(E_b^{-}, I_b^{-})$... 3.11

A contractionary *monetary effect* can be expected from the growth of informal activities. The balance of payments effect presented above reduces official foreign exchange reserves which

[15]Under-invoicing is commonly used by 'official' exporters, while smuggling of goods and capital across the borders is widely practised mainly by unofficial agents.

comprise the foreign component of the total money supply (Ms). Attracted by a higher interest premium, agents are likely to cash and shift their bank deposits to the informal sector, thereby reducing the credit creation capacity of the commercial banking system.[16]

$Ms = f(E_b^-, I_b^-)$ 3.12

One of the objectives of repressing the financial system is to finance public enterprises by collecting implicit tax revenues from depositors in the banking system and international traders who mobilize their resources through official channels. A negative fiscal effect can, therefore, be expected from the growth of informal activities which deny the government such a vital source of revenue. Given 'G' for government expenditure and 'T' for tax revenue the fiscal effect of financial repression can be presented as:

$(T - G) = f(E_b^-, I_b^-)$ 3.13

As mentioned earlier, the informal lending rate is determined by market forces which take into account developments in the domestic money market and by an arbitrage condition with the world market via the parallel rate of exchange. Thus, the informal lending rate represents the relevant opportunity cost for holding money in a financially-repressed economy which agents take into account in deciding the proportion of each asset held in their portfolio balance. Any change in the informal market premium will therefore, have a *direct portfolio effect* leading to a sizeable effect on the flow of income and revaluation of private wealth.

Private expenditure or aggregate demand (AD) is expected to respond to the effects of the informal premium on income and wealth. Private agents are likely to see the informal rate of interest as the appropriate indicator of the real cost of funds and use it to calculate the present value of their expected income. The inter-temporal effect of the informal rate of interest is therefore likely to reduce the present value of the expected flow of income and thereby dampen current household spending. Since spending is a function of both income-flow and the stock of wealth, expected

[16]Note that money supply (Ms) is defined as the sum of domestic credit (DC) and foreign exchange reserves (FA) (see Montiel et al 1993 p. 184). The cash transfer of banking deposits to the informal sector is consistent with the logic of associating growth in informal activities with the ratio of cash outside the banking system (CC) to total money supply, i.e., $CC/Ms = f(E_b^+, I_b^+)$ (see Dongala 1993 p.164).

depreciation of the parallel rate of exchange (which reduces the expected foreign currency value of domestic assets while increasing the expected domestic currency value of foreign asset holdings) is likely to cause a sizeable revaluation of private wealth and thereby reduce current expenditure.

$AD = f(E_b^{-}, I_b^{-})$ 3.14

3.3 Implications of the informal sector for the effectiveness of monetary policy

The policy simulations in chapter nine try to evaluate the effects of Ethiopia's participation in a monetary union which might arise from the existing/proposed integration schemes in the region. Empirical tests of this argument involve identifying the instruments and conducting a simulation exercise which traces the effects of policy-induced shocks through the transmission channels discussed in section 3.2.1 above. This is because the cost of integrating a country's economy into a regional union of 'sovereign states' is directly related to the effectiveness of her monetary instruments. In this section we will identify the instruments available to policy-makers in a financially-repressed economy and discuss the failure of the financial liberalization experiments in Africa in order to make the case for independent regional monetary union as a more credible institution.

3.3.1 Instruments of monetary policy in a repressed economy

The policy instruments available to the monetary authorities of a financially-repressed economy are *interest rate, credit, reserve requirement ratio and exchange rate.* Following Agénor and Haque (1996 p. 95-6), the discussion below assumes that the authorities change these instruments in a non-market based fashion but consistent with a given macroeconomic objective. Although the strength of the linkages between the formal and informal markets and the transmission channels may vary across countries, the following simulated outcome can be expected from a macroeconomic model which incorporates the informal market. [17]

3.3.1.1 Official rate of interest

An increase in the official rate of interest involves a move towards the market-determined level. This increases the relative attractiveness of bank deposits at the expense of informal loans and assets denominated in foreign currency and "non-productive" assets held as hedges against inflation. To the extent that the shift of resources is confined to conversion of 'non-productive'

[17] See Montiel et al. (1993) p. 3 and Agénor and Haque (1996) p. 94.

assets (such as idle land, houses, and consumer durables such as gold and furniture), an increase in the official rate of interest succeeds in increasing the proportion of investment without dampening aggregate demand. Thus, a positive output effect can be expected (see section 9.1.4).

If, on the other hand, the policy leads to swapping already-employed informal assets for bank deposits it will lead to an increase in the informal rate of interest and to appreciation of the parallel rate of exchange. This will have a negative output effect as the financial cost of production increases while export price declines in the informal sector. Contraction of demand can also be expected inasmuch as the *negative wealth effect* of the appreciated parallel rate of exchange, and the *decline in the flow of income* (i.e., the decline in producers' profit because of the higher rate of interest and the decline in export earnings owing to the appreciated exchange rate) exceeds the boost in household earnings from deposits in the banking system and additional jobs created in the formal sector.

3.3.1.2 Credit expansion

Credit expansion can be achieved by increasing the supply of cheap loans from the central bank to the commercial banking system. The initial effect would be an increase in the supply of money and upward pressure on prices which reduces the real rate of interest. Given administratively-fixed bank rates and market-determined informal rates, agents would increase their holdings of informal assets. An increase in the supply of loanable funds would dampen the upward pressure on informal rates of interest caused by inflation and, consequently, informal producers would be able expand investments. Demand for foreign currency, physical capital and consumer durables used as inflationary hedges, would also be expected to increase. An increase in the parallel rate of exchange (given the rise in inflation while the official rate of exchange remains administratively fixed) would also boost informal exports leading to an increased demand in the informal sector. This stimulus is, however, dampened by the negative effect of inflation on financial wealth held in the formal economy, and a deterioration in the balance of payments. The latter is caused by two factors. Firstly, following the increase in domestic economic activity the demand for imports is expected to rise, leading to a deterioration of the current account. Secondly, in order to benefit from the increase in the parallel rate of exchange, exporters resort to under-invoicing and smuggling and the central bank loses foreign exchange reserves. The net effect of credit expansion in a financially-repressed economy can be expected to be an expansion in private spending which would stimulate output and prices and reduce the stock of foreign assets of the central bank (see section 9.1.2).

3.3.1.3 Reserve requirement ratio

A decrease in the reserve requirement ratio can be used to reduce financial repression, stimulate demand and thereby promote economic activity in the private sector.[18] By reducing the cost of deposits, a lower deposit ratio enables commercial banks to raise deposit rates and supply more credit at a cheaper rate to the private sector. This is expected to boost output and demand. Such a reduction of the repression tax dampens the demand for credit and foreign currency in the informal sector and thereby reduces the premium on informal assets.

Although growth in demand leads to an increase in imports, the effect on the central bank's reserves is expected to be more than offset by the shift to formal exports induced by the decline in the parallel exchange rate. The reduction in implicit tax revenue is expected to reduce economic activity in the public sector. However, the boost in private economic activities is expected to be stronger. The net effect of a reduced reserve requirement would therefore be an increase in both aggregate demand and the foreign asset reserves of the central bank (see section 9.1.3).

3.3.1.4 Official exchange rate

The devaluation of the official exchange rate involves an announcement by the monetary authorities that they will increase the units of domestic currency exchanged for a unit of foreign currency in the banking system (see section 9.2). The immediate effect of this policy announcement is the reduction of the premium on foreign assets held in the informal sector and an increase in inflow of foreign currency to the banking system. The official balance of payments will improve as exporters are induced to reduce under-invoicing and holders of foreign currency find it attractive to cash their earnings in the official market.

The foreign asset reserves of the central bank increase, leading to an increase in money supply. There is also a positive effect on expenditure through the wealth effect (the revaluation of foreign asset stocks) and income effect (growth of domestic currency earnings of official exporters) which join the growth of money supply in exerting an upward pressure on prices. Inflationary pressures are also reinforced by the effect of devaluation on official imports.

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[18]Large reserve ratios are common in LDCs. Besides restricting the commercial banks' credit-creation capacity, they enable the central bank to extend cheap (or free) funds for government projects. It is therefore an implicit tax on the commercial banking system and a restriction on economic activity in the private sector (see section 9.1.3).

Inflation reduces the purchasing power of currency and thus, the demand for money will increase. This will draw funds out of the production sector and the informal financial market will react quickly by increasing the informal rate of interest and appreciating the parallel rate of exchange. The increase in the cost of informal loans, the negative wealth effect of appreciation of parallel rate of exchange and the increase in the price level will all reinforce each other in reducing private spending. A devaluation which reduces the informal market premium may also have a negative effect on public spending because it denies the public sector the revenue which used to be collected from implicit taxation on private capital inflows. On balance therefore, devaluation can be expected to have a contractionary effect on private spending in a financially-repressed economy.

As mentioned earlier both the strength of the effect and even the direction of causality may vary across countries depending on the position of the economy and the expected policy in the post-shock period. This will be discussed in chapter nine. One can, however, safely conclude that the effectiveness of monetary instruments is weaker in countries with large informal sectors than otherwise. The next section will comment on the policy of financial liberalization prescribed to reduce the informal sector and thereby enhance the effectiveness of official sector.

3.3.2 Financial liberalization in theory and in practice

There is a widespread consensus in the literature on the desirability of unifying the formal and informal sectors of the economy because the latter is associated with inefficiencies emanating from corruption, tax-evasion and unregulated cross-border movements of resources which may destabilize the economy and retard growth. In short, the growth of informal activities reduces the effectiveness of policy instruments so that incorporating informal activities within the formal sector becomes necessary. There is, however, little consensus on how to induce informal operators to use the official channels in their daily transactions.

The financial liberalization school, led by McKinnon (1973) and Shaw (1973), views the informal sector as a natural part of the formal sector but disenfranchised by repressive rules such as the ceiling on interest rates, credit rationing, control on exchange rates and a discriminatory taxation system. Consequently, they suggest that allowing the official rates to be determined by market forces can attract financial resources into the banking system and increase the supply of loanable funds thus rendering credit rationing unnecessary (also see section 4.2.5). Besides unifying the two markets, the increase in the rate on official assets will shift resources from consumption to investment. Such a change in the composition of aggregate demand is expected to have a positive effect on output.

This conclusion, however, has been criticized by those who envisage the persistent coexistence of the formal and informal sectors in the post-reform period. By making a distinction between two components of the informal market, 'autonomous' and 'reactive' credit systems[19], critics argue that liberalization programs that increase the bank rate of interest would reduce the reactive component of the informal credit system and thereby increase the cost of production in the autonomous component of the informal sector. High cost of production is translated into low supply and - through a mark-up pricing system - to inflationary pressures. The neo-structuralists led by Taylor (1983) and Van Wijnbergen (1983), therefore, expect the final outcome of such financial liberalization programs to be stagflationary.[20]

In practice, financial liberalization has hardly been a success story (see Agnor and Haque 1996 p. 97). Although the McKinnon-Shaw school inspired the liberalization policies that have engulfed the developing world in the past two decades, very few countries, if any, have succeeded in maintaining a completely liberalized financial system. Most countries have reinstated (at least partially) the pre-reform controls on credit and foreign exchange and informal financial markets have continued to operate alongside their official counterparts. This statement is also supported by the situation in the Horn of Africa. Following the devaluation of the Ethiopian currency in 1992 from 2.07 birr/US$ to 5 birr/US$ and the periodic adjustments thereafter, the informal market premium has been (and still is) large enough to divert foreign exchange inflows away from the official sector.

Mehari (1998) gives a detailed discussion on the persistence of the informal sector as a symptom of a decline in the credibility of the national monetary policy and/or as an indicator of

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[19]The autonomous credit system is an indigenous institution which precedes the advent of modern banks. An indigenous institution based on community networks is likely to persist under financial liberalization by exploiting information asymmetry and low transaction cost. The reactive component on the other hand, is the result of financial repression and is likely to respond to policy-induced shocks (see Montiel et al 1993, p. 19).

[20]One of the criticisms against this approach refers to the emphasis given to mark-up pricing instead of modelling it as an interactive process leading to a general equilibrium (see Montiel et al. 1993 p. 55-69).

strong complementarity of neighbouring economies. The argument is then developed in the context of past and present African monetary union experiments to make a case for monetary union in the Horn of Africa. We will return to this point in chapter nine where we show the negative effect of informal exchange rate and credit restraint on aggregate output. The next section will discuss the implications of the dual structure of the economy on Ethiopia's policy on regional economic integration and the modelling of expectations.

3.4 Dual economic structure and strategy for collective industrialization

Developing economies are dominated by subsistence agriculture from which up to 90% of the population earns its livelihood. In regions such as the Horn of Africa some countries have per-capita income as low as US$ 100 which limits the purchasing power, thereby reducing the 'effective size' of the domestic market. The production process is still predominantly dependent on rudimentary technology, although the region was one of the early starters on the path towards modernization. In Ethiopia, for example, the 1930s can be seen as the period in which the transition from subsistence agriculture to a modern industrial economy began. Nonetheless the economic infrastructure of the region is still well below the standards of a developed economy. The major part of the society is still in subsistence agriculture with very little access to electricity, transport and communication facilities (see chapter four).

The small exchange economy (or modern sector) includes a predominantly urban people engaged in public service, private trade, tourism-related activities and the manufacturing of import substitutes. In the rural areas this sector is represented by those engaged in the production of cash crops, minerals and other primary products for export.

The domination of traditional subsistence agriculture has led to a low level of productivity, vulnerability to climatic changes and frequent food crises in the past two decades. It also implies that national markets are too small to support any major industrial project because very few people can produce a surplus and participate in the exchange economy. Poor infrastructures also contribute to the isolation of the rural majority from the market centres and the education, health and related services of the modern sector. The origin of such a dual economic structure and its effect on industrialization strategies will be discussed below.

3.4.1 Inherited economic dualism

Unlike the European experience where market towns developed as centres for accumulation and exchange of surplus wealth created in the rural sector, the African urban economy (mostly created by colonial settlers) was geared towards the world market; they used imported raw materials and sold to the world market with very little, if any, interdependence with the traditional sector. Post-colonial Africa inherited such a dual economic structure and the Horn of Africa is not an exception.

Tables 3.1 and 3.2 respectively present the economic infrastructure and major products of the Horn of Africa. Most of the modern utilities, transport and communications infrastructure was built during colonialism for colonial purposes. These facilities were unevenly distributed and thus, their impact on transferring technology and diversifying the rural production process was very limited.

This economic duality was maintained in the post-colonial era because it was hoped that it would serve as a springboard for technological advancement that would spread (or in modern economics jargon, 'trickle down') to the rest of the economy. In some cases it was even strengthened by external borrowings (see Degefe 1992, p. 1) to expand production of cash crops (i.e., exportable goods such as coffee, bananas, cotton etc.) in order to maximize foreign exchange earnings which could be used for importing advanced technology. The result was a dismal failure.[21]

External debt became unbearable. By 1991 for example, the Sudanese per-capita debt was more than five times the per-capita income (see table 2.16). The debt services alone reached up to 39% of export earnings (see EIU 1994-95) and inflation in some countries reached a dangerously high level (see section 2.1.3.2). The trickle-down effect never materialized, the increased neglect of the rural majority adversely affected peace and national cohesion and, above all, national markets remained as small as ever.

This dual structure of the economy creates problems in both the economic and political dimensions. The economic problem is related to the effect of market size on industrialization. Persistence of fragmentation of the national economy into subsistence and exchange sectors reduces the internal market. This has become one of the main obstacles for investment and

[21]African trade for example declined from 8.96% of world trade in 1980 to 3.78% in 1990s (see UN trade statistics).

industrialization as major industrial projects have found it difficult to sell their products owing to the small internal markets and high competition in the international market.

It is also a sensitive political issue in terms of nation-building and the process of democratization. The large subsistence sector is marginalized in the process of decision-making and deprived of the economic resources necessary for the introduction of new technology and skills in their production process. Access to the provisions of basic public services like education and health is disproportionately concentrated in urban centres. In short, economic dualism entails the concentration of political and economic power in the small exchange-oriented sector and the neglect of the majority engaged in the subsistence sector.

If incidents like the 1974 Ethiopian revolution are anything to go by, such rural-urban polarization could easily lead to political tension and instability. Accordingly, transforming the large subsistence sector into a surplus-producing exchange economy is (or should be) the number-one priority of policy-makers in each country. The question is, given the decline in foreign exchange earnings caused by frequent crashes in the world commodity markets and the expansion of trade-blocs in the developed world, the scarcity of national capital, and the intensity of competition for international capital, how can countries like Ethiopia raise the desperately-needed investment for their infrastructure and industry?

Table 3- 1: Infrastructure and Utility

	Ethiopia	Eritrea	Djibouti	Somalia	Sudan
Electricity:					
Capacity	kwh 330000		kwh 115000		kwh 610000
Production	mil kwh 650		mil kwh 200		mil kwh 905
Per-capita	kwh 10		kwh 580		kwh 40
Communication:					
Rail roads	km 781	n.op km 307	km 97		km 5516
Highways	km 39150	km 3845	km 2900	km 22500	km 20703
Pipeline				km 15	km 815
Ports:-	none	2	1	4	2
		Assab	Djibouti	Mogadishu	Port-Sudan
		Massawa		Berbera	Sawakin
				Kismaayu	
				Bender Kassim	
Merchant Marine	none	14		3	5
Airports/airstrips:					
Total	121	5	13	69	68
Usable	82	5	11	48	56
Telecommunication:					
Radio-relay	for gov't use				large & well equipped
Open-wire	for gov't use				
	to Djibouti				
	to Sudan				
M-wave radio relay	to Djibouti		available		available
	to Kenya				
Cable			to Saudi Arabia		available
Radio communication					available
Troposcatter					14
Domestic satellite stns					14
Broadcast stations:					
AM	4		2		11
FM	none		2		none
TV	1		1		3
Satellite earth stations:-					
INTELSAT	Atl.1 & Pacif.2		Indian oc. 1		Atlantic 1
ARABSAT			1		1

Source: World FactBook (1994) [n. op = non-operating owing to war damage]

Table 3- 2: Major industrial and agricultural activities

	Ethiopia	Eritrea	Djibouti	Somalia	Sudan
Industrial products	food processing	food processing	dairy products	sugar refining	cotton ginning
	beverages	beverages	mineral water bottling	textiles	textiles
	textiles	textiles & clothing		petroleum refining	cement
	chemicals				edible oil
	metal processing				sugar
	cement				soap distilling
					shoes
					petroleum refining
Agricultural products	cereals		goats		cotton
	pulses		sheep	cattle	oilseeds
	coffee		camels	sheep	sorghum
	oilseeds		fruit & vegetables	goats	millet
	sugarcane			bananas	wheat
	potatoes & vegetables			sorghum	gum arabic
	hides & skins			corn	sheep
	cattle			mangoes	
	sheep			sugarcane	
	goats			fish (potential)	

Source: World FactBook (1994)

3.4.2 Collective approach to industrialization

From table 3.1 it is very clear that countries like Ethiopia need to industrialize urgently. One of the widely-prescribed development-paths for these countries is the Structural Adjustment Program (SAP) of the IMF which advocates integrating the developing economies directly into the global market.[22] The neo-liberal argument for SAP-type development is supported by the experience of the Newly Industrialized Countries (NICs) of South East Asia which have succeeded through closer integration with the global economic system, the free-market mechanism and an export promotion strategy. This success of free-market policy, however,

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[22]SAP targets the reduction in the economic role of the government through market reforms which include privatization, reduction of subsidies and other public expenditure, and the liberalization of prices, exchange rates and interest rates.

should be treated with some caution because the NICs were characterized by development - oriented states governing the market. At least in the initial stages, market forces were subordinated to an import substitution strategy and later shifted to export promotion policy when the situation was ripe for their industries to compete in the world market. Given the relatively liberal trade policy and availability of surplus capital in the developed world, transformation to export promotion was easier in the 1960 - 70 period (see Nafziger 1997).

This opportunity was lost by many African countries and may not happen again in the foreseeable future. The situation has now changed; regionalism is back in world trade with a new vigour and complexity. Protectionist tendencies have restricted the access of African exports to the markets of the developed world. Also, the end of the cold war reduced the capital inflow to Africa by opening up the Eastern-bloc countries for western investment. Africa, therefore, stands little chance of benefiting from the SAP and the resulting global integration. The benefit expected from "trade creation" is likely to be marginal due to the weak industrial base at home, protectionist tendencies in the developed world and the increased competition from Eastern Europe for foreign capital.

Secondly, instead of transforming the subsistence sector and integrating the national economies, the SAP has a tendency to perpetuate the outward-oriented and urban-biased structure of the economy. This strategy, as we have seen above, has failed to integrate the internal markets and is unlikely to do so unless regional capital is mobilized in such a way that it could benefit a wider regional market.

Thirdly, the opening of the Eastern bloc and China to international capital reinforces the argument for regional cooperation. With their small and fragmented markets, countries of the Horn stand little chance of attracting the much-needed foreign capital. Thus, integrating their national markets into a single regional free-trade area is an obvious way forward. After all, more than anything it is the market size which is attracting foreign capital to China.[23]

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[23]As home for 20% of the world population, China is widely viewed as the economic power of the 21st century and governments and multinational companies are positioning themselves accordingly. The frequent criticisms about the Chinese records on democracy, basic human rights and government interference in the operation of market forces seem to be too academic to influence investment decisions by governments and private investors.

Industrialization via regional integration is therefore one of the main arguments for regional cooperation in Africa. This does not necessarily mean an isolationist strategy but a realistic view of the fact that successful integration into the world market requires a strong industrial base and - given the resurgence of protectionism in the world market and the scarcity of international capital - a large regional market is a vital precondition for building such a strong industrial base in Africa. Secondly, given the marginalization from the world economy due to long devastating wars, drought and inefficient governments, countries like Ethiopia do not have the luxury of going it alone. The problem is too big to be solved by introducing free-market reforms at the national level. Regional economic co-operation is, therefore, needed in order to reduce the effect of the dual structure of the economies and to obtain economies of scale which spur large-scale investments and innovation. Such an approach provides a better chance for a smooth transition from import substitution to export promotion and thereby integrating the Ethiopian economy into the global economy. When cooperative schemes like these mature, one can envisage the establishment of monetary unions - a scenario which forms the basis for the policy simulations in chapter nine.

3.5 Concluding remarks

In this chapter we have seen that the post-independence economic policies of countries like Ethiopia have failed to integrate the formal and informal sectors. The informal sector is highly deregulated and is assumed to operate in accordance to free-market forces. Since it involves cross-border trade and capital inflows it responds to changes in both the national and international markets. Operators in the international finance section of the informal sector are assumed to be well-informed agents and thus can be expected to form their expectations rationally. Agents in the traditional sector (be it formal or informal) have less access to vital current information and are less equipped to process it thus making adaptive expectation a more plausible modelling strategy (section 5.1).

Another implication of the dual structure of the developing economy is its impact in reducing the size of the domestic market for industrial goods. Given the resurgence of trade protectionism in the world market, the establishment of a regional common market is increasingly occupying the centre stage in policy debate. For example, the World Bank president, James Wolfensohn, referred to the 34% of Africa's wealth which is outside the continent (compared to 2% for Asia and 17% for South and Central America) to emphasize potential role of African capital and the importance of large markets in attracting private investment. He said "most individual African nations in sub-Saharan Africa are too small, and without regional integration Africa would be marginalized in global trade and investment".[24]

If and when such regional integration schemes come to fruition their likely impact is to limit the monetary and fiscal autonomy of national governments. The model specification and policy simulations of this study should therefore reflect this possible scenario. Before we proceed to specifying the macro-model, the next chapter will review the literature on macroeconomic modelling and its applications in LDCs and Ethiopia.

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[24]PANA (January 27, 1998)

CHAPTER FOUR

LITERATURE REVIEW ON MACROECONOMIC MODELLING

Macroeconomic models are instruments for analyzing economic problems, and the most important economic question in sub-Saharan Africa is why countries like Ethiopia failed to improve the living standards of their citizens for most of the post-colonial era. In the absence of the Marxist development strategy, the prevailing post-cold-war views on this issue can be summarized into two broad categories (Abegaze 1994).

The neo-classical explanation of the Bretton Woods institutions puts the blame squarely at the gates of the 'inept or parasitic governments in Africa who followed ill-conceived policies' (World Bank, 1989, 1992). The policy prescriptions advanced by the economists in these institutions are:

I. implementing the so-called 'Four Ds' (i.e., devaluation, deregulation, deflation, and denationalization);
II. providing an enabling environment for private economic activity; and
III. getting politics right (i.e. good governance in managing society's resources).

The structuralist view of the United Nations Economic Commission for Africa (see ECA-UN 1989) attributes the problem to structural factors discussed in chapters two and three, such as:

I. dominance of subsistence agriculture and commerce;
II. narrow and poorly articulated industrial base;
III. neglect of the large informal sector;
IV. environmental degradation;
V. urban-biased development strategy;
VI. small and fragmented markets;
VII. excessive dependence on external trade (of primary goods) and aid; and
VIII. weak institutional capabilities.

Consequently, the ECA-UN's preferred approach for achieving the twin goals of alleviating poverty and sustainable development in sub-Saharan Africa is *'adjustments with transformation"*. In practice these include:

I. expansion and diversification of productive capacity;

II. promotion of equitable distribution of income;

III. focusing on satisfaction of basic needs of citizens; and

IV. expanding the capacity of institutions that foster mass participation in the process of transformations.

Most of the macroeconomic models built for LDCs reflect either one or a hybrid of these views on reforming the economies. The objective of this chapter is, therefore, to review macroeconomic modelling and its applications in developing countries like Ethiopia. Section 4.1 classifies macroeconomic models on the basis of their underlying economic theory. Section 4.2 reviews models of developing countries, their position in the neo-classical/Keynesian spectrum of economic thought, and highlights the innovation and flexibility needed in their application. Section 4.3 reviews the models designed for the Ethiopian economy. Section 4.4 presents the key features of the model estimated in this study; and finally section 4.5 concludes the chapter by identifying some gaps in the literature to which this study intends to contribute.

4.1 Classification of macroeconometric models

Macroeconomic systems can be econometric or analytical (Challen and Hagger 1983). The macroeconometric system is one in which all relationships have specific mathematical form with numerical parameters estimated from relevant statistical data. A macroanalytical system on the other hand, is a non-numerical system where the intercepts, coefficients and exponents of variables are not presented as distinct numerical values.

The model presented in this study can, therefore, be described as a macroeconometric system. It is generally concerned with structural macroeconometric models in the sense that it excludes the non-theoretical, time-series models of the VAR type. The equations represent a mathematical formalization, causal interpretation and a testable version of the theoretical view of how the economy functions (Hall and Henry 1988). At this stage, therefore, it is important to review the classification of macroeconometric models according to the theory they represent. Challen and Hagger (1983) suggest a taxonomy of the five most important families of macroeconometric systems as Keynes-Klein (KK), Phillips-Bargstrom (PB), Walras-Johansen (WJ), Walras-Leontief (WL) and Muth-Sargent (MS).[1]

Alternatively, Hall and Henry (1988) suggest classification of macroeconomic models on the basis of the economic theory as: income-expenditure models, equilibrium models, supply-side models, disequilibrium models, and bargaining models. Disequilibrium macro-models are not widely used in macroeconomic modelling. Theoretically they are the multi-market analogue of the single market disequilibrium where the supply and demand functions of the model are defined and actual trade takes place at the minimum of the two, with prices adjusting possibly extremely slowly. In bargaining models the supply and demand functions become boundaries of the region of possible trade within which prices and quantities are set by some largely unspecified bargaining system. The approach enables the inclusion of both supply and demand factors in the determination of prices and quantities and gives at least the impression that prices are set by the bargaining process. The final equations of such models, however, usually tend to be similar to those of supply-side and equilibrium models (see Hall and Henry, 1988).

The following classification is based mainly, but not exclusively, on the suggestions of Challen and Hagger (1983). It is meant to serve as a general guide to the theoretical and econometric underpinnings of the existing macroeconometric models. However, it should be clear at the outset that the categorization involves some simplification. It is a stylized representation or 'broad brush approach' and that estimated models (such as the one presented from chapter five onwards) are likely to include aspects from different categories.

4.1.1 Income-expenditure (or KK) models

The income-expenditure models to a large extent incorporate the implementation of conventional Keynesian theoretical views and are by far the most popular models in both the developed and developing world (see Murinde 1994). Such models assume that the goods market always clears economy-wide with the dominant role being played by the demand side in determining aggregate output. Consequently, models have detailed equations for the components of aggregate demand combined with labour and money markets. Government expenditure, wage level and money supply are treated as exogenous. In general, the supply-

[1]In each group the first name belongs to the theoretical economist who provided the vision and the second to the econometrician who used the vision to build a framework for his prototype (Challen and Hagger 1983).

side is less emphasized, variables related to expectations and open-economy relationships are missing, and prices are usually set on a fairly ad-hoc cost mark-up basis.

Later versions of this model have increased their emphasis on the supply side, and include additional sectors determining prices and monetary aggregates. Furthermore, the emergence of the equilibrium models, supply-side models, disequilibrium models, and bargaining models may, to some extent, be seen as an attempt to relax the restrictive assumptions of the income-expenditure models on demand-dominance and determination of prices. Consequently, modern KK models feature endogenous money supply and wages with explicit treatment of the open economy and the supply side of the macroeconomy.

Notable modifications to the original Keynes (1936) macroanalytical model include: Klein (1946), Tobin (1956), Phillips (1958), Ando and Modigliani (1963), and Jorgenos (1967). The modifications attempted to draw on new empirical insights and alternative theoretical arguments including those drawn from the neo-classical theories on the labour market, government operations, financial markets, and their general equilibrium model of product markets.

Klein's (1946) contributions to Keynes's model include the introduction of non-linear relationships, inclusion of dynamic terms in both the exogenous and the endogenous variables and emphasis on the stochastic rather than the deterministic nature of relationships. Others tried to base the specification of macro-functions on sound microeconomic arguments. Tobin (1956) showed the consistency of the upward-sloping LM curve with the individual maximization of financial portfolios. Ando and Modigliani (1963) showed the consistency of maximizing life-time consumption by individual households with an aggregate consumption function. Jorgensen (1967) also showed the possibility of determining aggregate investment behaviour by analyzing the behaviour of individual firms. Phillips (1958) proposed a relationship between unemployment and money wages which was later modified by Lipsey (1960) and Samuelson and Shaw (1960) to represent a direct relationship between output and price inflation. The Phillips curve was then augmented by including adaptive expectations and was used in the debate of how to explain inflation within the Keynesian framework.

In spite of all the modifications and adaptations of new ideas, the KK models are still demand-driven models where aggregate supply is assumed to adjust to aggregate demand. Their major policy prescription tends to support an active role of government in the stimulation of stable economic growth by varying its own expenditure and monetary policy. Aided by the assumption of adaptive expectations, these policy instruments can be used to achieve some predetermined macro-economic targets because they serve to offset variations in private sector spending, mobilize idle resources, and to inject new money into the economy.

4.1.2 Muth-Sargent (MS) Models

The models in this category tend to adhere to the neo-classical equilibrium theory, emphasizing the supply side of the economy (Al-Meshal 1996). Equilibrium models assume that prices are set so that markets clear continuously. While recognising the deviation of actual from equilibrium values, they see it as a temporary phenomenon, postulating a quick convergence of the two. Although the continuous-market-clearing assumption may be seen as an extreme, this approach offers sound theoretical foundations for price determination. The term 'supply-side' is generally taken to mean that the supply side of the market has some important influence in the determination of the quantities actually traded. In practice this often means that an unusually large role is played by relative price effects in expenditure equations, without the model being explicitly formed in terms of supply and demand functions with full market-clearing (see Hall and Henry 1988).

Another important factor which distinguishes these models from the Keynesian models is the introduction of rational expectations into structural equations. The rational expectation hypothesis was proposed by Muth (1961) where he stated that expectations depend especially on the structure of the relevant system describing the economy because, as informed predictions, they are essentially the same as the relevant system describing the economy.

The idea represented an important improvement on macroeconomic modelling because it enables agents to react to up-to-date relevant information in the macroeconomic environment in an optimal manner. On this basis the case for interventionist policy (suggested by the adaptive expectations models) is seriously weakened, because with the complete integration of expectations into agents' behaviour, the later is affected by all available information and the implications of such information for future periods. Secondly, the rational expectations hypothesis takes the basic assertion of rationality in microeconomic theory one step further towards macro-rationality by stating that individuals in the aggregate act in a regular manner as if each was a typical individual following a systematic decision-making process by utilizing information efficiently in forming expectations about future outcomes (see Minford 1992, Holden et al 1985).

A decade after the publication of Muth (1961), the rational expectations hypothesis triggered a revolution in macroeconomic modelling. Notable among the earlier works is Sargent (1976) who made a serious attempt to incorporate rational expectations in his macroeconomic model. This work and the advances in electronic computing resulted in the so-called 'rational expectation revolution' in which rational expectations models such as the Liverpool model (Minford et al 1984) were widely published.

One of the criticisms against the rational expectations approach is based on the cost and benefits of gathering and processing information. It is argued that its information assumptions are too stringent for the hypothesis to be literally true. In applying rational expectations in macroeconomic modelling therefore, it is presumed that agents have access at a relatively low-cost to the relevant information. Public forecasts and time-series methods are also suggested as low-cost methods of forecasting (see Holden et al 1985).

Another criticism is based on the Lucas (1976) critique which states that under a regime of alternative economic policies, the estimated coefficients which reflect the existing rules and behavioural relationships in the economic system are subject to change. Some of the suggestions to overcome this problem include the imposition of many theoretical restrictions on the structural parameters (Hansen and Sargent 1980) and by solving the model forward in time and treating the results as expected ones (Minford and Peel 1983). None of these procedures claims to completely overcome the problem. In spite of the world-wide acceptance of the Lucas critique, however, rational macroeconometric modelling is still widespread, probably because its deficiencies are believed to be less than those of alternatives.

4.1.3 The Phillips-Bergstrom (PB) Models

The distinguishing criterion of these models is the method of estimating the parameters of continuous models; otherwise their theoretical insights can be traced to the Keynesian and/or neo-classical growth-models. The idea is due to Phillips (1954, 1957) which emphasizes the importance of the dynamics that lead from one equilibrium to another during the adjustment process. Bergstrom (1967) suggested an estimation technique which enables the derivation of forecasts of continuous paths from discrete observations. The adjustment process in these models can be instantaneous or gradual, depending on whether the econometric model is specified as a system of differential equations or difference equations respectively. The need to recognize time-paths of target variables arises from the fact that agents continuously react to deviations of variables from their equilibrium position, and this may affect adjustment periods and/or the eventual equilibrium position of the target variable.

4.1.4 The Walras-Johansen (WJ) and Walras-Leontief (WL) Models

These are models which emphasize the interactions and optimal resource allocations between the different sectors of the economy on the basis of the microeconomic theory of maximizing profit and utility by firms and consumers respectively. They are based on Walras (1954) who views the economy as a set of competitive and interdependent markets which arrive at a state of market-clearing equilibrium through the interaction of profit-maximizing producers and utility-maximizing consumers; with the overall result being optimal allocation and full employment of resources in the sense of Pareto-optimality. Consequently, the Walrasian general economic theory states that, given information on endowments, factor supplies, techniques of gathering and processing of information, preferences and tastes of economic decision-makers, the structure of the economy is best described by a simultaneous-equations system.

Johansen (1960) applied the basic ideas of the Walrasian general equilibrium theory to macroeconomic planning and forecasting by building a Multi-Sectoral Growth Model of the Norwegian economy. Contemporary versions of the model include Rattso and Torvik (1994) Davies, Rattso and Torvik (1994). They are used to outline future growth patterns over a long period of time, to analyze issues of economic structures and income distribution, and to coordinate the development and policy issues of different sectors of the economy.

Leontief (1941) built an input-output version of the Walrasian general equilibrium model. The model provides technical coefficients which link the production process of each sector with the supply of intermediate inputs from the different sectors of the economy and with the market for final demand of its products by consumers. The input-output model provides a useful way of tracking the flow of goods and services between the different sectors of the economy, and provided the technical coefficients are periodically adjusted, it can be used to forecast and plan future development patterns of an economy.

4.2 Macroeconomic Models in LDCs

There are a number of macroeconomic models built by both LDCs and the international financiers of the Structural Adjustment Programs (SAPs) in order to assess borrowing needs and to ascertain the implications of policy prescriptions and conditionalities on major economic variables. In this section therefore we will review the distinguishing features of growth models, the IMF model, the World Bank model, and the models of the McKinnon-Shaw tradition. Some of the recent innovations in the applications of these models to LDCs will also be discussed.

However, the fact that most multi-equation models of LDCs are specified as IS-LM framework with some supply-side modifications, makes labelling on the basis of the categories discussed in section 4.1 very difficult. The classifications below, therefore, are based mainly on the purpose of the model and its prominent variables/sectors. All growth models for example target the capital-output ratio as a key determinant of economic growth. However, they tend to show the Keynesian-Classical divide in the institutions and policy variables advocated to mobilize investable resources necessary to maintain the desired level of capital-output ratio. On balance the IMF, World Bank, and McKinnon-Shaw models tend towards the classical school, whilst they differ in their emphasis/purpose which is respectively the promotion of international trade, international investment, and the effect of financial repression on a developing economy.

4.2.1 Growth models

Key contributors in the evolution of these models include Harrod (1939), Domar (1947), Lewis (1954), Solow (1956), and Kaldor (1979). Given the overlapping of the theories underlying these models, it is difficult to apply strict classifications in terms of the categories discussed in section 4.1. In general, however, it is possible to conclude that the policy implications of the Solow-Lewis models tend towards the neo-classical school, while Kaldorian models have more of the Keynesian economic outlook. It is also important to note that both sides share (and even are inspired by) the basic principles of the Harrod-Domar model.

4.2.1.1 Harrod-Domar Model

The Harrod-Domar Model is one of the earliest models used for LDCs and is based on theories of growth and capital accumulation. The model is basically a relationship between savings-investment and the rate of economic growth. It attempts mainly to determine by how much national income has to grow in order to induce sufficient investment to sustain a given rate of growth of income.

The model is based on assumptions that are too restrictive to apply it to a modern economy. The dynamic structure of the model is unstable because any unwarranted departure of growth from its natural path leads to farther departures on the same direction. This is because producers are assumed as slow learners from past errors and this prevents their ability to react correctly to the divergence between warranted and actual growth. Secondly the model assumes instantaneous production of capital goods to support growth of output. A further problem of the model is its assumption of fixed capital-labour ratio which rules out adjustments in response of the relative abundance of labour and capital inputs and technological advances (Nafziger 1997).

Models of this type lack an insight into the structural and institutional arrangement of the economy and would be more appropriate for an economy which has already accumulated capital rather than those which need kick-starting in the process of growth. Their wide use in the early post-independence period of LDCs can be attributed to the absence of detailed information at that time rather than their ability to explain the causes and consequences of the behaviour of agents and institutions within the macroeconomy. These models were later adapted to an open-economy framework by including foreign capital to bridge the gap between domestic savings and investment (see the World Bank model).

4.2.1.2 Solow - Lewis Models

Solow's neo-classical theory of growth (for which he won the Nobel Prize) used the Cobb-Douglas production function to formalize the role of labour and capital inputs in economic growth. The basic assumptions of the model are flexible wages and interest rates, cross-substitution between labour and capital, variable factor proportion, and flexible prices. On the basis of these assumptions he envisaged a stable growth path sustained by relatively cheap labour in times of high interest rate and by relatively cheap capital in times of high wages. Solow's model, therefore, agrees with the Harrod-Domar model in acknowledging the importance of savings and capital formation for economic development, but departs from it by easing the stranglehold of capital formation on the processes of economic growth via factor substitution and flexible prices. Later versions of this model tried to accommodate the implications of technological changes on the labour-capital ratio in the world of imperfect competition. The neo-classical analysis has been applied by the Bretton Woods institutions (i.e., the IMF and World Bank) and the USA in their policy-based lending to LDCs (Nafziger 1997).

Another influential work in the literature of economic growth of LDCs that incorporated the implications of the neo-classical model was Lewis (1954). For Lewis growth in LDCs gets started by capitalist accumulation. He assumes zero savings in the subsistence sector and thus the industrial sector is the engine of growth. The fuel for this engine is capitalist profit which, in LDCs, comes by employing cheap labour from the unlimited supply of surplus farm labour. The open-economy adaptations of the Lewis model envisages the transformation of a subsistence economy into an industrial society through interactions with foreign capitalists lured to the region by its comparative advantages (James 1996). Similar argument is used by Degefe (1992) in modelling the relationship between the Ethiopian foreign debt and economic growth (see section 4.3.3)

Critics question Lewis's premises of zero marginal productivity of surplus farm labour and hence its availability at fixed wages over time (Leeson 1979). Lewis's theory draws heavily on the history of western industrialization. However, the logic that farm labour can migrate to the industrial economy without reducing agricultural output and/or increasing wage levels fails to accord with the processes of contemporary developments. Rural-urban migration in post-colonial Africa has increased the urban subsistence economy and the neglect of agriculture has exposed these countries to severe food crises. In a world of imperfect competition and rapid technological change it is also possible to envisage a rise in industrial wages even in the presence of surplus rural labour, as the Japanese experience indicates (Nafziger 1997). Even recent versions of the Lewis model start to underplay the role of surplus labour by suggesting technical progress in LDCs, access to markets, and the terms of trade as the key determinants of growth (Adachi 1996).

4.2.1.3 Kaldorian models

Kaldor's contribution to the analysis of economic growth was inspired by the Harrod-Domar models and so the savings-investment relationship is central to the Kaldorian growth models. However, he had difficulties with the classical assumptions which he rejected to emphasize the role of government in planning growth and stability of output. Such policy prescription is consistent with Kaldor's conviction on the basic correctness of Keynesian macroeconomics, and the irrelevance of perfect competition (King 1994).

In his effort to bridge the gap between economic theory and policy, Kaldor adopted a pragmatic approach in the structure and emphasis of his model. The 1950s-60s versions were elaborate formal models of steady-state growth in a one-sector economy. By the mid-1960s his emphasis had shifted to a multi-sectoral economy where the relationship between agriculture, manufacturing and service industries was modelled as a key to understanding the process of growth (Thirlwall 1986). Towards the end of his life he was emphasizing the world economy and the critical importance of export demand and the stabilization of commodity prices to growth (Thirlwall 1986, Pasinetti 1983).

Latest versions of Kaldorian models borrow Lewis's idea of the importance of intersectoral capital flows as engines of growth while still emphasizing the role of government in facilitating flow of capital and stabilizing growth (Dutt 1996). However, unlike Lewis where subsistence wages determined profits and investment, the Kaldorian multi-sectoral model treats investment as exogenously determined by the investment decisions of capitalists.

Although it is possible to see the incorporation of Kaldor's views in models of LDCs such as the Ethiopian model discussed in section 4.3.2, Kaldorian models are less influential in academic and policy circles. As Thirlwall (1992) found out, there is even a tendency to see them as a version of Lewis's classical model. Observers attribute such apparent unpopularity and misunderstanding of the models to Kaldor's inability (or unwillingness) to write systematic treatises, as well as to the fluidity of his ideas in the classical-Keynesian-Marxist spectrum of economic thought. He rejected both general equilibrium theory and Marxism, attacked Keynes for the treatment of money supply as exogenous and for neglecting increasing returns, and criticized the retreat of the post-Keynesians on full employment. Such unorthodox views and his personal character contributed to his isolation, thereby diminishing his influence on post-war economic policies (Pasinetti 1983, Harcourt 1988).

4.2.2 IMF-models

These models are focused mainly on the aggregate demand side of the economy with particular emphasis on the impact of balance of payments and domestic credit on aggregate demand. Using the monetary approach to the balance of payments under a fixed exchange rate system the models assume that the monetary authority can control money supply through net domestic credit, and they thus emphasize the role of domestic credit in managing aggregate demand and the balance of payments (Khan and Montiel, 1989).

The supply of domestic credit is modelled to have a positive impact on aggregate expenditure and a negative impact on balance of payments via its impact on the demand for imports. Simulations by these models are consistent with the IMF's objective as a facilitator of international trade. They focus on domestic credit and official exchange rate as policy instruments with targets being real output, money supply, inflation, foreign exchange reserves, external debt and balance of payments.

4.2.3 World Bank models

As a leading development bank, the World Bank's major task is to find foreign resources to finance investment projects geared towards raising economic growth and standards of living of populations in the long-run. The WB models can therefore be seen as the open-economy versions of the Harrod-Domar models (Burton 1955, Degefe 1992, pp. 8-9). The modifications are based on the fact that a developing economy (which in most cases is at a subsistence level) cannot generate the capital accumulation to kick-start and sustain the much-needed economic growth. The gap between domestic savings and desired level of investment should therefore be filled from surplus capital accumulated abroad. Secondly, the model emphasizes the importance of technological transfer and intermediate inputs from the developed to the developing world. In other words, domestic savings and capital transfers are not perfect substitutes and therefore lack of foreign exchange represents a major bottle-neck constraining economic growth in LDCs.

The WB model-type is formulated mainly to act as an accounting framework (or a planning model) geared towards estimating the levels of investment, imports and external finance that are required to achieve some targeted growth rate of real GDP. The model has been revised periodically to accommodate the changes in the structures of the developing world which required changes in the emphasis of the World Bank's activities. The 1973 version known as the Revised Minimum Standard Model (RMSM) was a modification aimed at (i) providing a useful insight into the long-term future perspective of a country, (ii) separating aggregate imports between consumer and capital goods, and (iii) including a balance of payments section that caters for exports, imports, interest on foreign debt, and long-term capital inflows. Further extensions to RMSM i.e. RMSM-X and RMSM-XX were done in the 1980s to accommodate the bank's increased interest in formulating macroeconomic policy prescriptions for developing countries. These new versions still retained the financial programming aspects, as well as coming closer to macroeconomic models by allowing the specification and econometric estimation of some behavioural functions, and permitting simulations of various policy scenarios. Such change in the functions of the World Bank led to convergence between the IMF and World Bank models as seen in the Bank-Fund (BF) models. While still emphasizing the saving-investment-growth relationship of the Harrod-Domar argument, the BF models try to provide an integrated framework for the supply and demand sides of the economy that links government policies and foreign resources to a specified macroeconomic objective (for more details see Khan et al, 1986, Khan and Montiel, 1989, Degefe 1992).

4.2.4 Models of the McKinnon-Shaw tradition

These models were inspired by the works of McKinnon (1973) and Shaw (1973) who attributed the poor performance of investment and growth in LDCs to financial repression. They identified interest rate ceilings, high reserve ratios, credit rationing, and inflation tax as the main instruments used by many LDCs to satisfy their inter-temporal budget constraint. Administratively-fixed nominal interest rates hold the real rates below their market-clearing level, thereby leading to (i) low savings, (ii) increase in low-yielding direct investment instead of lending via banks, (iii) more use of the non-price rationing of loanable funds, (iv) decline in the overall level of investment, and (iv) qualitative deterioration in investment due to moral hazard and adverse selection.

The policy prescription was liberalization of financial markets in order to minimize the repression tax by raising the rate of interest to market-clearing level in order to increase savings and thereby investment and output growth. The models, therefore, tried to formalize and provide empirical support to such causal relationships between saving, investment and growth. The IMF was one of the first major institutions to incorporate these prescriptions into its structural adjustment programmes in LDCs. For critical appraisal of the case for and against the McKinnon-Shaw thesis see Fry (1997), Singh (1997), and Arestis and Demetriades (1997).

4.2.5 Some innovative applications of models to developing economies

If one is to use a macroeconomic model essentially designed for a western economy and/or inspired by the history of western industrialization, creativity and innovation is needed in selecting its adaptable features without hesitating to discard the parts which cannot be usefully adapted to or indigenized into the most enduring values of agents, institutions, and structures of the relevant economy. It is therefore, important not to lose sight of the fact that models are built on the basis of certain assumptions about the structure of the economy and the behaviour of agents operating within the economic system. Economic structures differ between developed and developing countries and even within the developing world. The impact of the 1973 and 1979 oil crises, for example, led to economic boom in the oil-exporting LDCs whilst the rest of the LDCs suffered from mounting external debt and deteriorating terms of trade which all resulted in unmanageable trade deficits. Some LDCs have been politically stable, while others experienced civil wars and revolutions.

Prior understanding of the economic structure is, therefore, fundamental in macroeconomic modelling because serious mistakes in such assumptions would render the model irrelevant. In other words, if applied as they are, the models presented above may not function satisfactorily in a developing economy. But this does not mean that these models cannot be modified to explain the economic structure and simulate macroeconomic policy. Notable examples in this respect include: the attempts to include rational expectations in macroeconomic models (Montiel et al 1993), and the use of cointegration and ECM in single-sector estimation (Adam 1991), (Tariq 1996) and small macro-model (Atingi-Ego 1996).

Given that government expenditure has significantly increased in post-independence LDCs, the demand-driven models of the Keynesian tradition can be applied to analyze whether government expenditure crowds-in/out the level of private expenditure, to examine its relationship with income via the multiplier and accelerator principles, and to evaluate its impact on external trade and thereby the current account. However, it is worth noting that the Keynesian framework must be augmented with some built-in structural factors that are relevant to developing economies. It is a model that advocates raising effective demand to avoid economic recession caused by excess supply, while the situation in developing economies is such that domestic absorption exceeds output and consequently, the current account becomes negative. In other words, the problem of developing economies is basically that of (a) supply (or capacity) constraints caused by factors such as the shortage of capital and of imported intermediate goods, and (b) backward technology which limits their short-run flexibility to adjust to changing aggregate demand conditions.

Such deficiencies in the demand-driven models, therefore, suggest the need for a detailed disaggregation of the supply side of the economy. Some significant attempts have been made in this direction, mainly by modelling the external sector in detail in order to highlight the supply-constrained nature of the economy. Lipumba *et al* (1988) constructed a supply-constrained macroeconomic model for Tanzania where exports and foreign exchange receipts are the major determinants of the capacity to import and thereby of the production of non-agricultural output which is heavily dependent on imported inputs.

Extensions to the Walrasian models have been applied in the context of developing economies and these are mainly in the form of Computable General Equilibrium (CGE) models. Davies *et al* (1994) for example used a five-sector CGE model for Zimbabwe and found agricultural shocks and import-compression policies as the major causes in the variation and stagnation of economic growth. The Leontief input-output analysis has not to date attracted much application in developing countries mainly because of the difficulties associated with the estimation of the technical coefficients matrix. The few published works in this area include Oshikoya (1990) who used an integrated input-output and macroeconomic model to analyze the growth prospects of the Nigerian economy. The study tried to bring the treatment of the underlying determinants of demand and income in macroeconomic models into combination with the detailed systematic treatment of inter-sectoral flows of goods and services, made possible by input-output models. He estimated the model on the basis of annual data for the period 1962-84 and used it to predict an average of 4.5% over the period 1984-2000. On the structural adjustment, the study acknowledged the importance of oil exports in the medium-term future but recommended a shift of emphasis in favour of the agricultural sector to ensure a higher and more sustainable development in the long-run.

4.3 Previous economic models from Ethiopian economy

Macroeconomic modelling is not a well-researched area for the Ethiopian economy. Earlier works were limited to a general description of the economy and an estimation of correlation coefficients between variables (see Love, 1985). Single behavioural equations were estimated for some sectors of the economy such exports by Tegene (1989). The first macroeconomic model (i.e., multi-equation system) was specified by Kidane and Kocklaeuner (1985) followed by the works of Tsegaye (1987), Degefe (1992) and Nega (1994). These macro-models will be reviewed in this section so that the model that will be estimated in this study can be put in to the context of the literature on Ethiopian macroeconomic modelling.

4.3.1 Kidane and Kocklaeuner (1985)

Kidane and Kocklaeuner (1985) is the first real attempt to build a macroeconomic model of Ethiopia with the objective of forecasting Ethiopia's future growth-paths.[2] The model attempted to present a relatively disaggregated set of equations to arrive at a rather conventional identity that equates the financing of the saving-investment and trade gaps by the inflow of foreign capital net of debt servicing cost.

The model can be summarised as a standard aggregate income identity (i.e., the IS curve) with output disaggregated on the basis of the supplying sectors and the markets to which they are sold. In this respect, the absence of the monetary sector can be seen as a main weakness of the model. This is because variables such as interest rate, price, and exchange rate are closely related to the supply of and demand for broad money, as well as being key determinants of aggregate demand, investment and growth.

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[2]We were unable to find the full text of the model. Consequently, our understanding of the model is based on inspection of the equations of the model (Götz, 1995) and comments made by Tsegaye (1987). It has eight identities explained by nineteen equations, but the documents do not indicate the sample period. Given the data available at that period, the model is likely to have been based on annual data of the 1960s to early 1980s.

The model was also criticised by Tsegaye (1987) for failing to provide a coherent theoretical justification for the specification of the equations. Although Tsegaye did not justify it, to an extent the criticism is valid. The specification combines static and dynamic variables in a rather random fashion and key variables are missing in some of the equations. On the latter point, it is likely that the researchers may not have found the relevant data or the variable may have failed the statistical tests in the estimation process. Our criticism should therefore be seen in the context of the importance of acknowledging the relevance of the variables at least in the theoretical specification of the model.

An important aspect of the model is its attempt to disaggregate supply into agriculture, other commodities, construction, and other services, and estimate a separate equation for each. Labour, land, rain, and capital are modelled as key determinants of supply. The specification of agricultural output as a function of land, labour, and rain has some deficiencies in its emphasis. Following Lewis's surplus labour arguments and the reality of the huge unemployment pool in Ethiopia, one may tend to give less emphasis to labour as a constraint in agricultural production (Degefe 1992). Exclusion of capital input from the determinants of agricultural output is therefore, a strong assumption given importance of industrial tools and the concerted effort of successive government to introduce mechanisation, fertiliser and other modern production practices to the Ethiopian agricultural sector. Secondly, the functions for the supply of construction and other services are more of a technical relationship expressing these two components of aggregate supply as a proportion of agricultural output and other commodities. Thirdly, the supply side of the model would have been more comprehensive if it acknowledged the importance of imported inputs or its determinants such as foreign exchange reserves. Finally, there is no mention of prices (domestic or foreign) in the supply equations; surely, producers respond to the actual and expected level of prices.

On the demand side the model has a set of quite detailed and interesting equations. These include the specification of two consumption functions (private and public); three investment functions (agriculture, other commodities, construction, and services); two export functions (coffee and other exports); five import functions (capital, intermediate, fuel, services and consumption goods), and two savings functions (private and public). Such attempt to disaggregate the demand side may help to highlight the important determinants of growth in

Ethiopia and guide policy in accordance with the relative elasticity of each. However, it is doubtful whether the quality and quantity of the available data can yield a theoretically and statistically sound model. The time-series data we found on some key variables of the model are too poor (in quantity and quality) to warrant the estimation of a dynamic model and the researchers did not indicate the sources of the data.

Even with sufficient data, the theoretical specification of the equations have some shortcomings. In the specification of the consumption functions, for example, no attempt is made to cater for the saving/borrowing behaviour of consumers. Of course one would argue that in a low-income economy such as Ethiopia's, the current income (GDP) is the single most important determinant of private consumption and banks rarely lend to consumers. However, it is important to note that most of the time there is a section of society with surplus income that can be induced to save, and informal financial institutions extend loans to private consumers. Therefore, the theoretical model should have to acknowledge these relationships and leave their significance to be tested by data in the estimation stage of the model. Secondly, the terms of trade are included in government consumption function, and not in the specification of private consumption function. The reason for this is not clear. If the reason for including the terms of trade is in recognition of the dependence of government consumption on imports then private consumption is also dependent on imported goods especially in times of domestic food crisis such as have frequently hit the economy in the past three decades. Finally, demand function for consumer goods is specified in nominal values, but price is not included as explanatory variable. Surely, consumer demand responds to price fluctuations at least in the urban economy.

Investment function is disaggregated in to four equations. In most cases the explanatory variables are relevant and theoretically justifiable. However, the disaggregation is based on the kind of production activity rather than the 'public versus private' approach adopted in the specification of consumption. The latter approach could have made the model more useful in the analysis of the crowding-in/crowding-out debate which is central in the appraisal of the economic role of governments in LDCs.

Secondly, it is not clear why the model which specified the supply and consumption functions as a static-equilibrium relationship started to include dynamics in the form of GDP at period 't' and 't-1', export at period 't-1', and loans at 't-1'. One possible explanation could be the assumption that investors form their expectations of future demand adaptively, but it is possible to model this as expected growth (ΔGDP^e) generated from an appropriate expectation model. If the intention is to indicate the dependence of current saving and investment on both current and past income, then the same line of argument must also apply to the specification of consumption functions.

Similar criticisms apply to the dynamics introduced in the form of loan and export of period 't-1'. The attempt to link domestic investment to foreign trade is, however, an important innovation. The inclusion of export as an explanatory variable may probably be justified on the basis that higher demand for exports induces firms to expand and thereby increase the demand for investment goods. Another explanation would be the relationship between exports and foreign exchange reserves, i.e., domestic investment depends on imported goods and services, and the ability to import is constrained by the level of foreign exchange reserves collected from export earnings. However, the exclusion of such variables from the function defining investment in the construction sector is inconsistent with the fact that this component of aggregate demand is even more dependent on imports than others.

The use of loans as an explanatory variable instead of interest rate seems to assume financial repression where loans are allocated to the different sectors at a subsidized rate on the basis of the government's macro- and sectoral policy. If this is the assumption then it is consistent with the policy stance especially in the post-1974 era. On this point, however, the model falls short of explicitly recognising the informal financial sectors which cater for the private investors who are rationed out of the official system.

International trade is represented in the model by two export equations and five imports equations. But none of the equations has exchange rate as explanatory variable. Given that Ethiopian exports are sold in a very competitive segment of the international market it is possible to think of the demand curve for exports as horizontal. In such a case exchange rate policy can be used to encourage the exporters and thus real effective exchange rate (REER) calculated from a weighted average of relative prices should have been included as a key determinant of competitiveness. Similarly, REER is also an important variable in the specification of import function because the supply curve for Ethiopian imports can be assumed as horizontal and exchange rate policy can be used to influence its demand in the domestic market. The fact that the Ethiopian official exchange rate was fixed for most of the last 30 years cannot be used as an excuse for the absence of REER in the export and import functions. Such policy of financial repression does not immunize the domestic economy from the international currency fluctuations but merely shifts the route of the impact to the informal market. In such a situation, therefore, the informal rate of exchange must be included in both export and import functions. The absence of real effective exchange rate and informal exchange rate can be seen as the main shortcomings of these equations.

The model tends to assume that Ethiopian non-coffee exports are a function of income of her trade partners, but it is not clear why the same variable has not been used as an explanatory variable in the function for coffee exports. Similar inconsistencies can be observed in the inclusion of domestic consumption of exportables in the function for non-coffee exports, and the absence of domestic coffee consumption in the function for coffee exports. Both coffee and non-coffee exports are demanded and consumed in the domestic market. If such domestic demand is accepted as explanatory variable for non-coffee exports it is difficult to argue against similar specification in the function for coffee exports.

The disaggregation of the imports function into five equations seems to have added unnecessary complication to the model. The functions for imported investment and imported consumer goods are specified as functions of aggregate investment and aggregate consumption in the domestic economy. Following similar logic, therefore, one can expect imported intermediate goods and fuel to be determined by their respective demand in the domestic economy. The use of aggregate income instead of domestic demand for intermediate goods and fuel, therefore, needs better explaining. It is also not clear how a separate equation for imported services defined as a function of only the four categories of imports would enhance the explanatory power of the model. In short, the model pioneered an interesting specification of the output sector of the Ethiopian economy. The disaggregation of the sectors and sub-sectors, however, added unnecessary complication and inconsistencies (see section 4.3.4).

4.3.2 Tsegaye (1987)

Tsegaye (1987) specified quite a detailed set of equations with the objective of analyzing the impact of export instability on the country's economic development. The model uses annual data of 1961-80, and has nine identities and fourteen behavioural equations representing the production, consumption, investment, government and foreign trade sectors. The discussion here will be briefer because the general structure of the model is similar to Kidane and Kocklaeuner (1985) and it is difficult to see significant improvement on theoretical coherence claimed by Tsegaye (1987).

Like its predecessor, this model ignores the monetary sector and jumps between level and difference variables and between static and dynamic specifications without giving the theoretical justifications. The model fails to justify the level of disaggregation and the inclusion of the same variable in different forms in the equations. Aggregate imports and aggregate exports are, for example, included as explanatory variables for industrial production. In the specification of the production function for services, however, imports and exports are added together to be included in the list of explanatory variables as foreign trade. Since the only difference in the specification of the functions for industrial production and service production is the treatment of trade as total vis-à-vis splitting it in to imports and exports, then one can envisage merging the equations and making the model more manageable. Following similar logic it is possible to merge the three equations for imports into one.

The main improvement of the model over its predecessor is on the statistical procedure followed in estimating and testing the goodness-of-fit of the model as a system and the use of such system of equations to analyze the impact of sectoral shocks on the macroeconomy. The absence of policy instruments such as interest rate, exchange rate, and money supply, however, restricts the usefulness of the model in simulations and evaluation of macroeconomic policies. The objective of model is to analyze the impact of instability in export earnings on the macroeconomy, but it does not attempt to calculate and include REER.

4.3.3 Other smaller models

Degefe (1992) presents an accounting framework (not a regression analysis) that links Ethiopian economic growth to foreign debt. The reduced-form equation is derived from Taylor, (1985). It determines the level of exports, transfer payments, imports (i.e., capital, intermediate inputs and consumer goods), foreign debt, and output-capital ratio required to secure a desired level of economic growth. The empirical analysis uses annual data for 1964-86.

The model displays the typical characteristics of an open-economy version of the growth models with incremental capital output ratio (ICOR) defining the technology and inflow of foreign savings to fill the gap between domestic saving and panned investment. An interesting assumption of the model is the exclusion of labour from the constraints of aggregate output and growth of the Ethiopian economy. In line with Lewis's surplus labour argument (see section 4.2.1.2) he assumes an elastic supply of unskilled labour. Furthermore, he refers to the fact that all managerial, technical and administrative post are held by Ethiopians to justify an elastic supply of skilled labour for Ethiopia. Consequently, only capital stock and intermediate imports are specified as constraints to the Ethiopian economic growth.

Finally, Nega (1994) employed a structuralist macroeconomic model of the 'open peripheral socialist economy' (OPSE) to evaluate the effectiveness of a socialist development strategy in delivering on the twin goals of high investment and equitable income distribution. The model has five equations estimated using 1965-85 annual data and linked by an identity. Nega used the model to simulate the impact of government intervention in setting prices of agricultural products and state-produced manufactures. His results suggest that (a) lowering the prices of agricultural products leads to dependence on imported food, lower investment and unfavourable income distribution to both workers and peasants; (b) increasing agricultural prices may enhance accumulation and peasant income only at the expense of urban dwellers; (c) provided the government restrains its consumption, a policy of lower mark-up on state-produced manufactures can increase the real income of peasants and workers without hurting investable surpluses. The paper concludes by stating that investments are mainly determined by the international capitalist market over which an OPSE has no control. Given the replacement of Marxist development strategy by the current reforms towards a free-market system, however, the analysis is more of "historical interest" rather than an instrument of "active policy debate" in post-cold war Ethiopia (Nega 1994, p. 69).

4.3.4 Room for improvement

The model of Kidane and Kocklaeuner (1985) was good for its time and should be commended as a pioneer in the Ethiopian macroeconomic literature. It is also the only published model listed in the Ube (1995) edition of 'World of Economic Models'. Nonetheless, the model has serious shortcomings which are also reflected in Tsegaye (1987). The latter model should be credited for demonstrating the use of macro-models to conduct simulations and measure the magnitude of the impact of sectoral shocks to the overall economy. The notion of using foreign finance as a constraint on the supply side of the economy in Degefe (1992) is a useful suggestion. Nega (1994) however, tends to exaggerate the ability of government in controlling and administering the price system. As we have seen in chapter three, agents are likely to frustrate such repressive policies by shifting their activities to the informal sector.

This study will try to build on the positive contributions of these models and present an alternative model which combines both the real and monetary sectors of the Ethiopian economy. The specification follows an adaptation of the IS-LM framework that is widely used by many African scholars (see for example Murinde 1994). However, the model will accommodate the relevant principles of the MS and BP approaches. These include: the supply-side constraint, determination of price by the 'free' interaction of supply and demand, relative prices, rational expectations, and the dynamics between equilibrium positions. The Walrasian inter-sectoral interaction could not be accommodated because the relevant data is not available. The model will be estimated using recent developments in cointegration and dynamic modelling and used for policy simulation. Its key features are presented in the next section.

4.4 The model in this study

We have seen the various classes of macroeconomic models and their application in LDCs. The main criticisms directed at the IS-LM approach are based on its being a 'demand-driven' model and on its use of aggregate variables that fail to show the intersectoral input-output interdependence. However, we have also seen that these deficiencies can be remedied by including supply-side equations in the form of foreign exchange constraints (Lipumba et. ál.

1988) or input-output relationships to the macro-model (Oshikoya 1990). The ad-hoc cost mark-up system of these models can also be modelled in such a way that prices respond to the interplay of supply and demand in both the real and monetary sectors. The rational expectations hypothesis which was usually associated with the neo-classical school can also be accommodated within the an IS-LM model for LDCs (Montiel 1993).

Furthermore, our choice of the IS-LM framework for the Ethiopian economy is consistent with the gap in the literature of macroeconomic modelling identified in section 4.3.4 The models available for the Ethiopian economy are predominantly sector-specific. The 'macro-models' that we were able to find try to analyze the goods market with little or no mention of the monetary sector, 'free' interplay of real and monetary variables to determine prices, policy implication of the informal sector, the relationships between long-run equilibrium and its short-run dynamics, or the implication of the dual structure of the economy on agents' expectations. A comprehensive IS-LM model that incorporates these attributes will, therefore, contribute to a better understanding of the Ethiopian macroeconomy.

Availability of data is another factor. Supply-side modelling such as the input-output model requires information on the technical coefficients and very detailed sectoral data. Collecting such data was beyond our means and so, we decided to build a macro-model with detailed equations for the components of aggregate expenditure and monetary variables. Nonetheless, it is important to note that our model accommodates the supply side of the macroeconomy via the link of output to investment, investment to imported inputs, imports to supply of foreign reserves, and exchange reserves to net exports. Furthermore, the model diverges from the 'mark-up pricing' approach of the neo-structuralist school (Montiel et al 1993) because the specification of our price equation follows the interactive process used in general equilibrium models, i.e., price is specified in such a way that it responds to the supply and demand in both the real and monetary sectors.

4.4.1 Alternative Procedures for model specification

A macroeconomic system is a mathematical representation of a set of markets which together describe the macro-economy. Such models tend to be detailed and comprehensive with the implicit premise that the structure of the economy cannot be sufficiently approximated by a few equations (Fair 1984). Each equation represents a particular sector or region of the economy, and is linked to the system by identities and the specification of the equation as a function of economic variables endogenous to the rest of the system and variables predetermined outside the system. A relevant question at this stage is how does one decide whether or not to include a particular variable and accept its estimated coefficient in an equation.

On this point Fair (1984) identifies three approaches: traditional, Hansen-Sargent and Sims. The traditional approach heavily relies on economic theory in determining the explanatory variables that should be included, signs and sizes of the coefficients, and to a lesser extent the length of lag distributions and functional forms of each of the equations in the model.

The Hansen-Sargent (1980) approach focuses on estimating structural parameters of the objective function for decision-making units by imposing many more theoretical restrictions than does the traditional approach. Such emphasis on theoretical purity can be seen as a way of minimizing the changes in parameters following exogenous shocks and/or shifts in policy pointed out by Lucas (1976). But the procedure is criticized for being too difficult to set up in a non-quadratic function and its restrictions on macroeconomic data may lead to misspecification of the model.

Sims (1980) on the other hand suggests less emphasis on the restrictions of economic theory, arguing instead for the specification of VAR equations where each variable is specified as a function of its own lagged values and the lagged values of other variables. Thus, the Sims approach is even less restrictive than the traditional approach.

In this chapter we follow the traditional approach. On the basis of economic theory and within the limits of the available data, all relevant variables will be identified, included in the equations, and an a-priori view will be stated on the expected sign and size of the coefficients. The variables in the final equation of the model will, however, be determined in subsequent chapters when the equations are estimated.

4.4.2 Key features of the model

In this chapter, a macroeconomic model is specified to be used in the examination of the structure of the Ethiopian economy and its fitness to anchor any future monetary union in the

Horn of Africa. To this effect, the key policy instruments, namely: public expenditure, tax, money supply, credit, interest rates and exchange rates will be modelled in the next chapter and their effectiveness will be evaluated in the simulations in chapter nine.

The coexistence of the official and informal sectors will be modelled explicitly by the inclusion of the informal rate of exchange and proxies for the informal rate of interest. The dual structure of the economy is explicitly modelled by justifying the use of adaptive expectations for the subsistence sector and rational expectations for the modern sector (see section 5.2).

The interdependence of the Ethiopian economy with the rest of the world is emphasized in the foreign-trade sector of the aggregate income identity. More specifically, the importance of imports as sources of intermediate inputs for the modern sector of the Ethiopian economy will be shown in the specification of the investment function. Later, in chapter nine, the sensitivity of the Ethiopian economy to official devaluation, fluctuations in the informal rate of exchange and external shocks (such as increases in the price levels of her trade partners) will be examined.

The role of government expenditure (as emphasized in the 'crowding-out' debate in macroeconomic textbooks) will be reflected in the specification of the model. The simulations in chapter nine will link this to the debate on regional monetary union by examining the temptation of the Ethiopian government to finance its expenditure using taxation, printing money, credit-restraint on the private sector and the sale of bonds at the free-market rate of interest.

A demand function for broad money will be specified on the basis of the traditional functions of money. It will be linked to the level of aggregate output on the basis of the transactions motive, while the rate of interest will be included to cater for the speculative motive for holding money (i.e., as an asset). The scenario of government borrowing via the banking system at the market-determined rate of interest will be considered by including a proxy for treasury bills in the specification of the demand-for-money function.

4.5 Conclusion

From the discussion so far, it is possible to see that the structures and policy scenarios of a developing economy can be analyzed within a macroeconomic framework. For such models to be valid, however, they must have sound theoretical underpinnings and be detailed enough to explain the interactions of the economic agents and institutions of a developing economy. One way of achieving such a comprehensive model is by augmenting the detailed demand-driven model with monetary and supply-side constraints.

Secondly, the models should integrate the short-run adjustment and long-run equilibrium within a dynamic framework. This has been confined mainly to single-sector equations in LDCs and needs to be applied in simulating monetary and fiscal policies using detailed macroeconomic models.

Thirdly, the modelling of expectations for countries such as Ethiopia should reflect the dual structure of a developing economy. Although the recent attempts to introduce rational expectations in macroeconomic models is commendable, it is important to recognize the difficulty in applying it beyond the elite residing in the urban enclaves. In LDCs, the vast majority of the population lives in the rural subsistence sector, with low literacy and less access to markets and information technology. The use of adaptive expectations is therefore, more appropriate for this section of the economy.

Finally, the coexistence of the formal and informal sectors is common in LDCs and has important implications for the formulation and effectiveness of monetary and fiscal policy. In spite of three decades of rural development policies and the recent financial liberalization programs, separation of the two systems has persisted. Macroeconomic models should therefore, formalize this coexistence and estimate an empirical link.

We believe these four points have not been adequately explored in the empirical modelling of LDCs. This study will therefore, focus on these points and try to contribute to the macroeconomic literature of LDCs using Ethiopian data. The next chapter specifies the theoretical model for estimation and policy simulations in subsequent chapters.

CHAPTER FIVE

THEORETICAL MACROECONOMIC MODEL

Developing economies have structural features which can not be adequately accommodated by the text-book models designed for industrialized countries. As discussed in chapters three and four, the exchange economy is limited to urban centres and exporters of primary products, while a significant portion of the GDP is produced for subsistence. The financial sector is also under-developed and geared towards serving the public sector and selected firms in the private sector. This leads to the emergence of informal markets for credit and a parallel exchange rate, possibly frustrating the government's economic policy.

The objective of this chapter is to introduce a macroeconomic model with an explicit recognition of the coexistence of the informal sector alongside the official economy. In line with the Mundel-Fleming approach the commodity structure of the economy is simplified by assuming a single domestically-produced good and an imported one. Such an IS-LM approach to modelling is discussed in many standard macroeconomic textbooks such as Parkin and Bade (1988, chapter 15). Its LDC-version is also used by the financial repression/liberalization school (Fry 1993, 1995) and is modified to link the official and informal sectors (see Montiel et al 1993).

The justifications for the modelling approach of this study, the key features of the theoretical model and its innovations vis-à-vis other models was discussed in chapter two. This chapter will specify the real and monetary sectors of the economy. Our attempt to model the supply side of the real sector has been frustrated by the lack of data on some key variables such as the level of employment and wages. Supply side constraints are therefore introduced by linking the level foreign exchange reserves to imports, and imported inputs to the level of investment in the domestic economy. The demand side of the real sector will, however, be disaggregated into its five components, while behavioural functions will be specified for private consumption, private investment, imports, exports, the informal exchange rate, and foreign exchange reserves. The monetary sector will be represented by a demand function for broad money and will be linked to the real sector. In subsequent chapters the equations of the model will be estimated and used to analyze the effectiveness of monetary authorities in influencing macro-economic outcomes in Ethiopia.

The discussion in this chapter is organized as follows: section 5.1 discusses the justification of the adaptive and rational expectations hypothesis and derives expected values of the relevant variables. In section 5.2 the equations for the demand for domestic output are specified, followed by equations for the financial sector in section 5.3. Section 5.4 specifies the price equation by linking it to both the real and monetary sectors. The chapter will be concluded in section 5.5 by listing the main behavioural equations and identities of the model.

5.1 Adaptive and rational expectations

Many of the variables in the model are dependent on expectations. These include foreign exchange rate, real interest rate, and expected growth of real output. Before proceeding to specify the equations of the model, therefore, it is important to show the mechanism through which expectations are generated in the modern and the subsistence sectors of the Ethiopian economy.

There are three expected variables in this model: expected inflation, expected growth of output, and the expected return on foreign assets. The first two are derived using the adaptive expectations procedure, while the third is based on the rational expectations hypothesis. Before proceeding to the derivation procedure, however, it is worth presenting a brief discussion on the logic underlying both expectations hypotheses.

The works of early economists such as Marshal (1887) and Shackle (1958) indicate that expectations have been at the centre of economic theory for a long time. Indeed as the study of economic decision-making, economics is concerned with how people deal with the future (which is unknowable) given the existing situation (see Minford 1992, chapter 1).

In earlier applied economics the idea of modelling expectations as endogenous variables took the form of adaptive expectations, following Nerlove (1958). Its basic hypothesis is that economic agents adapt their expectations in light of past experience, and in particular they learn from mistakes. The model involves a simple partial adjustment transformation (due to Koyck, 1954) where the current expectation ($E_t\ P_{t+1}$) is specified as the sum of the past expectation ($E_{t-1}\ P_t$) and a fraction of past expectational error $\alpha(P_t - E_{t-1}\ P_t)$, where $0 < \alpha < 1$, while P_t and E_t are respectively the price level and expectation formed at time t.

$$E_t P_{t+1} = E_{t-1} P_t + \alpha(P_t - E_{t-1} P_t) \quad \text{......} 5.1$$

This method dominated economic modelling until the mid-1970s and its performance was apparently good - although this may have been helped by the relative stability and fixed exchange rates of that period (see Hillier 1991, p.155).

The partial adjustment of the adaptive expectation model implies that the expected inflation lags behind its actual counterpart. Opponents of this approach view this as a green light to undesirable government fine-tuning of policies. Moreover it is criticized for ignoring the impact of readily available information (such as fresh announcements of government policies) on the behaviour of economic agents.

Following the work of Muth (1961) and the attack on the theoretical basis of the Phillips curve led by Phelps (1967) and Friedman (1968), therefore, rational expectations made their way into macroeconomic modelling. The rational expectations hypothesis asserts that "individuals in the aggregate act in a regular manner as if each was a typical individual following a systematic decision process ... utilizing efficiently the information available to him in forming expectations about future outcomes" (see Minford 1992, p. 3).

Following Minford (1992) a formal definition of the hypothesis can be demonstrated using the following simple rule for money supply (M_{t+1}).

$$M_{t+1} = M^p + \varepsilon_{t+1} \quad \text{......} 5.2$$

where ε is a random disturbance term. In this case we are assuming the existence of a known policy target which sets the money supply at M^p and, thus, any deviation is expected to be due to purely unpredictable events. Given the current information set (ϕ_t), therefore, the expected level of money supply for the next period is

$$\begin{aligned} E_t(M_{t+1}) &= E_t(M^p + \varepsilon_{t+1} \mid \phi_t) \\ &= M^p + E_t(\varepsilon_{t+1} \mid \phi_t) \end{aligned}$$

$= M^p$ 5.3

In other words, rational expectations are expectations formed by economic agents who use current information and their implications for the future. If such information is used in a correct model, rational expectations give a better result.

The rational expectations hypothesis is one of the major building-blocks of the new classical model. One implication of such models is that government fine-tuning policies are rejected as ineffective in the short run and adversely affecting the credibility of government policy in the long run.

As we have seen in previous chapters, this study recognizes the merits of both approaches given the wide discrepancy in information technology available to agents operating in the subsistence sector vis-à-vis those in the modern sectors of the Ethiopian economy (see section 2.5, 3.5, and, 5.1.2). Thus, expectations will be derived adaptively for prices and output while rational expectations will be applied in the foreign exchange market where better-informed agents operate.

5.1.1 EXPECTED INFLATION AND GROWTH OF OUTPUT.

Actual inflation is defined as the annual percentage change of consumer price index - which is the only price series published by the IMF for Ethiopia. Similarly, actual growth is the annual percentage change of gross domestic product (GDP). In this section the expected values of these variables will be derived as endogenous variables in the model.

Adaptive expectations are used to generate the expected values of inflation and growth of output. Such use of past information to generate expected values of a variable is justified on the basis of the structure of the economy and the information technology available to the average economic agent in Ethiopia. Since the economy is dominated by subsistence agriculture, the day-to-day fluctuations of market forces will have very little impact on the decision-making process of most citizens. The majority of economic agents lack the skills and resources needed to access the modern information technology. Even those who are literate and can afford to use the national media can hardly get sufficient information to form rational expectations of prices and output. Even the weather forecast - which is the most important factor in the investment decisions of an agrarian economy - is at a very rudimentary level. The average economic agent is, therefore, forced to rely on his past experience in generating the expected level of output and the price that is likely to prevail in the post-harvest period.

The adaptive expectation procedure followed in this study is based on Nugent and Glezakos (1979). Actual inflation and growth were calculated from the levels of the consumer price index and the GDP series published by IMF. The formula used in deriving expected inflation is

$$E_{t-1}\,\Delta P_t = \Sigma[\alpha(1-\alpha)^i\,P_{t-1-i}] \quad \ldots\ldots 5.4$$

Note that this is derived from equation 5.1 using a simple algebraic transformation. Since the model is based on annual data (with 30 observation points) agents are assumed to limit their memory to three periods. In other words, i = 0, 1, 2 and equation 5.4 becomes

$$E_{t-1}\,\Delta P_{t+1} = \alpha\,P_{t-1} + \alpha(1-\alpha)\,P_{t-2} + \alpha(1-\alpha)^2\,P_{t-3} \quad \ldots\ldots 5.5$$

Equation 5.5 was used to calculate expected inflation for various values of the partial adjustment coefficient (α) and the optimal coefficient was selected at the minimum level of forecast error using the following quadratic loss function:

$$L = \Sigma(\Delta P^e_t - \Delta P_t)^2 \quad \ldots\ldots 5.6$$

For inflation we found a 3-year adjustment coefficient, α = 0.3247 (see table 5.1 and figure 5.1). The model which generated the expected inflation (ΔP^e) is, therefore,

$$\Delta P^e_t = 0.3247\,\Delta P_{t-1} + 0.2193\,\Delta P_{t-2} + 0.1481\Delta P_{t-3} \quad \ldots\ldots 5.7$$

Figure 5.2 shows the values of actual and expected inflation. The model captures most turning-points and the general trend of inflation, although its average forecast error seems to have suffered by missing some sharp changes. Since the sum of the adjustment coefficients is 0.69, this may imply that expected inflation never catches up with a persistently upward trending actual inflation. If on the other hand the sum of the adjustment coefficients approaches to one, on can expect the forecasting error of the model to decline. Thus, the ideal result (in both equations 5.7 and 5.8) is for the sum of the coefficients to equal to 1.

One can envisage the sum approaching to 1 as i approaches infinity, but this is not practical with a sample period of 30 (annual data). Furthermore, the theoretical justification to can be week/wrong if a lag of more than three years is applied for a subsistence economy. It implies, among other things, agents who cannot read and write will have long memories (records of more than three years) upon which they base their future decisions. Thus, a 3-year lag is a reasonable choice given the size of the sample period used in this study.[1]

In the event, where prices show a large change within a short period of time one can expect agents to give very little weight to the more distant past and, consequently, they use a larger adjustment coefficient. This interpretation is consistent with the Ugandan adjustment coefficient of $\alpha = 1$ during the period when the country experienced triple-digit inflation (see Atingi-Ego 1996, p. 184). Our result can, therefore, be interpreted as an indication of the relative price stability of Ethiopia because it enables agents to make a reasonable expectation of inflation from their past experience.

The same procedure was followed for deriving expected growth of output. The forecast error for various levels of coefficient was calculated as $L = \Sigma(\Delta Y^e_t - \Delta Y_t)^2$, presented in table 5.1 and figure 5.3 below. On this basis an adjustment coefficient of $\alpha = 0.38$ was selected. The model which generated the expected output is, therefore,

$$\Delta Y^e_t = 0.38\ \Delta Y^e_{t-1} + 0.2356\ \Delta Y^e_{t-2} + 0.1461\ \Delta Y^e_{t-3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 5.8$$

The expected growth generated by equation 5.8 is presented in figure 5.4 which is more or less similar to that of expected inflation. Although, in both cases the actual are more variable

[1]Note that the actual data has 30 observation points (1964-93) and thus, yields expected inflation for 1968-93. To avoid such reduction in the sample size the data of price and output was extended to 1960-93 by assuming the annual rate of change during 1960-63 to be similar to that of 1964-67. As discussed in chapter two the 1960 was a period of relative stability and steady growth. Thus, although our assumption is done for the sake of computational convenience, it is not far from the reality of that period.

than the expected values, the deviation is smaller in growth of output vis-à-vis inflation (see table 5.1).

Table 5- 1: The L-schedule for inflation and growth of output in Ethiopia

Change in prices			Change in output	
α	$\Sigma(\Delta P^e_t - \Delta P_t)^2$		α	$\Sigma(\Delta Y^e_t - \Delta Y_t)^2$
0.1	0.32577200485		0.1	0.1338607
0.2	0.28727649086		0.2	0.1125264
0.3	0.27458005015		0.3	0.1032837
0.32	0.27416851355		0.32	0.1024535
0.322	0.27415862059		0.34	0.1018923
0.324	0.27415417095		0.36	0.1015753
0.3242	0.27415402312		**0.38**	0.1014799
0.3244	0.27415392908		0.382	0.1014817
0.3246	0.27415388877		0.384	0.1014855
0.3247	0.27415388875		0.386	0.1014913
0.32471	0.27415388948		0.388	0.1014991
0.3248	0.27415390214		0.4	0.1015855
0.4	0.27748927643		0.5	0.1045469
0.5	0.28946178501		0.6	0.1104717

Figure 5- 1: The L-curve for expected inflation (1964-93)

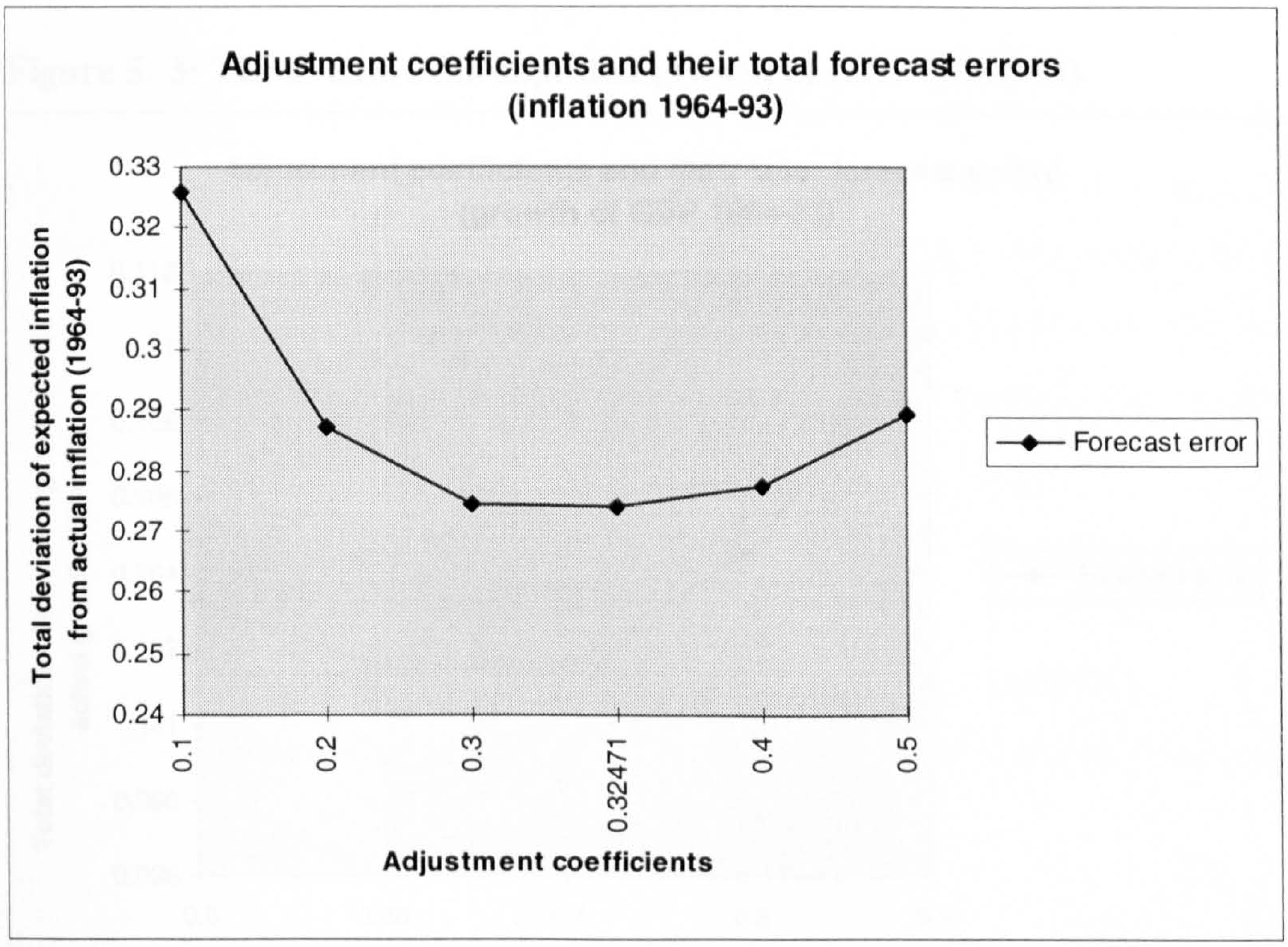


Figure 5- 2: Actual and expected inflation

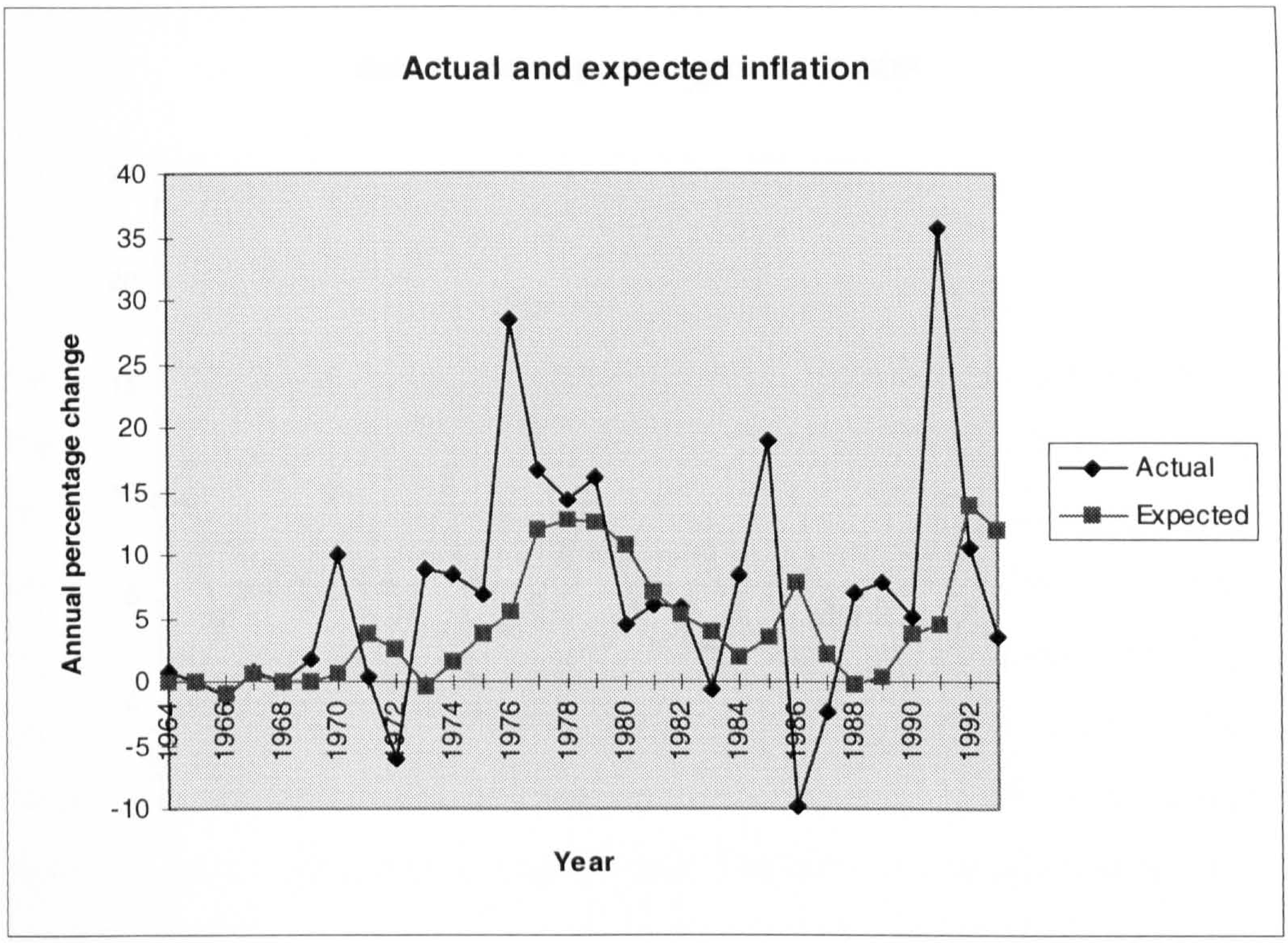


Figure 5- 3: The L-curve for expected growth of GDP (1964-93)

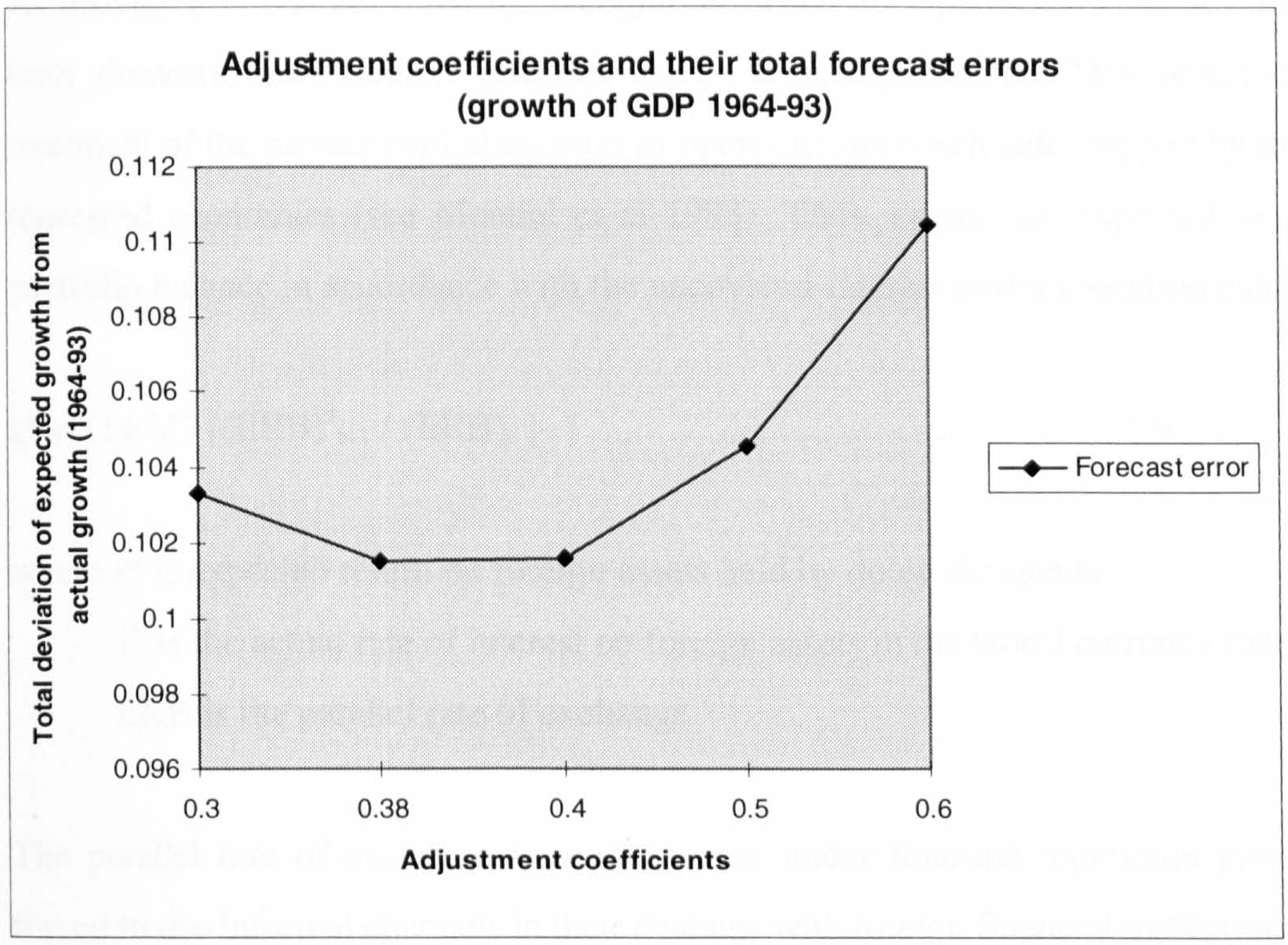
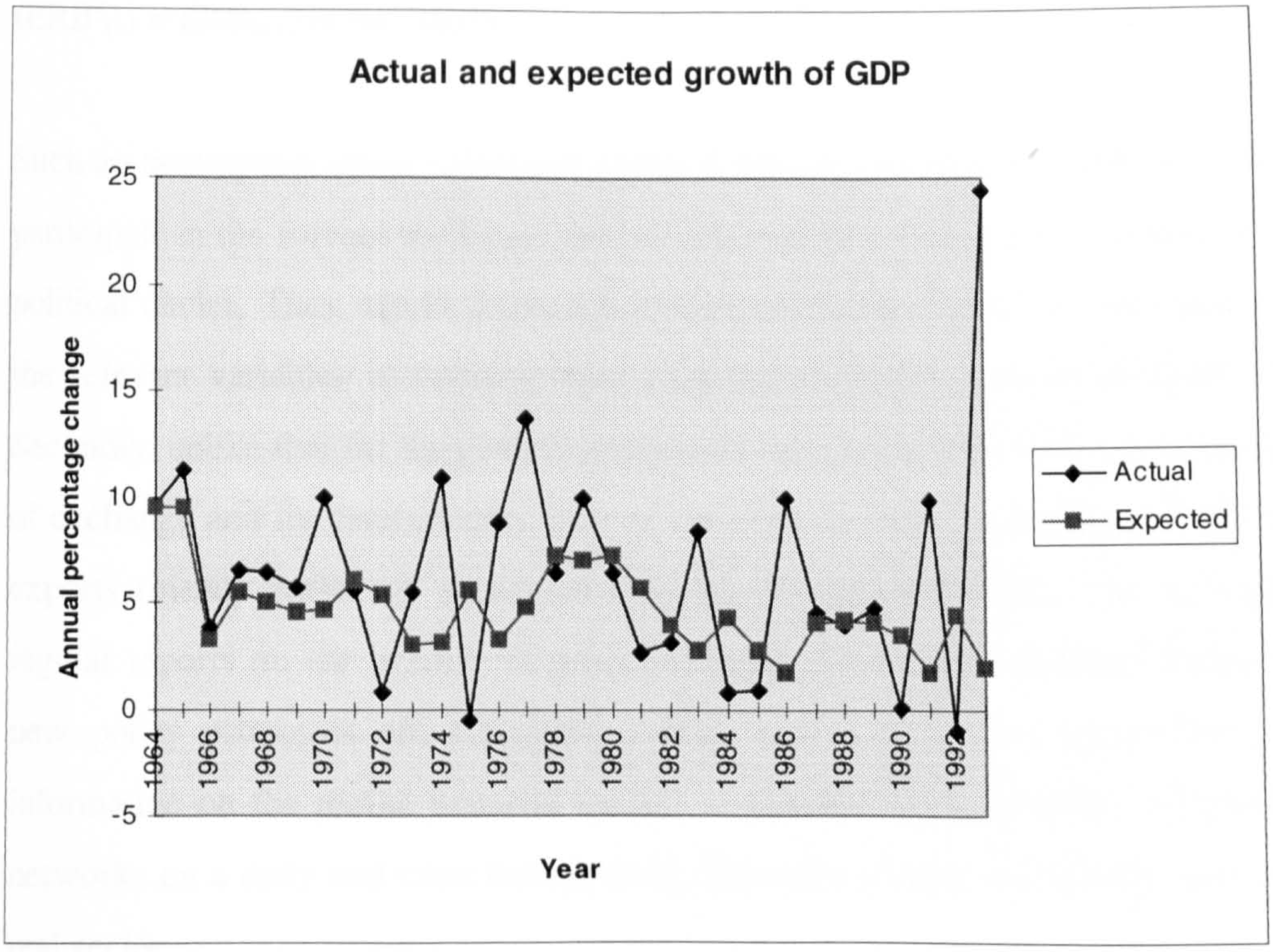


Figure 5- 4: Actual and expected growth of GDP



5.1.2 RETURNS ON FOREIGN ASSETS

As discussed in chapter three the recognition of the informal market implies that agents hold both domestic and foreign financial assets in their portfolio. This argument allows the treatment of the private capital account as open - an approach side-stepped by most studies on repressed economies (see Montiel et al 1993). Thus, agents are expected to maintain their portfolio balance in accordance with the uncovered-interest-parity condition calculated as:

$i_t^* = (1+ i_t^w)\ [(ERB)^e_{t+1} / (ERB)_t\ ]- 1$ 5.9

where i* is expected return on foreign assets held by domestic agents

i^w is the actual rate of interest on foreign assets in the world currency market

ERB is the parallel rate of exchange

The parallel rate of exchange is used because under financial repression private agents are forced to use informal channels in their dealings with foreign financial institutions. The variable "i^w" is proxied by the US Treasury Bill rate and agents are assumed to have perfect foresight of the one-period-ahead shift in the rate of exchange (see Montiel et al. 1993, p. 125). Thus, the expected rate of the informal rate of exchange will be assumed as equal to the actual ($ERB^{e}_{t+1} = ERB_{t+1}$) in this study.

Such an assumption about Ethiopian agents is not as unrealistic as it seems to be. Agents who participate in the foreign exchange market are mainly the elite of the business community and political circles. They can be expected to have sufficient access to up-to-date information on the relevant variables in forming their expectation of the one-period-ahead exchange rate. Secondly, unlike that for the general price level and output growth, the information on the rate of exchange and its determinants is more readily available. Fluctuations in the price of major exports (mainly coffee) is broadcast daily by the national media. The national banks issue regular reports on the balance of payments; and information regarding budget forecasts and new policy proposals are circulated within these circles at a reasonable speed. Finally, information on the global financial market is available from the BBC and other information networks on a daily and even hourly basis. The next section will specify the equations of the real sector.

5.2 The real sector

The IS-LM framework is followed to link the real and monetary sectors in determining the aggregate demand for goods and services in the economy. Demand for tradable goods and the foreign exchange market will be used to link the domestic economy to developments in the world market. The model assumes a small open economy with four types of domestic agents (i.e., households, government, central bank and the rest of the banking system) and foreign agents operating through the external sector. Agents are assumed to observe all the current variables and their current rate of change, but cannot necessarily predict levels of variables very far into the future. The goods market is expected to clear when output produced in the supply side of the economy is matched by an equal expenditure from the private sector consumption (C^P), private investment (I^P), government expenditure (G) and exports (X). Thus overall expenditure (EX) on domestic product can be expressed as[2]

$$EX = C^P + I^P + G + X \quad \text{......................5.10}$$

---

[2]Note that capital letters indicate nominal variables. If a variable is in real terms it will be represented by a lowercase letter or by a nominal variable deflated by the price level.

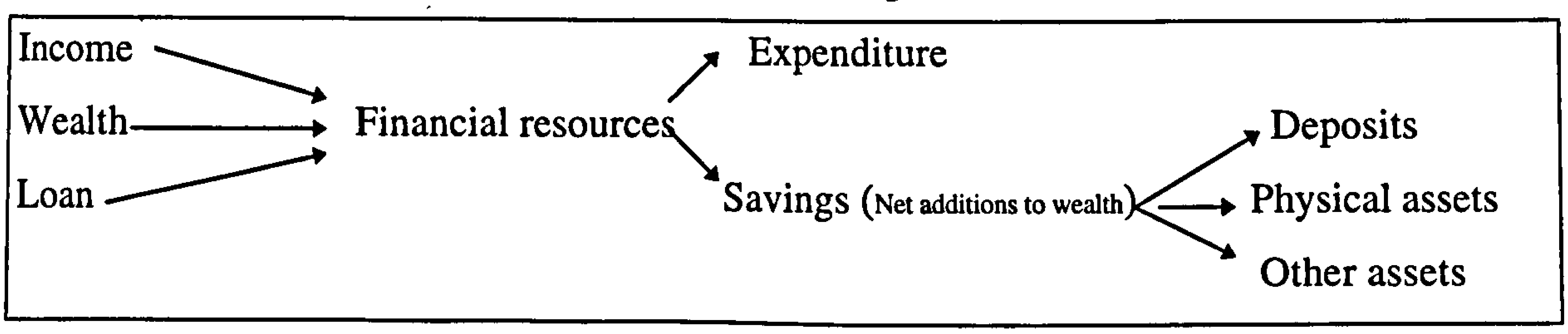
Domestic expenditure or absorption (A), however, excludes expenditure by foreigners for exports (X) while including expenditure on imported goods (IM).

$A = C^P + I^P + G + IM$ 5.11

5.2.1 Household expenditure

Following Tobin (1969) a distinction is made between the decision to *save* and the decision to *allocate savings*. Before choosing the composition of their assets, agents are expected to allocate their resources between expenditure (EX) and savings (S). It is only after determining the proportion of income to be added to their wealth that agents begin to decide on how to manage their savings by efficiently allocating them among the various assets.

Figure 5- 1: Allocation of household income and expenditure



Private sector expenditure (E^P) consists of four categories; namely expenditure on domestic consumer products (C_d), imported consumer products (C_{IM}), domestic investment goods (I_d), and imported investment goods (I_{IM})[3].

$E^P = C_d + C_{IM} + I_d + I_{IM}$ 5.12

5.2.1.1 Private consumption

As indicated in figure 5.1, households finance their expenditure and portfolio balance by their personal net worth (W^H) or by borrowing (L^P/P). The former would normally consist of real disposable income (y^d) and real wealth (W/P). Thus, household consumption expenditure can

[3]The relevant data reported in the national accounts is private consumption (C^P), government consumption (C^G), total government expenditure (G), and total investment or gross capital formation (I). From this we can split investment into government investment (I^G) and private investment (I^P) as $I^G = G - C^G$ and $I^P = I - I^G$. We can also calculate total expenditure of the private sector as $E^P = C^P + I^P$. It is, however, not possible to calculate a disaggregated data series for imports.

be expressed as a function of average real interest rates (i_L-ΔP^e), real financial wealth (W/P) and real disposable income (y^d).

$$C = C(i_L-\Delta P^e, W/P, y^d) \quad\ldots\ldots 5.13$$

where $C_1 < 0$, C_2, $C_3>0$. This specification is consistent with the Keynesian consumption function because it is based on the assumption that the private sector is composed of liquidity-constrained agents whose consumption is dependent on their current disposable income. It also accommodates Friedman's permanent income hypothesis. This is because the specification assumes the existence of individuals who can maintain their consumption level in response to temporary negative shocks to income by borrowing from financial institutions or by drawing on past savings. Disposable income is defined as

$$y^d = (1-t)\ RGDP \quad\ldots\ldots 5.23$$

where t is the average rate of taxation and RGDP is the real value of domestic output. Real wealth is composed of the private sector's wealth held as human resources (w^h), physical capital (w^{ph}) and financial assets (w^f)[4].

$$w = w^h + w^{ph} + w^f \quad\ldots\ldots 5.15$$

The annual return from the stock of private wealth enters current disposable income in the form of labour remuneration, rental on physical assets and interest on financial assets. If private expenditure exceeds current disposable income, however, private agents are expected to reduce the stock of wealth itself. Due to lack of sufficient data on human and physical wealth, we will proxy private wealth by financial wealth which is defined as the sum of currency in circulation (CC) and deposits held in the banking system (D^p), net of bank loans (L^P).

$$w \approx w^f = CC + D^p - L^P \quad\ldots\ldots 5.16$$

[4]See Parkin and Bade 1988, p. 161

Besides the conventional transaction motive, currency in circulation is assumed to represent the size of financial intermediation in the informal sector. The main deficiency of equation 5.16 is that it excludes financial assets denominated in foreign currency (F^p) which agents acquire through the informal sector. As a 'quasi-illegal' activity these assets are denominated at the parallel rate of exchange (ERB) so that their domestic currency value is ($ERBF^p$). There is no record of the size of such assets. Nevertheless, its domestic currency value is expected to increase in direct proportion to the rate of depreciation of the parallel rate of exchange (ΔERB^e).

$ERBF^p = f(\Delta ERB^e)$ 5.17

We now consider the average real interest rate (i_L-ΔP^e). At times when consumers' disposable income and their stock of wealth falls short of their current expenditure, they are expected to borrow from the banking system, the informal money market and the world financial market. The lending rate applicable to private agents is therefore a weighted average of the bank lending rate (LR), informal lending rate (ILR) and foreign lending rate (i_f)[5]. There is no credible data on the informal lending rate and the size of private borrowing outside the banking system. Using credit restraint (CR) as proxy for informal lending rate (ILR)[6] we specify the average lending rate facing the private sector as

$(i_L - \Delta P^e) = f(LR, CR, i_f)$ 5.18

By substituting equations 5.16, 5.17, and 5.18 in 5.13 we specify the consumer demand for domestic output as

$C_d = c_{d1}(y^d) + c_{d2}(w^f) + c_{d3}(\Delta ERB^e) - c_{d4}(LR) - c_{d5}(CR) - c_{d6}(i_f)$ 5.19

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[5]As discussed in Section 5.1.2 the rational expectation hypothesis is justified in the informal financial market. Thus, we calculate i_f using the foreign interest rate (i_f*) and the one-period-ahead expected rate of depreciation of the parallel exchange rate (Eb_{t+1}/b) as $i_f = (1 + i_f^*)(Eb_{t+1}/b) - 1$.

[6]Given C^P as official credit extended to the private sector we define credit restraint as $CR = 1 - (C^p/GDP)$. The specification is due to Wong (1977) which states that as more and more private borrowers are rationed out of the banking system, the demand for credit in the informal credit sector increases. This leads to an increase in its price, i.e., the informal lending rate (see figure 3.1 and section 6.1.1).

Private consumption expenditure, however, also includes expenditure on imported consumer goods (C_{IM}). As part of household consumption it responds to all the variables in equation 5.19. The real effective exchange rate (REER) and the stock of foreign exchange reserves in the banking system (FER) are included to capture the effect of international competitiveness and the country's purchasing power in the official market. The effects of developments in the informal market are captured by the premium on the parallel exchange rate (PREM).[7]

$$C_{IM} = c_{IM1}(y^d) + c_{IM2}(w^f) + c_{IM3}(\Delta ERB^e) - c_{IM4}(LR) - c_{IM5}(CR) - c_{IM6}(i_f) + c_{IM7}(FER) - c_{IM8}(REER) - c_{IM9}(PREM) \quad \text{......5.20}$$

By combining equations 5.19 and 5.20 and after considering the balance of the underlying theoretical fundamentals, we specify private consumption function as

$$C^P = (c_{d1} + c_{IM1})\, y^d + (c_{d2} + c_{IM2})\, w^f + (c_{d3} + c_{IM3})\, \Delta ERB^e - (c_{d4} + c_{IM4})\, LR - (c_{d5} + c_{IM5})\, CR - (c_{d6} + c_{IM6})\, i_f + c_{IM7}(FER) - c_{IM8}(REER) - c_{IM9}(PREM)$$

$$C^P = c_1\, y^d \pm c_2\, w^f \pm c_3\, \Delta ERB^e - c_4\, LR - c_5\, CR \pm c_6\, i_f + c_7\, FER - c_8\, REER \pm c_9\, PREM \text{......5.21}$$

Equation 5.21 implies that consumption increases with disposable income (y^d) and the foreign exchange reserves (FER) because these variables determine the purchasing power of consumers from domestic and foreign markets respectively. The sign of private financial wealth ($\pm c_2 w^f$) recognizes the fact that financial wealth (as current income) determines purchasing power and also the fact (described in figure 5.1) that income is divided into expenditure and savings. Expected increase in the informal rate of exchange ($\pm c_3 \Delta ERB^e$), expected return on foreign assets ($\pm c_6 i_f$) and the premium on informal rate of exchange ($\pm c_9$ PREM) all increase consumption via the positive revaluation of private wealth held in foreign currency. They may also reduce consumption by increasing the price of imported consumer goods in the informal market. The lending rate ($- c_4$ LR) is expected to reduce consumption by increasing the cost of credit. In countries like Ethiopia, however, the banking system is unlikely to extend credit to private consumers and thus the lending rate of the informal sector

[7]The premium on parallel exchange rate is defined as the ratio of the parallel exchange rate (ERB) to its official counterpart (ERO), i.e., PREM = ERB/EO.

($- c_5$ CR) is more relevant in this case. The deposit rate of the banking system is expected to reduce consumption by encouraging savings, although one may also see interest income as part of current income and thus tending to increase consumption. An increase in the real effective exchange rate ($- c_8$ REER) is expected to increase the price of imported consumer goods in the official market and thereby reduce their purchase.

5.2.1.2 Private investment

Investment models range from the various accelerator models to the neo-classical models.[8] The literature on investment functions includes De Leeuw (1962), Almon (1965), Evans (1969), Jorgenson (1967 and 1969), Koyck (1954), Mayes (1981), Ahmed and Jackson (1982). In our case the demand for investment goods by the private sector (I^P) can be specified as

$$I^P = f(\Delta Y, y^d, w^f, \Delta ERB^e, DC^P, LR, CR, i_f, I^G, FER, REER, PREM) \text{ ....5.22}$$

ΔY is growth in the level of output, DC^P is credit extended to the private sector by the domestic banking system while I^G is public sector investment. The rest of the variables (y^d, w^f, ΔERB^e, LR, CR, i_f, FER, REER, PREM) are defined as in equation 5.21 above. The signs of these variables are discussed as follows.

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[8] Following Mayes (1981, chapter 4) and Tsegaye (1987) the accelerator investment models can be demonstrated as follows. Capital stock (K_t) is defined as the previous period's stock (K_{t-1}) plus current investment (I_t) net of depreciation (D_t).

$K_t = K_{t-1} + (I_t - D_t)$ A1

From this we derive gross investment as

$I_t = K_t - K_{t-1} + D_t$

$\quad = \Delta K_t + D_t$ A2

Using the neo-classical production function such as the Cobb-Douglas production function with constant returns to scale and fixed factor prices we can derive a fixed capital output ratio (q) as

$K_t = qY_t$; $q>0$..A3

where Y_t is the level of output. By substituting A3 in A2 we get a positive relationship between investment and output growth (ΔY_t).

$I_t = q\Delta Y_t + D_t$ A4

For simplicity, we assume the stock of capital to depreciate at a constant rate d so that

$D_t = dK_{t-1}$; $d>0$..A5

Substituting for K_{t-1} from A3 we get

$D_t = qdY_{t-1}$ A6

By substituting A6 in to A4 we get another version of investment function with lagged output as

$I_t = q\Delta Y_t + qdY_{t-1}$ A7

Private investment involves the purchase of durable capital goods by households and firms. As part of the private sector's expenditure, it is positively related to the households' financial resources. Thus, following similar arguments as in equation 5.22, we have private investment negatively related to the lending rate and positively to private wealth and disposable income.

$I^P = I(i_L\text{-}\Delta P^e, W/P, y^d)$ 5.23

where $I_1 < 0$, I_2, $I_3 > 0$

By substituting for $i_L\text{-}\Delta P^e$ from 5.18, equation 5.23 becomes

$I^P = I(LR, CR, i_f, W/P, y^d)$ 5.23a

Real wealth can be replaced by financial wealth w^f and a function of expected depreciation of the informal exchange rate $[f(\Delta ERB^e)]$ on the basis of the argument in equations 5.15 and 5.16. Equation 5.23, therefore, becomes

$I^P = I(LR, CR, i_f, w^f, \Delta ERB^e, y^d)$ 5.23b

Considering the arguments in the accelerator models discussed above, investment is positively related to output growth (ΔY). In a repressed financial system where credit is rationed by the monetary authorities, the level of domestic credit extended to the private sector (DC^P) is expected to boost private investment. Similarly, public sector investment (I^G) is expected to act as an incentive for the private sector if it is spent on improving the national infrastructure.[9] By adding our arguments, therefore, we express the signs of the determinants of the demand for domestic investment goods as

$I_d = I_{d1}(\Delta Y) + I_{d2}(DC^P) + I_{d3}(I^G) + I_{d4}(y^d) + I_{d5}(w^f) + I_{d6}(\Delta ERB^e) - I_{d7}(LR) - I_{d8}(CR) - I_{d9}(i_f)$ 5.24

[9] Of course, government expenditure will have a negative effect on private investment if it shifts resources to 'prestige projects' which have nothing to do with production. Our argument does not reject the possibility of excessive government spending crowding out private investment. In a developing economy which lacks the basic economic infrastructure and skills, however, government investment can play a positive role in encouraging private investment. (For the debate on the 'crowding-out effect' see, for example, Hillier 1991).

Note that private and public investments are part of the over-all investment in the economy. The latter is assumed to be determined by the government's decisions to consume and invest which may complement or crowd out private investors. Furthermore, as stated in equation 5.21, private investment is composed of both domestic and imported goods. It should also be noted that a significant amount of intermediate goods is imported through the informal sector. Thus, following the same logic as in the derivation of equation 5.20 and considering the effects of ΔY, DC^P, I^G we specify the demand for imported investment goods as

$$I_{IM} = I_{IM1}(\Delta Y) + I_{IM2}(DC^P) + I_{IM3}(I^G) + I_{IM4}(y^d) + I_{IM5}(w^f) + I_{IM6}(\Delta ERB^e) - I_{IM7}(LR) - I_{IM8}(CR) - I_{IM9}(i_f) + I_{IM10}(FER) - I_{IM11}(REER) - I_{IM12}(PREM) \qquad 5.25$$

An alternative specification would be to include the value of imported inputs as an explanatory variable in equation 5.24. In fact this will be the specification which passes the estimation test (see section 7.2.2 in chapter 7). At this stage, however, we prefer equations with a larger number of explanatory variables in order to maximize the candidate variables for the final investment function. Thus, by combining equations 5.24 and 5.25 we specify private investment as

$$I_d = (I_{d1}+ I_{IM1})(\Delta Y) + (I_{d2}+ I_{IM2})(DC^P) + (I_{d3}+ I_{IM3})(I^G) + (I_{d4}+I_{IM4})(y^d) + (I_{d5}+ I_{IM5})(w^f) + (I_{d6}+I_{IM6})(\Delta ERB^e) - (I_{d7}+ I_{IM7})(LR) - (I_{d8}+ I_{IM8})(CR) - (I_{d9}+I_{IM9})(i_f) + I_{IM10}(FER) - I_{IM11}(REER) - I_{IM12}(PREM)$$

$$I^P = I_{P1}\Delta Y + I_{P2}y^d \pm I_{P3}w^f + I_{P4}\Delta ERB^e + I_{P5}DC^P \pm I_{P6}LR - I_{P7}CR - I_{P8}i_f + I_{P9}I^G + I_{P10}R - I_{P11}REER - I_{P12}PREM \qquad 5.26$$

As indicated in equation 5.26, therefore, firms are expected to increase their investment if they anticipate aggregate demand ($I_{P1}\Delta Y$) to grow. This is expected to be financed from current after-tax income ($I_{P2}y^d$), financial wealth ($I_{P3}w^f$), and domestic credit extended to the private sector ($I_{P5}DC^P$). The cost of credit in both the banking system ($I_{P6}LR$) and the informal financial institutions ($I_{P7}CR$) is expected to have a negative effect on private investment, while government investment ($I_{P9}I^G$) is expected to encourage private investment unless, of course, it is spent on non-productive projects and/or is so excessive as to crowd out the private investors in the rationing of bank credit. In the latter case one can envisage a situation where private financial wealth ($I_{P3}w^f$), as defined in this study, has a negative impact on private investment because savings in the private sector will reduce private expenditure without increasing the supply of credit to private firms.

The level of intermediate imports is assumed to be positively linked to private investment. The impact of expected depreciation of the informal exchange rate (ΔERB^e), the expected returns on foreign assets ($I_{P8}i_f$), the level of foreign exchange reserves ($I_{P10}R$), the real effective exchange rate ($I_{P11}REER$), and the premium on informal rate of exchange ($I_{P12}PREM$) presented in equation 5.26 are, therefore, based on the relationship of private investment and imports.

We conclude this section by commenting on the sign of the official lending rate (LR). The financial liberalization literature of the Mckinnon and Shaw tradition expects a positive relationship between investment and the lending rate of the banking system. The argument is based on the assumption that the shortage of loanable funds is the main bottleneck for investment in a financially-repressed economy. Increasing the lending rate and thereby raising the deposit rate will increase the supply of loans by attracting resources from consumption and from other non-productive assets held as hedges against inflation. The neo-structuralists, on the other hand, argue that an increase in the lending rate will reduce investment by reducing the supply of loanable funds in the informal sector and increasing the cost of capital to firms operating in the official sector. In this study, therefore, the relationship of private investment and the lending rate is left as an empirical matter determined in the estimation of the investment equation as discussed in chapter seven.

5.2.2 Government expenditure

Government expenditure is composed of exogenously-determined spending on public consumption (C^G) and public investment (I^G).

$$G = C^G + I^G \quad \ldots\ldots 5.27$$

The government's spending-power is constrained by the amount of taxes raised (T_t), grants received (GR), the increase in base money (ΔM_t), and by borrowing from domestic and foreign financial institutions (B). Given r as the average rate of interest at which the government borrows, the budget constraint can be presented as

$$G_t + rB_{t-1} = T_t + \Delta M_t + \Delta B_t + GR \quad \text{.......} 5.28$$

Although the government can reasonably be assumed to determine its expenditure exogenously through its effective control over the money supply (ΔM_t) and domestic borrowing (ΔB_{dt}), the amounts of funds raised from taxation (T_t) and foreign borrowing (ΔB_{dt}) are likely to depend respectively on the growth of domestic output (GDP), and the supply and cost of international loans.[10]

5.2.3 Current account

Our discussion has so far covered the national expenditure on goods and services. We have shown that part of the national income is spent on goods and services imported from abroad. In this section we will derive the export equation by discussing the factors which determine the demand for domestic output by foreigners. This will be used to derive the current account equation which will conclude our discussion of the aggregate demand function.

We can define the current account balance (CA) as the difference between gross domestic product (GDP) and national absorption (A). Thus, from equations 5.10 and 5.11 we derive the current account identity as

$$CA = X - IM \quad \text{.......} 5.29$$

Such a definition of the current account from the national accounts excludes unrequited transfers and hence differs from the balance of payment definition of current account. Similar definitions such as Fry (1993) relate the current account to national savings demonstrated by

[10] Tsegaye (1987) for example found a significant relationship between direct tax revenue and income for Ethiopia. He also found a reasonable relationship in his estimation of indirect tax revenue as a function of private consumption and external trade.

equating the components of national output to the use of income for consumption (C), savings (S) and taxes (T).

$$C + I + G + X = C + S + T + M$$
$$\Leftrightarrow (X - M) = (S - I) + (T - G)$$
$$\Leftrightarrow CA = S_P + S_g \quad \ldots\ldots 5.30$$

where S_P is private savings, and S_g is the government's budget balance. This definition relates the external balance to the spending-behaviour of both the household and government sectors. In other words the size of the current account balance depends on the national economic agents' influence on the volume of exports (Q_x), volume of imports (Q_{IM}), price of exports (P_x) and price of imports in domestic currency (P_{IM}).

$$CA = P_x Q_x - P_{IM} Q_{IM} \quad \ldots\ldots 5.31$$

5.2.3.1 Exports

Prices of exports and imports are determined by the major players in the world market. The ability to influence world prices depends, among other things, on the market share of each exporter. Consequently, most non-oil producing African countries are price-takers in the world market because they export primary agricultural products for which there is a large number of alternative suppliers offering competitive prices. Collective bargaining institutions such as trade-blocs or monetary unions are non-existent or ineffective in the case of such countries. Thus, our model assumes a horizontal demand for exports to represent developing countries as passive price-takers in the world market. The demand curve is expected to shift up following growth in foreign income (Y^F).

$$P_x = f(Y^F) \quad \ldots\ldots 5.32$$

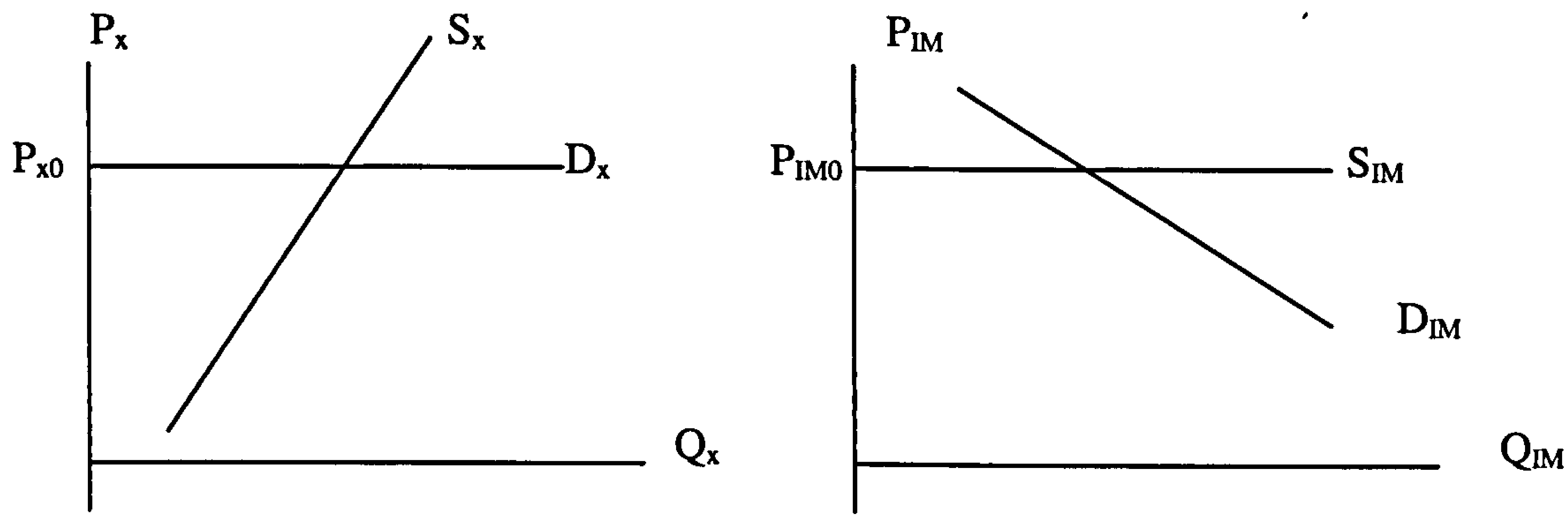
Given a horizontal demand for exports, therefore, the main constraint for the current account of developing countries is their ability to supply and earn profits at world prices. As a producer price, an increase in P_x increases the profitability of the export industry and hence the supply of exports is positively related to P_x. The supply curve is expected to shift with the increase in international competitiveness represented by the real effective exchange rate (REER).

$Q_x = f(P_x, \text{REER})$ 5.33

From equations 5.32 and 5.33 we specify the function for export (X) as

$X = f(P_x, \text{REER}, Y^F)$ 5.34

Figure 5- 2: The supply and demand for exports; The supply and demand for imports



The positive relationship between foreign income (Y^f) and exports assumes, however, that Ethiopia's exports are normal goods whose demand increases with income. However, this is not the case. Ethiopia exports primary agricultural goods, mainly coffee, hides and skins, pulses and oil-seeds and her main trade partners are Western Europe and North America. As these countries get richer, therefore, one can envisage a decline in the proportion of their income spent on Ethiopian exports.

5.2.3.1.1 Informal exports

At this stage we distinguish between officially-recorded exports (X_o) and the unrecorded part (X_u). Given the proportion of exports smuggled through informal channels to be ϕX_o where $0 < \phi, < 1$, the equation for total exports can be expressed as

$X = X_u + X_o = f(P_x, \text{REER}, Y^F, \phi)$ 5.35

High taxes on exports (T_x), inconvertibility of regional currencies and the parallel exchange premium (PREM) are some of the factors which push exporters to the informal sector. Growth in the level of income of neighbouring countries (Y^R) is expected to increase exports and, owing to the poor incentives given to regional trade, a large portion of this trade is likely to be smuggled through the informal sector.

An increase in the parallel exchange premium attracts exporters to the informal sector by providing an opportunity to maximize the domestic currency value of their export earnings. The parallel exchange premium, as defined above, is the ratio of parallel rate of exchange (ERB) to its official counterpart (s). It increases following the demand for foreign exchange by importers who are rationed out of the official supply of foreign exchange and agents who expect a devaluation of the official exchange rate or high taxes.

The factors which trigger such expectations include: (a) a persistent current account deficit which might tempt the government to try to boost exports by devaluation; (b) a persistent budget deficit, fuelling expectations of higher taxes and/or higher inflation due to monetization of public debt in the near future. The second reason is based on the Ricardian equivalence hypothesis: excessive budget deficits trigger capital flight through the informal sector by agents who rush to escape paying higher taxes (and/or inflation tax) in the future as the government plans radical actions to balance its books (see Fry 1993, p. 63).

Since the official exchange rate in Ethiopia was fixed during most of the sample period, any volatility of the exchange rate is likely to be concentrated in the informal market. Thus, informal exports are expected to respond to volatility of the informal rate of exchange (VERB). The impact of VERB is to reduce the transparency and predictability of the price system in international trade. This will reduce the overall trade activity, although it is also possible to argue that it may shift trade from the informal to the official sector.

Thus, the proportion of informal trade can be expressed as a function of regional income, the export tax, the parallel exchange premium, and the volatility of the informal exchange rate. In the absence of reliable data on regional income, however, the specification of the proportion of informal exports becomes

$$\phi = f_1\,(Tx) + f_2\,(PREM) \pm f_3\,(VERB) \qquad 5.36$$

where f_1 and f_2 are both positive while f_3 can be either positive or negative. From equations 5.35 and 5.36 we specify the official exports ($X_o = X - X_u$) as

$$X_o = \pm x_1(Y^F) - x_2(Tx) + x_3(P_x) + x_4(REER) - x_5(PREM) \pm x_5(VERB) \quad \text{..................5.37}$$

Thus, the level of Ethiopian official exports is expected to be positively related to the price of exports (P_X), and the real effective exchange rate (REER). The impact of the premium on the informal exchange rate (PREM) is negative, while the income of Ethiopia's trade partners (Y^F) and the volatility of the informal exchange rate can be either positive or negative.

5.2.3.2 Imports function

As indicated in equation 5.31, the value of imports in the income identity is a function of its quantity (Q_{IM}) and price (P_{IM}). The bargaining power of Ethiopia in the imports market is presented in figure 5.2. above. As a junior member of the world trading community, Ethiopia is likely to face a horizontal supply function where she can import as much as she can without having any effect on the world price. Higher prices, however, are likely to depress the demand for imports and hence the demand curve (D_{IM}) is a downward-sloping function. In the official domestic market, however, the government can regulate the level of imports by changing its price or by introducing quantity restrictions.

Goods and services are imported to satisfy the demand for consumer and investment products by both the private and the public sector. The textbook approach to modelling such a relationship between imports and domestic demand is to include aggregate income as an explanatory variable in the imports function. This approach, however, does not adequately show the sensitivity of imports to each sector of the economy. To remedy this, we will disaggregate domestic demand into private consumption (C^P), private investment (I^P), government consumption (C^G) and government investment (I^G). Generally all these components of aggregate demand can be expected to have a positive relationship with imports, although a negative relationship with consumption can be justified on the grounds that the government was actively discouraging the importation of consumer goods for most of the sample period.

The supply of foreign exchange reserves (FER) is another important instrument by which governments try to regulate imports. Ethiopia depends on a few primary goods for her foreign exchange earnings and, thus, scarcity of foreign exchange is one of the most important bottlenecks affecting decisions to import. The authorities process applications for foreign exchange from importers and ration it on the basis of availability starting with their priority sectors. Thus, imports are expected to have a positive relationship to the level of foreign exchange reserves.

Obviously importers who are rationed-out from the official supply of foreign exchange are forced to purchase foreign currency from the informal market at a premium. Thus, the higher the premium on informal rate of exchange (PREM), the lower will be the level of imports. Finally, the government can discourage imports by devaluing the official rate of exchange. The impact of devaluation is captured by the real effective exchange rate (REER) which is expected to have a negative relationship to imports.

On the basis of these arguments, therefore, the demand for imports is specified as

$IM = \pm_{IM1}(C^P) \pm_{IM2}(C^G) +_{IM3}(I^P) + im_4(I^G) + im_5(FER) - im_6(REER) - im_7(PREM)$...........5.38

5.2.4 The IS-curve

So far we have derived the behavioural functions which determine expenditure on aggregate output of an open economy as

$Y = C^P + I^P + G + X - IM$ 5.39

where:

$C^P = c_1 y^d \pm c_2 w^f \pm c_3 \Delta ERB^e - c_4 LR - c_5 CR \pm c_6 i_f + c_7 FER - c_8 REER \pm c_9 PREM$ 5.21

$I^P = I_{P1}\Delta Y + I_{P2}y^d \pm I_{P3}w^f + I_{P4}\Delta ERB^e + I_{P5}DC^P \pm I_{P6}LR - I_{P7}CR - I_{P8}i_f + I_{P9}I^G$

$+ I_{P10}R - I_{P11}REER - I_{P12}PREM$ 5.26

$G = C^G + I^G$ 5.27

$X_o = \pm x_1(Y^F) - x_2(Tx) + x_3(P_x) + x_4(REER) - x_5(PREM) \pm x_5(VERB)$ 5.37

$IM = \pm_{IM1}(C^P) \pm_{IM2}(C^G) +_{IM3}(I^P) + im_4(I^G) + im_5(FER) - im_6(REER) - im_7(PREM)$ 5.38

5.3 The financial sector

The debate on monetary union is centred on the effectiveness of national monetary authorities in influencing the real economy and thereby improving the living-standards of its citizens. This argument assumes that there is a strong linkage between real economic variables and monetary policy instruments controlled by the central bank. The objective of this section is therefore to model the structural equations which link instruments of monetary policy with real variables. Attempts will be made to capture the effects of the external sector and the informal financial market on the effectiveness of monetary policy. The final part will specify the determinants of supply and demand for money which will be used in the derivation of an LM curve.

5.3.1 The link between real and financial sectors

The link of the financial sector to the real sector is based on the traditional role of money as a medium of exchange, and instrument for hoarding. This section will demonstrate the link of the financial sector to private and public expenditure, to savings and the external balance.

5.3.1.1 Link with private expenditure and savings

The financial sector is linked to the real sector mainly through the role of financial assets as a medium of transaction and a store of wealth. In figure 5.1 we have shown that agents divide their earnings into expenditure and savings, which involves the use of money in a modern economy. Any disruption in the financial sector is therefore likely to have an impact on real activity by affecting the efficiency of exchange of goods and services and the value of real savings.

The link between money (M) and the aggregate expenditure on goods and services (Y) can be presented by the quantity theory of money as

$$M = k\,(PY) \qquad \text{......} 5.40$$

where k is the reciprocal of the velocity of money and P is the price level. This implies that for a given k and P, an increase in the level of aggregate output requires a proportional increase in the level of money to ensure a smooth movement in economic transactions. But part of the value of national output is saved and added to households' financial wealth. Given the average rate of taxation (t) and the propensity to save (s), the level of private sector savings (S) can be expressed as

$S = s(1\text{-}t)Y$ 5.41

This represents the portion of current income converted into claims to future consumption and investment by the private sector. One way of transferring current value to the future is by investing it in financial assets which include currency (CC), bank deposits (D^P), and foreign assets (F^P). By converting foreign assets at the market rate of exchange (ERB) and subtracting the loans extended by the banking system (L^P), we can present the net value of private financial wealth (w^f) as

$w^f = CC + D^P + ERBF^P - L^P$ 5.42

Following Montiel et al (1993) we define the change in private financial wealth (Δw_t) as

$\Delta w^f_t = (Y^d\text{-}E^P)_t + i_d D^P_{t\text{-}1} - i_c L^P_{t\text{-}1} + i_f ERBFP_{t\text{-}1} + \Delta ERBF^P_{t\text{-}1}$ 5.43

where Y^d is disposable income, E^P private expenditure, i_d is deposit rate, i_c is interest charged by banks on credit extended to the private sector and i_f interest on foreign assets. Equation 5.43 therefore, defines change in the private financial wealth as the sum of savings from current income $(Y^d\text{-}E^P)_t$, interest earnings from domestic deposits ($i_d D^P_{t\text{-}1}$) and foreign assets ($i_f ERBF^P_{t\text{-}1}$) plus the change in the value of foreign assets due to fluctuations in the market rate of exchange ($\Delta ERBF^P_{t\text{-}1}$) and minus interest payments on bank loans ($i_c L^P_{t\text{-}1}$). From equations 5.42 and 5.43 we can express private financial wealth in terms of past stock ($w_{t\text{-}1}$) and flow-changes in financial wealth (Δw^f_t).

$w^f_t = w^f_{t\text{-}1} + \Delta w^f_t$

$= CC_{t\text{-}1} + D^P_{t\text{-}1} + ERBF^P_{t\text{-}1} - L^P_{t\text{-}1} + (Y^d\text{-}E^P)_t + i_d D^P_{t\text{-}1} - i_c L^P_{t\text{-}1} + i_f ERBF^P_{t\text{-}1} + \Delta ERBF^P_{t\text{-}1}$

....5.44

5.3.1.2 Link with government budget

The public sector also has links to the financial sector. Given government expenditure (G), tax revenue (T), other revenues (OR), transfers of high-powered money from the central bank to the government (ΔM) and government borrowing (B) we can define the government budget constraint as[11]

$G = T + \Delta M + B + OR$ 5.45

Government expenditure is assumed to be exogenously determined by fiscal policy and a ceiling is likely to be imposed on foreign financing either by the government or by suppliers who question the credit-worthiness of the government as foreign debt piles up. Thus excessive government expenditure is financed by credits and transfers from the domestic banking system thereby affecting the functioning of the rest of the economy through the creation of new money.

5.3.1.3 Link with the external sector

The balance of payments provides the vital link between the external sector and the central bank balance sheet. The asset side of the balance sheet is composed of foreign exchange reserves (FER) valued at the official exchange rate (s) and credits extended to the government (L^g) and the commercial banking system (L^b)[12], while its liabilities consist of base money (M_0), defined as the sum of the reserves deposited by the commercial banking system (RR) and currency in circulation (CC).

$sR + L^g + L^b = RR + CC$ 5.46

According to the monetary approach to the balance of payments (see Krugman and Obstfeld, 1994, pp. 516-7) equation 5.46 implies that any unsterilized build-up of foreign assets in the central bank's balance sheet leads to a corresponding increase in base money. This will

[11]Note that G is composed of expenditures on current output (G_C) - which is assumed to be exogenous - and debt services and repayment (G_B). Other revenues (OR) include grants, interest on government deposits at home ($i_d D^g_{t-1}$) and abroad ($i_f{*}sF^p_{t-1}$) where s is the official rate of exchange. Finally, B is composed of loans from the domestic banking system (L^{gd}) and foreign financial institutions (L^{gf}) with an interest payment of i_c and i_f* respectively.
[12]Our definition assumes that the central bank does not extend credit to private agents directly.

eventually affect the supply of money through the money multiplier (K_m) which is defined as the ratio of money supply (Ms) to base money (M_0).

$K_m = Ms / M_0$ 5.47

where $K_m > 0$. Given that the base money grows proportionally to the change in foreign exchange reserve (ΔsR) we can define the link of external balance to money supply as

$M_S = K_m (\Delta sR)$ 5.48

Acquisition of foreign exchange reserves, however, does not necessarily lead to the growth of the monetary base nor need the latter lead to a proportional growth in the supply of money. The central bankers can sterilize the effects of their intervention in the foreign exchange market by reducing their holdings of domestic assets, i.e., selling government bonds in the open market and/or reducing credits extended to the commercial banking system. Moreover, increasing the reserve requirement ratio can simultaneously increase the base money and reduce the money multiplier. The effect of such intervention on the demand for money is reflected in the rates of interest. In this study this will be accommodated by the inclusion of official rates and proxies for informal rates and treasury bills in the demand for money function (see equation 5.67 and section 7. 2.5).

The discussion so far, therefore, helps us understand the link between the financial sector and the real sector. Equation 5.49 indicates that financial instruments are used in the financing of current expenditures; while equations 5.40 and 5.42 show that money is used in the transfer of the private sectors' surplus purchasing power to the future. Equation 5.45 on the other hand, provides a framework within which the effect of fiscal decisions on monetary policy is analyzed, while equation 5.48 links domestic money supply to the balance of payments. The next section presents the structure of the financial sector.

5.3.2 Structure of the financial sector

The financial sector of any developing economy has its fair share of the underdevelopment and inefficiency seen in the economy at large. Private agents have a very limited choice of financial assets. Secondary security markets are mostly non-existent and private agents are prohibited from holding foreign assets. Exchange rates and interest rates are deliberately kept below their market clearing rates in order to supply public enterprises and a few selected private firms with sufficient credit and foreign exchange at a subsidized rate.

Such financial repression reduces the efficiency of the banking system and leads to the emergence of informal markets for credit and foreign exchange. Private agents use the informal money market as a means of channelling credit and foreign assets at the market rate. As more and more of the economy shifts to the informal sector, the government's tax base shrinks and the supply of bank credit (via commercial bank deposits) declines. Many governments therefore turn to seigniorage as a means of financing public expenditure and thereby fuelling inflation and capital flight through the informal money markets. It is against this background that we are modelling the financial sector. The model assumes a small open economy with four types of agent: households, government, central bank and the rest of the banking system. Agents are assumed to hold physical assets directly in the form of physical capital, consumer durable goods and land. The asset menu for private agents is restricted to: (a) currency, (b) demand and time deposits issued by the banking system, (c) loans from the commercial banks, (d) deposits and loans from the informal market, (e) foreign currency (mainly from the informal market), (f) durable goods such as physical capital and land. The monetary authorities are expected to use policy instruments in their attempt to exert an influence on aggregate demand. Open market operations are excluded from the list of policy instruments because of the absence of organized security markets. Consequently, the tools of monetary policy are restricted to: (a) administered bank interest rates, (b) the required reserves ratio, (c) the amount of credit extended by the central bank to the commercial banking system, and (d) intervention in the parallel exchange market. We will first present the balance sheet of the banking system and proceed to the menu of assets available to private agents.

5.3.2.1 Banking system

The balance sheet of the commercial banking system is given by

$$RR + L^P = D^p + L^b \qquad \text{...5.49}$$

where RR is reserves held at the central bank, L^P is credit extended to the private sector, D^p is private deposits held in the commercial bank, L^b is credit received from the central bank. From equation 5.46 we have the balance sheet of the central banks as

$$sR + L^g + L^b = RR + CC \text{ ....} 5.46$$

Assuming that banks hold no excess reserves, the reserve requirement ratio (μ) can be expressed as the ratio of reserves (RR) to deposits (D^p).

$$RR = \mu D^p \,;\, \mu > 0 \text{ ....} 5.50$$

By substituting equation 5.40 in 5.49 we can specify the credit extended to the private sector as

$$L^P = (1- \mu)D^p + L^b \text{ ....} 5.51$$

This implies that central banks can use both μ and L^b to control the amount of credit extended to the private sector.

5.3.2.2 The private sector's financial portfolio

Following our arguments about equation 5.51, we categorize the asset menu in the financial wealth of the private sector as

$$w^f = CC + D^P + ERBF^P - L^P \text{ ....} 5.51$$

The groupings are based both on the desire to simplify the model and the assumption of substitutability. Deposits and loans in the informal sector are conducted within the same sector and thus cancel out each other without affecting total private financial wealth. Foreign exchange and physical assets are categorized as F^p to represent assets with flexible, market-determined prices and thus, substitute each other in their role as 'inflation hedges'.

This definition, however, ignores the effect of financial repression on household wealth. The fact that bank deposit rates (i_c) are kept artificially below the market interest rate (i_L) implies an implicit tax to depositors and implicit subsidy to borrowers. The sizes of these taxes and subsidies are $(i_L - i_c)D^p/P$ and $(i_L - i_c)L^p/P$ respectively[13]. Assuming that agents use the market rate of interest as a discount rate, the present value of taxes on a unit of bank deposit is represented by the repression index (ρ).

$\rho = (i_L - i_c)/\, i_L$ 5.52

Note that the present value of the repression tax on private depositors is $\rho D^p/P$, while the net present value of the subsidy on those allowed to borrow from the banking system is $\rho L^p/P$. Thus, the net effect on private financial wealth ($\Delta W^f/P$) due to such financial repression is

$(\Delta W^f/P) = [\rho\, D^p - \rho\, L^p]/P = \rho\, [D^p - L^p]/P$ 5.53

The total real financial wealth of the household sector under financial repression can, therefore, be shown as the sum of the real value of equation 5.51 and 5.53

$W^f/P = [CC + D^p + ERBF^p - L^p + (\rho\, D^p - \rho\, L^p)]/P$

$\quad = [CC + (1-\rho)\,(D^p - L^p) + ERBF^p]/P$ 5.54

Financial repression, therefore, negatively affects private wealth inasmuch as the private sector is a net lender to the banking system. Given that the monetary authorities control the rate of interest at which banks accept deposits and extend credit they can alter the financial repression tax and, thereby, private agents' asset portfolios. Intervention in the foreign exchange market would also influence the premium on the parallel exchange rate and thereby the holdings of foreign assets. Thus, the monetary authorities, at least theoretically, use their policy instruments to influence private demand for financial assets.

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[13]Note that we are assuming banks follow a zero-profit condition so that the lending rate is equal to the deposit rate in the banking system.

Following Tobin (1969) and Montiel et al. (1993), the demand for financial assets can be specified as functions of real output (y), the market lending rate (i_L), the bank deposit rate (i_d), the expected rate of return on foreign assets (i_f) and financial wealth (w^f).[14]

$CC/P = L(i_L, i_d, i_f, y, w^f)$ $\quad L_1, L_2, L_3 <0, L_4 >0, 0<L_5<1$ 5.55

$D^p/P = L'(i_L, i_d, i_f, y, w^f)$ $\quad L'_1, L'_3 <0, L'_2, L'_4 >0, 0<L'_5<1$ 5.56

$L^p/P = H(i_L, i_d, i_f, y, w^f)$ $\quad H_1<0, H_2, H_3>0, H_4<0, 0<H_5<1$ 5.57

$ERBF^p/P = F(i_L, i_d, i_f, y, w^f)$ $\quad F_1, F_2 <0, F_3>0, F_4 <0, 0<F_5<1$ 5.58

The signs of the three partial derivatives (i_L, i_d, i_f) in each function reflect the assumption that all assets are *gross substitutes* while real output shifts asset composition between narrow money[15] and all other assets in accordance with transaction motives. Since the value of each asset is a fraction of the total asset portfolio, the sum of the coefficients of w^f must always add up to 1. Note that, following equation 5.42, in our case we include w^f in equation 5.55 assuming that cash may be kept for reasons other than strictly transaction purposes. Thus, we have

$L_5 + L'_5 + H_5 + F_5 = 1.$ 5.59

Finally any reallocation of the equilibrium portfolio implies increasing the portion of one asset by reducing the other assets in the portfolio. Consequently, the following adding up constraint is satisfied:

$L_k + L'_k + H_k + F_k = 0$ 5.60

where k= 1, 2, 3, 4. For more detail on portfolio and currency substitution models see Tobin (1968) and Montiel et al. (1993), pp. 87-9. We now proceed to the specification of the functions for money demand, foreign exchange reserves and the informal rate of exchange.

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[14]The expected rate of return on foreign assets is defined as $i_f = i_f^* + Eb$ where i_f is foreign rate of interest and Eb is the one-period-ahead expected rate of depreciation of the parallel rate of exchange.
[15]Narrow money is defined as currency and the portion of deposits held for transaction purposes.

5.3.3 The money and foreign exchange markets

The money market is the dominant part of the financial sector in a developing economy, where the market for bonds and equity is almost non-existent. It involves dealings in notes, bank deposits, inter-bank loans and treasury bills. The coexistence of informal money markets alongside the official money market is a common phenomenon in most developing countries mainly because of over-regulation and the rationing of a large portion of the private sector out of the official sector. Our discussion in this section will therefore concentrate on specifying the supply and demand for money in both the formal and informal sectors.

5.3.3.1 Money supply

Standard macroeconomic textbooks define the supply of money as exogenously determined by the monetary authorities at a level consistent with the broader macroeconomic targets such as output growth and inflation. Such definitions presume that there is a stable money multiplier which enables the central bank to predict the effect of a given monetary base program on the stock of money.

$Ms = K_m (M_0)$ 5.61

The money multiplier is a measure of the willingness and ability of the banking system to create credit. The banking system is able to increase its credit to the non-banking system if central bank loans are high and/or the legal reserve requirement is low. We have also seen that the domestic supply of money directly relates to the balance of payments. Thus, from the asset side of a consolidated balance sheet of the banking system the money supply can be measured as

$Ms = DC + FA$ 5.62

where DC is domestic credit extended to the non-bank public and FA is net foreign assets held in both the central bank and the commercial banking system. On the liability side of the consolidated balance sheet, the supply of money is presented as the sum of currency in circulation (CC), demand deposits (DD), time and saving deposits (TD) and net other items (OIN).

$Ms = CC + DD + TD + OIN$ 5.63

Narrower definitions of money include the base money

$Mo = CC + RR$ 5.64

and

$M1 = CC + DD$ 5.65

5.3.3.2 Demand for money

The demand for money refers to the functions of money as a medium of transaction and store of wealth. In the former case, agents require more money as the level of output increases while in its latter role, however, money is one among many alternative assets which agents use to transfer their current surplus income into future consumption. These include domestic assets deposits (D^P) in both the formal and informal sector and foreign assets (F^P) and other inflationary hedges. The amount of each asset held by agents in their portfolios depends on the asset's own rate of return and the opportunity costs i.e., the rate of return on other assets. If agents anticipate inflation, for example, they are likely to reduce their demand for money while increasing foreign assets and other inflation hedges in their portfolio.

Following this argument and our discussions in equations 5.64 to 5.66 we specify the demand for money as

$Md = m_1(y) - m_2(i_L) + m_3(i_d) - m_4(i_f) - m_5(CR) + m_6(TBR)$ 5.66

CR is credit restraint proxying for interest rates on the informal assets (see section 6.1). Furthermore, a proxy for treasury bill rate (TBR) is included in the demand for money. It is defined as the ratio of the public sector's borrowing requirements to GDP, (i.e., TBR = PSBR/GDP). It reflects the credit-worthiness of the government and thus lenders are expected to increase their interest rates on treasury bills as the government's debt increases. Thus the treasury bill rate can be expected to have a positive relationship with broad money if the government enters into a discipline that obliges it to borrow at the market-determined interest rate.

The money market achieves equilibrium by equating the supply and demand for money. The demand for broad money, for example, can be specified as

$$M_2 = m_1(y) - m_2(i_L) + m_3(i_d) - m_4(i_f) - m_5(CR) + m_6(TBR) \quad \text{..........................5.67}$$

The equations for the smaller monetary aggregates can be specified in a similar fashion as M2 and the sign and size of their coefficients can be expected to conform to the arguments advanced in equations 5.55 and 5.56. As we shall see in chapter seven, however, we were unable to get a theoretically sound cointegrating vector for Mo or M1.

5.3.3.3 Informal rate of exchange

In a financially-repressed economy the coexistence of an informal foreign exchange market alongside its official counterpart is a common phenomenon. As summarized in Figure 3.5 the foreign exchange is demanded as a means of transaction by importers and residents travelling abroad, and as an asset which residents hold to diversify their portfolio. As presented in equation 5.58, the transaction motive for foreign exchange is determined by the demand for imports and foreign travel, which in turn are functions of current income (y) and accumulated wealth (w^f). The asset demand for foreign exchange on the other hand is a function of its own rate of return (i_f), and the returns on domestic bank deposits (i_d) and loans (i_L). In LDCs like Ethiopia only part of the transaction demand and almost non of the asset demand is satisfied in the official financial market. Consequently, private agents are forced to resort to the informal sector to fill the gap. The demand for foreign exchange in the informal sector ($ERBF^p/P$) can be specified as

$$ERBF^p/P = F(i_L, i_d, i_f, y, w^f) \quad F_1, F_3<0, F_3>0, F_4<0, \; 0<F_5<1 \quad \text{................5.68}$$

As in most informal activities, the data on the amount of foreign exchange transacted in the informal market is not available. However, we were able to find the informal rates of exchange (ERB), and this will proxy the demand for foreign exchange because informal rates of exchange increases as with the demand for foreign exchange in the informal market (see figure

3.1). The equation that will be estimated in this study is therefore, an equation for the informal rate of exchange.

Rationing of foreign exchange by the government to its priority sectors is one of the important causes of the persistence of the informal financial sector. As demonstrated in section 3.1, the demand for foreign exchange (and thereby its price) is a function of the supply of foreign exchange in the official market. The government decides who should get 'foreign exchange' and 'how much' at time 't'. This will have a dynamic effect on the supply of foreign exchange in subsequent years. For the time being let us stick to the static specification and come back to the dynamics in next section.

The willingness to grant official funds to agent 'A' is assumed to be the function of his projects consistency with the government's macroeconomic objective and the ability to supply foreign currency. The ability of the authorities to satisfy the demand for foreign exchange is constrained by the volume of foreign exchange reserves they hold. An increase in foreign exchange reserves enables the authorities to satisfy the demand for foreign exchange within the official sector, reduce the demand in the informal sector and thereby reduce the premium on the informal rate of exchange. Thus, the informal rate of exchange (ERB) is inversely related to the level of foreign exchange reserves (FER).

The volume of reserves is, in turn, dependent on the net inflow of foreign exchange from net exports and other sources.[16] We expect the informal rate of exchange to have a negative relationship with the level of current account balance (CA).

Finally, the informal market (unlike its official counterpart) is expected to respond to expected changes in the rate of return on assets. Agents use foreign currency as a hedge against inflation and as an asset which would generate income (see equation 5.68). They are expected to increase their demand for foreign assets (thereby increase its price) in line with the expected rate of inflation (ΔP^e) because it reduces real expected rate of interest on domestic assets and also signals that devaluation is likely to take place sooner than latter. Given that the nominal

[16]It is also possible to consider inflow from public borrowing abroad and aid although it cannot be relied upon as a long-term source. Direct investment by foreigners is also a relevant factor but excluded from this analysis because of lack of data.

lending rate and deposit rate in the official sector are administratively fixed, their expected real values are expected to fluctuate in line with the expected inflation. Thus the impact of i_L and i_d (see equation 5.68) is expected to be captured by (ΔP^e). Returns on foreign assets (I_F) are also expected to increase the demand for foreign exchange and thereby increase the rate of exchange in the informal sector. (Note that in Section 5.1 we have justified the use of rational expectations hypothesis for the informal financial markets). Thus, the informal rate of exchange (ERB) is specified as a function of the current account (CA), foreign exchange reserves (FER), expected rate of inflation (ΔP^e) and returns on foreign assets (I_F).

$$ERB = - e_1 (CA) - e_2 (FER) + e_3 (\Delta P^e) + e_4 (I_F) \text{ ....} 5.68$$

where e_1, e_2, e_3 and e_4 are all positive.

5.3.3.4 Foreign exchange reserves

The level of foreign exchange reserves depends on the net inflow of foreign exchange. As discussed above such an inflow depends on exports of goods and services, remittances from citizens living abroad, aid, public borrowing from abroad and direct investment of foreigners in the domestic economy. We were unable to obtain such disaggregated data on the components of net inflow of foreign exchange and therefore limited the search for a cointegrating vector to the current account (CA) and net public borrowing from abroad (PSFB).

$$FER = r_1 * CA + r_2 * PSFB \text{ ....} 5.69$$

where $r_1, r_2 > 0$

Note that equation 5.69 (as all equations specified in this chapter) shows the long-run equilibrium relationship. After estimating such an equilibrium relationship, the equation can be re-specified in an error correction mechanism (ECM) to show the short-run dynamics. Such an equation for the foreign exchange reserve shows a negative relationship between the current supply of reserves (FER) and its past value (R_{t-1}). On the dynamics of equation 5.69 one can also expect a negative relationship between current reserves and its past values (see equation 7.43). This means , ceteris paribus, the willingness to supply foreign exchange at time 't' have a depleting effect on the reserves and thereby the governments ability to supply foreign exchange declines at time (t+1).

5.4 Price equation

The level of price (P) reflects the value of goods and services in terms of monetary units. This relationship of price to both the real and monetary sectors can be derived from the quantity theory (equation 5.67) as

$$P = p_1 (M) - p_2 (Y) \quad \text{.......... 5.70}$$

where $p_1, p_2 > 0$. Any excess supply of money (Ms) over its real demand (Md/P) is therefore expected to increase the price level; while any excess supply of goods and services (Ys) above its real demand (Y/P) is expected to reduce prices. Note that the real demand for goods and services and the demand for real money are respectively determined on the basis of the derivation of equations 5.66 and 5.67. Both these equations were derived as equilibrium models (supply = demand) where any discrepancy between supply and demand will be corrected by movements in the price level. Thus, equation 5.70 can be re-written as

$$P = p_1 (Ms - Md/P) - p_2 (Ys - Yd/P) \quad \text{.......... 5.71}$$

Such a specification of the price equation links the price level to shocks emanating from both the real and monetary sectors. The size of the shock will of course, depend on the size of the coefficients, and as we shall see later in chapter 7, the monetary coefficient (p_1) is by far larger than the coefficient of the real sector (p_2).

The specification of the equations of the model has so far aimed at examining the theoretical justification for the inclusion of a particular variable in an equation. Whether a variable appears in the final equation will, however, depend on the theoretical soundness of the sign and size of the coefficients, to be estimated in chapter 7. The next chapter examines the sources and time-series properties of the data to be used in the estimation and simulations of the model in subsequent chapters.

5.5 List of the main behavioural equations and identities

Behavioural equations

$C^P = c_1 y^d \pm c_2 w^f \pm c_3 \Delta ERB^e - c_4 LR - c_5 CR \pm c_6 i_f + c_7 FER - c_8 REER \pm c_9 PREM$ 5.21

$I^P = I_{P1}\Delta Y + I_{P2}y^d \pm I_{P3}w^f + I_{P4}\Delta ERB^e + I_{P5}DC^P \pm I_{P6}LR - I_{P7}CR - I_{P8}i_f + I_{P9}I^G$

$+ I_{P10} FER - I_{P11}REER - I_{P12}PREM$ 5.26

$G = C^G + I^G$ 5.27

$X_o = \pm x_1(Y^F) - x_2(Tx) + x_3(P_x) + x_4(REER) - x_5(PREM) \pm x_5(VERB)$ 5.37

$IM = \pm_{IM1}(C^P) \pm_{IM2}(C^G) +_{IM3}(I^P) + im_4(I^G) + im_5(FER) - im_6(REER) - im_7(PREM)$ 5.38

$M_2 = m_1(y) - m_2(i_L) + m_3(i_d) - m_4(i_f) - m_5(CR) + m_6(TBR)$ 5.67

$ERB = - e_1 (CA) - e_2 (FER) + e_3 (\Delta P^e) + e_4 (I_F)$ 5.68

$FER = r_1 * CA + r_2 * PSFB$ 5.69

$P = p_1 (Ms - Md/P) - p_2 (Ys - Yd/P)$ 5.71

Identities

$Y = C^P + I^P + G + X - IM$ 5.39

$W^f = CC + D^P + ERBF^P - L^P$ 5.42

$G = T + \Delta M + B + OR$ 5.45

$Ms = DC + FA$ 5.62

$Ms = CC + DD + TD + OIN$ 5.63

CHAPTER SIX

DATA: SOURCES AND TIME-SERIES PROPERTIES

In addition to the theory on which they are based, models only are as good as the data and the statistical procedures used in their estimation. The estimation technique will be examined in chapter seven, while this chapter discusses the sources and time-series properties of the data.

The procedure followed in the derivation of some variables is discussed in section 6.1, while section 6.2 presents the sources of the data. This is followed by a discussion of the time-series properties of each data series in section 6.3.

6.1 Derived variables

Some of the variables used in the model are not available in official publications. These are expected inflation, expected output, returns on foreign assets, the informal interest rate, the real effective exchange rate, foreign output, the real interest rate, the premium on the parallel exchange rate, the volatility of the parallel exchange rate, private investment, and government investment. The first three variables are derived in chapter 5 (section 5.2). The purpose of this section is, therefore, to discuss the methods used in deriving the rest of these variables.

6.1.1 Informal interest rate

Although the coexistence of informal financial institutions alongside the modern banking system of LDCs is widely acknowledged, there are no credible data on the informal rate of interest. However, proxy variables can be generated using the ratio of domestic credit extended to the private sector (DCp) to the level of economic activity (GDP). Following Wong (1977) a credit restraint variable (Crp) is calculated as

Crp = 1 - DCp/GDP 6.1

where DCp is domestic credit extended to the private sector.

The theoretical basis for this approach relies on the close link between the persistence of informal financial dealings and financial repression. As the amount of credit extended by the banking system declines, private borrowers shift to the informal money market, thereby increasing the informal lending rate. The imposition of quantitative restrictions on bank credits extended to the private sector is, therefore, considered as the major determinant of movements in the informal rate of interest.

6.1.2 Real effective exchange rate (REER)

The textbook definition of real exchange rate RER is

$$RER = ERO\ P^f/P^d \quad \text{......} 6.2$$

where:

ERO is the official exchange rate (units of domestic currency per unit of foreign currency)

P^f is foreign price index

P^d is domestic price index

Such a definition is based on the theory of purchasing power parity or PPP (see Krugman and Obstfeld, 1994, chapter 16). According to this theory the nominal exchange rates of two freely-trading countries is determined by the law of one price. According to this law, the domestic price of a tradable commodity should (after adjustments for transportation and related costs) be equal to its price abroad multiplied by the nominal exchange rate.

$$P^d = ERO\ P^f \quad \text{......} 6.3$$

In other words, the price of a commodity is the same within members of a free trade-area when measured in the same currency. Provided the PPP holds, this yields the definition of the nominal exchange rate in terms of the relative prices in the two economies as

$$ERO = P^d/P^f \quad \text{......} 6.4$$

According to this definition an increase in domestic prices will shift demand away from domestic goods to imported goods. Assuming no change in P^f, an increase in the demand for imports will increase demand for foreign currency and thereby depreciate the nominal exchange rate (i.e., increase ERO). Inasmuch as the movement in the price level is offset by a proportional change in the nominal rate of exchange, the terms of trade of the economy will remain the same. A change in the real rate of exchange (defined in equation 6.2) will, therefore, occur only if the changes in the relative prices exceed (or fall short of) the change in the nominal exchange rate.

Equation 6.2 is, however, more appropriate for two trading partners who use the same basket of commodities in calculating their price indexes. In reality, production structure and consumption habits differ across countries and this is likely to be reflected in the commodity baskets used for the calculation of price indexes. Consequently, none of the published measures of the price index can claim to be a perfect measure of relative prices as defined in the PPP-condition (see Krugman & Obstfeld 1994 p. 420).

For the purpose at hand we will settle for the consumer price index (CPI). Our choice is based on the fact that Ethiopian exports are primary goods (coffee, hides and skins, and oilseeds) captured by the CPI of her trade partners directly (as consumer goods) or indirectly (as inputs for final consumer goods). Secondly, prices of imports enter the Ethiopian domestic CPI in the same way.

$$RER = ERO\ CPI^f/CPI^d \qquad \text{......} 6.5$$

Since Ethiopia has more than one trading partner equation 6.5 is used to calculate the RER of each major partner. This in turn is used to calculate the real effective exchange rate (REER) as

$$REER = \Sigma(W_i\ RER_i) \qquad \text{......} 6.6$$

where RER_i is real exchange rate of the *ith* partner

W_i is weight of trade with the *ith* partner calculated as

$$W_i = (X_i + IM_i) / (X_T + IM_T) \qquad \text{......} 6.7$$

where X_i is exports from Ethiopia to the *ith* partner

IM_i is imports from the *ith* partner to Ethiopia

X_T and IM_T are respectively the total exports and total imports of Ethiopia.

The use of a particular year for the selection of major trading partners was rejected in our procedure. This decision was taken because the size of trade conducted with each partner has changed significantly during the sample period due to both economic and political reasons. Trade with the USA, for example, declined from 28% in 1964 to 12% in 1993, while trade with Western Europe and Japan increased steadily. The comparable figures for Germany show an increase from 8% to 13%. This is consistent with the general trend in the world economy following the post-war recovery of Japan and Western Europe which led to the decline of the American share in world trade.

The impact of politics on the direction of trade is clearly seen in the Ethio-Soviet trade during the sample period. Before the 1974 Ethiopian revolution, trade with the USSR was almost non-existent. The figure steadily increased in the post-revolution period, reaching its peak of 16.6% in 1984. This was followed by a period of steady decline as the communist bloc weakened and was below 1% after 1990 (see tables 6.3-63D).

In order to minimize the effect of such variations in the direction of trade, a variable weight was calculated for each trading partner using the following formula.

$$W_{ij} = [(X_{ij} X_i) + (IM_{ij} IM_i)]/ (X_T + IM_T) \quad \text{.......................................6.8}$$

where the subscripts "i" and "j" respectively represent the particular trading partner and the year in which the trade took place. The trade weights Wij were calculated for each of the 39 trading partners which appeared in the Ethiopian section of the UN Trade Statistics Yearbook and/or the IMF's Direction of Trade Statistics publications during the whole or part of the sample period (see table 6.3). This was used to calculate the average weight (W^*_i) for the whole sample period (1964-93) for each country.

$$W_i^*= \Sigma(W_{ij} /30) \quad \text{..6.9}$$

A cut-off point of $W_i^* = 5\%$ was used to select the five major trading partners (see table 6.2) and then the result was converted to w_i^* by normalizing W_i^* to 100% as follows:

$w_i^* = W_i^* / \sum W_i^*$ 6.10

Table 6- 1: Trade weights of Ethiopia with her major trade partners during 1964-93

Partner	Germany	Italy	Japan	UK	USA	Total
W_i^*	11.14%	11.33%	9.35%	5.88%	17.67%	55.37%
w_i^*	20.12%	20.47%	16.89%	10.62%	31.91	100%

Following the same logic the results of equation 6.8 were taken for the five major partners and each year was normalized to 100% as follows:

$w_{ij} = W_{ij} / \sum W_{ij}$ 6.11

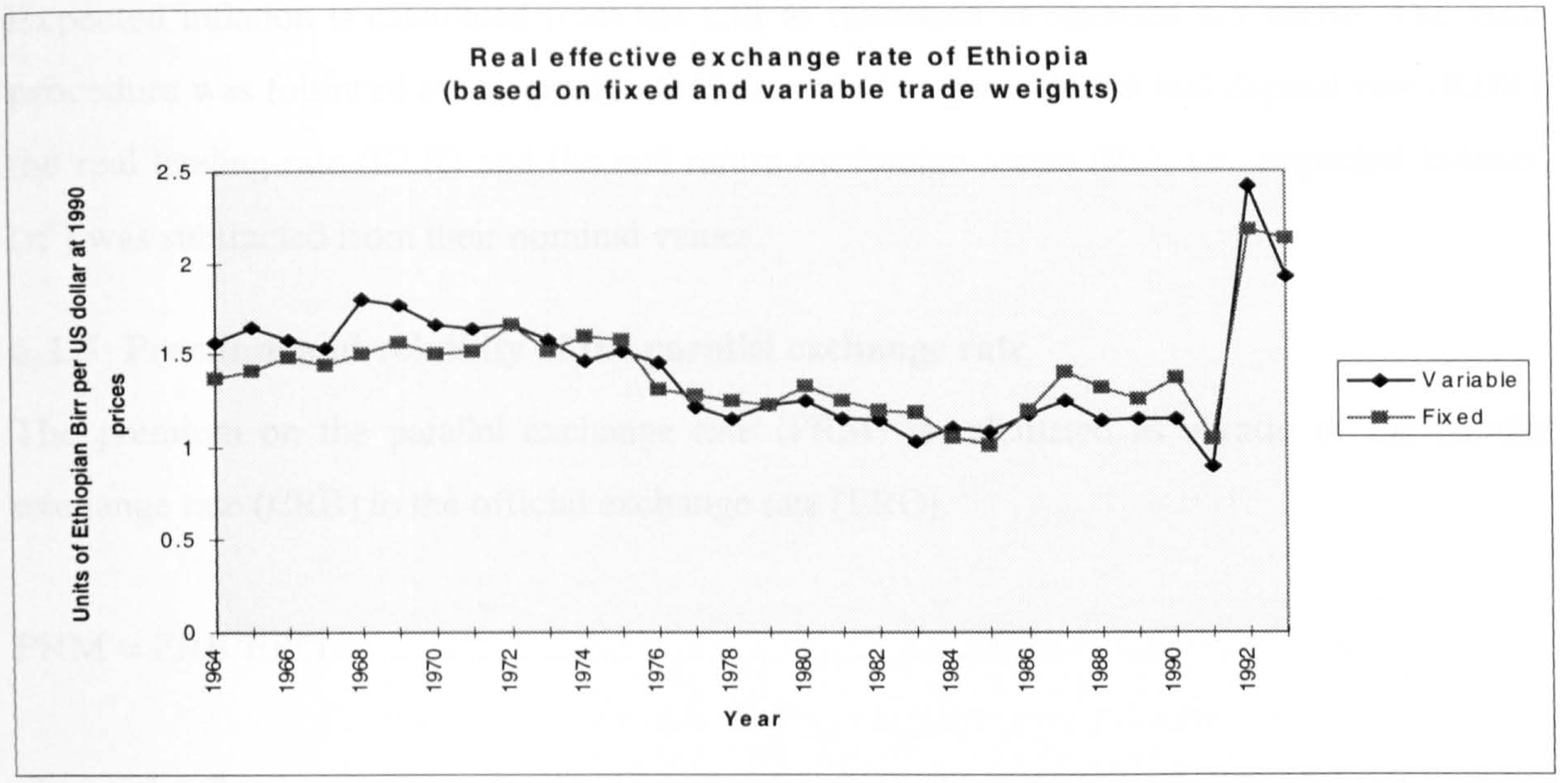
The results of equations 6.10 and 6.11 can therefore be used in equation 6.6 to respectively calculate the fixed ($REER_f$) and variable ($REER_v$) versions of the real effective exchange rates.

$REER_f = \sum(w_i * RER_i)$ 6.12

$REER_v = \sum(w_{ij}\ RER_i)$..6.13

The results of equations 6.12 and 6.13 are presented in figure 6.5 and in table 6.5. The two series move closely together but the REER based on variable weights will be used in this study because of its theoretical superiority over the fixed weight REER. As can be seen from table 6.3, Ethio-American trade fell sharply (from 20.21% to 13.4%) when the King was overthrown and the new government adopted a pro-Soviet trading policy. As a result the proportion of trade fluctuated during the sample period although the West remained the major trade partner of Ethiopia. The general trend Ethio-West trade was a gentle increase in the 1960s, sharp fall in the 1970s and 1980s, followed by an upturn in the 1990s. Equation 6.13 is superior because it accommodates these fluctuations, while equation 6.12 assumes as if the proportion of trade was fixed throughout the sample period.

Figure 6- 1: Real effective exchange rate of Ethiopia



6.1.3 Foreign income

Under normal circumstances imports depend on the level of disposable income, and foreign exchange earned from exports can be spent on imports. Our specification of the export function therefore includes foreign income as one of the explanatory variables. It is proxied by the weighted average of real output of the major trading partners selected above. The formula used in generating real foreign output (Y^f) is

$$Y^f = \sum w_{ij} (ERO_{ij} \; Y_{ij} / P_{ij}) \quad \text{.......}6.14$$

where w_{ij} is as defined in equation 6.11, but derived using weights of exports (see table 6.6).

ERO_{ij} is the official exchange rate of Ethiopian currency per the ith currency in year j.

Y_{ij} is the nominal GDP of the ith partner in year j (see table 6.8).

P_{ij} is the CPI of the ith partner in year j (see table 6.7).

6.1.4 Real interest rate

Following the reasoning underlying the Fisher effect (see Krugman and Obstfeld 1994, p. 406), the real rate of return (RRR) is defined as a difference between the nominal rate of return (NRR) and expected inflation (π^e).

$$RRR = NRR - \pi^e \quad \text{.......}6.15$$

Expected inflation is calculated from the CPI as discussed in equation 6.5 above. The same procedure was followed as in equation 6.15 was used to generate the real deposit rate (RDR), the real lending rate (RLR) and the real return on foreign assets (Ri_f), i.e., expected inflation (π^e) was subtracted from their nominal values.

6.1.5 Premium and volatility of the parallel exchange rate

The premium on the parallel exchange rate (PRM) is calculated as a ratio of the parallel exchange rate (ERB) to the official exchange rate (ERO).

$$PRM = ERB/ERO \quad \text{..........} \quad 6.16$$

Given the fixed exchange rate in the official sector, the effects of economic and political changes are likely to be concentrated in the informal market. As a freely-floating asset price, the parallel rate of exchange is expected to react quickly to actual and perceived changes in the economic and political structure of Ethiopia and thereby affect the decision-making process of investors (see De Grauwe 1992 and Montiel et al. 1993). Such volatility (VERB) of the parallel exchange market is measured by the 3-year standard deviation of the parallel exchange rate as follows.[1]

$$VERB_t = \sqrt{\Sigma(ERB_{t+i} - \overline{ERB})^2} \quad \text{..........} \quad 6.17$$

where i = -1, 0, 1and $\overline{ERB}$ is the three-year average of the parallel rate of exchange.

6.1.6 Private and public investment

The IMF data on investment report it as gross capital formation (I) for the whole economy. We have disaggregated it into private (Ip) and public (Ig) investment as follows:

$$Ig = G - Cg \quad \text{..........} \quad 6.18$$

$$Ip = I - Ig \quad \text{..........} \quad 6.19$$

[1]This definition of volatility is somewhat similar to that of Montiel et al. (1993, p.37).

where G is total public expenditure, and Cg is public spending on consumer products

6.1.7 Private financial wealth

Following Montiel et al (1993) the following formula is used to generate a proxy for private financial wealth (W):

$$W = CC + Dp - DCp \quad \text{..6.20}$$

where CC is currency outside the banking system

Dp is total bank deposits belonging to the private sector

DCp is domestic credit extended to the private sector by the banking system.

However, it is worth noting that this definition is accepted only because there is shortage of the relevant data. As a result it must be treated as a proxy for (and not a perfect measure of) the level of human wealth, physical wealth, and assets denominated in foreign currency held in the informal market.

6.2 Data sources

In this section we will discuss the sources of the data used in the estimation of the model. As an empirical study of a developing economy our model has its fair share of the problems relating to the availability of reliable data. Many important variables are categorized as confidential and thus, inaccessible to the public in their disaggregated form. Attempts have, therefore, been made to construct a consolidated data-set from different sources. The sources of the variables in each equation of the model are discussed below.

6.2.1 Consumption function

On the basis of our discussion in chapter 5, and given the availability and sufficiency of data, the function for private consumption is specified as

$$C^P = c_1\, y^d + c_2\, w - c_3\, LR - c_4\, CR - c_5\, i_f + c_6\, FER - c_7\, REER - c_8\, PRM \quad \text{..................6.21}$$

Disposable income (y^d) is calculated by deducting tax (T) from GDP. Private wealth is proxied by financial wealth (w) calculated using data on currency in circulation (CC), demand deposits (DD), time deposits (TD) and credit extended to the private sector by the domestic banking system (DCp). The lending rate (LR) is calculated as the difference between the nominal lending rate and expected inflation, while credit restraint (CR) is the ratio of domestic credit extended to the private sector (DCp) to GDP. The return on foreign assets (i_f) is the uncovered-interest-parity calculated using the US Treasury Bill rate (Iusa) and the parallel exchange rate (ERB). The real effective exchange rate (REER) is calculated using the official exchange (ERO) and trade weights and the ratio of domestic and foreign prices; while the premium on the parallel exchange rate (PRM) is the ratio of informal rate of exchange (ERB) to the official exchange rate. All these procedures are discussed in section 6.1 above.

The data for private consumption (C^P), GDP, the CPI, currency in circulation (CC), demand deposits (DD), time deposits (TD), bank credit extended to the private sector (DCp), the lending rate (LR), the US Treasury Bill rate (Iusa), the foreign exchange reserves (FER), the official exchange rate (ERO) and the CPI of Ethiopia's trade partners (P^f) were obtained from the various issues of the ***International Financial Statistics (IFS) Yearbook*** published by the International Monetary Fund. Tax revenue is collected from various issues of the ***Government Financial Statistics (GFS) Yearbook*** published by the IMF. The share of trade of Ethiopia's partners was calculated using data from various issues of the ***International Trade Statistics*** and the ***Direction of Trade Statistics*** published respectively by the UN and the IMF. Data on the parallel exchange rate (ERB) was obtained from various issues of the ***World Currency Yearbook***, and from correspondence with bank authorities and currency dealers in Ethiopia.

6.2.2 Investment function

In our search for an acceptable equation for the private investment function the following 10 explanatory variables are considered.

$$I^P = I_1\Delta Y^e + I_{P2}y^d + I_{P3}w + I_{P4}DC^P \pm I_5LR - I_6CR - I_7i_f + I_8IM - I_9CA - I_{P10}I^G \quad \text{............6.22}$$

As discussed in chapter 5 the expected growth in demand is proxied by ΔY^e and is calculated using the procedure set out in section 6.1. The availability of investable funds is represented by disposable income (y^d), financial wealth (w) and the domestic credit extended to the private sector (DC^P). The lending rate of the banking system (LR), the credit restraint variable (CR), and returns on foreign assets (i_f) are included to cater for the cost of borrowing from both formal and informal sectors. Since developing economies depend heavily on imported inputs for their industrial projects, the current account balance (CA) and/or the level of imports (IM) is included to cater for availability of imported inputs. Finally, public sector investment is included following the crowding-out argument.

I^P, I^G are calculated following the procedure discussed in section 6.1. The data used in this calculation, namely, government consumption (Cg), total public expenditure (G), and gross capital formation (I) are obtained from ***International Financial Statistics (IFS) Yearbooks*** (1994 and 1995). The same source was used for data on imports (IM) and exports (X). The current account balance (CA) is obtained by deducting imports from exports. The rest of the variables (ΔY^e, y^d, w, DC^P, LR, CR, i_f) are as defined in the equations above.

6.2.3 Export function

$$X = x_1(Y^F) - x_2(Tx) + x_3(P_x) + x_4(REER) - x_5(PRM) \quad \text{.........................6.23}$$

Foreign income (Y^f) is proxied by the weighted average of the GDP of Ethiopia's major trade partners deflated by their respective CPI. The data are obtained from the ***International Financial Statistics (IFS) Yearbooks*** and calculated according to the procedure discussed in section 6.1. The same source is used for the index of volume of exports (Qx) and value of exports (X). The ratio X/Qx was used to calculate the index of export prices (Px). Export tax (T_x) is collected from various issues of the ***Government Financial Statistics (GFS) Yearbooks***. REER and PRM are as defined above.

6.2.4 Import function

Imports are related to expenditure by the public sector (G) and the private sector. The latter is represented by the disposable income (y^d), financial wealth (w), and the credit extended by the banking system (DC). Given the scarcity of supply of foreign exchange, the reserves (FER) are expected to play a crucial role in the function. REER and PRM are included in order to represent fluctuations in international competitiveness and financial repression in the external trade of Ethiopia.

$$IM = im_1(G) + im_2(y^d) + im_3(w) + im_4(DC) + im_5(FER) + im_6(REER) - im_7(PRM) \quad \text{......6.24}$$

The definition and source of all variables are the same as in the equations above.

6.2.5 Informal rate of exchange

In chapter 5 the function for informal rate of exchange (ERB) was specified as a function of the current account (CA), foreign exchange reserve (FER), expected rate of inflation (ΔP^e) and returns on foreign assets (I_f).

$$ERB = - e_1 \ (CA) - e_2 \ (FER) + e_3 \ (\Delta P^e) + e_4 \ (I_f) \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6.25$$

The first term (CA) is defined as the ratio of net exports (i.e., exports minus imports) to GDP. The source of these variables and the rest in equation 6.25 are as defined in the discussion of the other variables.

6.2.6 Foreign exchange reserves

Similarly the equation for foreign exchange reserves (FER) was specified as a function of current account (CA) and net public borrowing from abroad (PSFB).

$$FER = r_1 \ CA + r_1 \ PSFB \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6.26$$

The data for PSFB are obtained from the ***International Financial Statistics (IFS) Yearbook***. The other variables in equation 6.26 are as defined before.

6.2.7 Money supply and the demand-for-money function

Three definitions of money supply are presented in the model. Broad money (M2) is defined as the sum of currency in circulation (CC), demand deposits (DD), time deposits (TD), and other items net (OIN). Alternatively, M2 can be defined on the asset side as the sum of domestic credit (DC) and foreign assets of the banking system (FA).

$$M2 = DC + FA \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6.27$$

$$M2 = CC + DD + TD + OIN \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6.28$$

Narrow money (M1) is defined as the sum of currency in circulation (CC) and demand deposits (DD).

$M1 = CC + DD$ 6.29

A narrower definition is the base money which is the sum of currency in circulation (CC) and reserves of the commercial banking system held by the central bank (RR).

$MB = CC + RR$ 6.30

Data on all these monetary variables is obtained from ***International Financial Statistics (IFS) Yearbooks***.

The demand for money is specified as a function of the scale variable (i.e., income, Y) and opportunity cost. The latter is represented by deposit rate (DR), lending rate (LR), credit restraint (CR), treasury bill rate (TBR), and the return on foreign assets (i_f).

$M_2 = m_1(y) - m_2(DR) + m_3(LR) - m_4(i_f) - m_5(CR) - m_6(TBR)$ 6.31

The data for the treasury bill rate are not available for most of the sample period. It is, therefore, proxied by the credit-worthiness of the government defined as the ratio of public sector borrowing requirement (PSBR) to GDP. The PSBR is defined as the excess of government expenditure (G) over its revenue (Rg) published in the World Tables by the World Bank. Source and definitions of the rest of the monetary variables are as in the discussion of the other equations above.

6.3 Time-series properties

Following the specification of the model on the basis of economic theory, we now proceed to testing the degree of integration of each series. The procedure involves analyzing the pattern of movement (or order of stationarity) of each variable of the model. If a series fluctuates around a well-defined mean with constant variance and covariance, it is called stationary or integrated of the order of zero, I(0). This enables the researcher to estimate the population parameter from a sample of observations because the difference of mean, variance and covariance across the samples is insignificant (see Holden and Thompson, 1992, p. 5).

Most economic time-series, however, increase over time and become stationary only when differenced once or twice. The order of such series is called I(1) or I(2). Formally, the degree of integration of a series X_t is defined as

$X_t \sim I(d)$ 6.32

where d is the number of times X_t needs to be differenced in order to achieve stationarity.

Testing for the order of integration of a series is important in economic research which involves time-series data because the inherent nature of any two series [$X_t \sim I(0)$ and $Y_t \sim I(1)$ or vice versa] is so different that the theoretical value of β in the following equation becomes zero (see Holden and Thompson 1992, p. 5)

$Y = \alpha + \beta X + \upsilon$ 6.33

Secondly, the theory of cointegration (see Granger and Weiss, 1983) requires that both Y and X be I(1) and that there exist a value of β which makes their linear combination $\upsilon = Y - \beta X$ stationary, i.e., $\upsilon_t \sim I(0)$. We will return to this in the next chapter where the theory of cointegration and error correction mechanism is discussed in detail.

6.3.1 Methods of testing stationarity

As discussed above, the procedure for testing the degree of integration of a series X is by testing the hypothesis H0: $X_t \sim I(0)$. If this is rejected we look for higher order of integration by testing H0: $\Delta X_t \sim I(0)$. If this is accepted we conclude that the series is I(1), if not we test for I(2) using the second difference i.e., H0: $\Delta^2 X_t \sim I(0)$.

There are three categories of tests of stationarity: Correlograms, Durbin-Watson and Dickey-Fuller tests (see Holden and Thompson 1992, p.10).

6.3.1.1 Correlograms

This is a simple correlation test of the variable X_t with its lagged value X_{t-i} formalized as

$\rho_{t,i} = \{\Sigma(X_t - \overline{X}_t)(X_{t-i} - \overline{X}_{t-i})\}/\sqrt{\{(\Sigma(X_t - \overline{X}_t)^2 \Sigma(X_{t-i} - \overline{X}_{t-i})^2\}}$ 6.34

The test is to check if $\rho_{t,i}$ dies away as the lag length 'i' increases. This test is however, prone to subjectivity.

6.3.1.2 Durbin-Watson test

This test was first proposed by Sargan and Bhargava (1983). It involves the regression of the variable X_t on a constant α and then use of the residuals (υ_t) to calculate the Durbin-Watson (DW) statistic as follows.

$X_t = \alpha + \upsilon_t$ 6.35

$DW(x) = \Sigma(\upsilon_t - u_{t-1})^2 / \Sigma(\upsilon_t)^2$ 6.36

For stationary variables the DW(x) is close to zero, while for non-stationary series it ought to tend towards 2. The calculated DW(x) statistic is compared to its critical values (provided in Sargan and Bhargava, 1983) and the null hypothesis that H0: $X_t \sim I(0)$ is accepted if DW(x) exceeds its critical value.

6.3.1.3 Dickey-Fuller test

This test is based on the work of Dickey and Fuller (1981) and tests whether the series X_t is a random walk, i.e., the significance of the coefficient β_1 in the equation below is tested using the standard "t"-ratio.[2]

$\Delta X_t = \beta_0 + \beta_1 X_{t-1} + \upsilon_t$ 6.37

The null hypothesis is H_0: $\beta_1 = 0$ (so that X is I (1)) and its rejection in favour of $\beta_{1 < 0}$ suggests that the series is stationary. If υ in 6.37 is autocorrelated, lagged values of ΔX are

[2]The t-ratio is applied in random walks with and without drift. If, however, the random walk involves a drift (β_0) and time trend (T) then

$\Delta X_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 T + \upsilon_t$

added to the equation until υ is white noise. In this case the test is the augmented Dickey-Fuller (ADF) test. However, it is worth noting that the tests are large sample tests, while this study is based on 30 annual observations only. The results should therefore be interpreted with this weakness in mind.

6.3.2 Results of test for stationarity

The Dickey-Fuller test was used to determine the order of integration of the variables of the model. The calculated statistic and critical values (CV) of each variable are obtained using Microfit (Pesaran and Pesaran, 1991) and are reported in table 6.8.

As can be seen from table 6.8, the DF-statistic for the level is larger than the critical value. However, the ADF(1)-statistic is -2.62 for levels and -4.23 first difference. Since the critical values in the ADF(1) case are -2.9706 and -2.975, we accept imports to be an I(1) series. Secondly, the DF-statistic is smaller than its critical value, implying that the expected return on foreign assets (lif) is an I(0) series. All the other variables are I (1).

The full list of these data-series is presented in table 6.9. Note that table 6.8 and table 6.9 show only the variables that are included in the final model. The rest of the variables are excluded after the coefficients of each of the equations were tested on the basis of economic theory and statistical diagnostic tests. The estimation procedure will be discussed in the next chapter.

The null hypothesis becomes H_0: $\beta_1 = 0$ and $\beta_2 = 0$ and as a joint test of two parameters, therefore, the F-test becomes more appropriate (see Holden and Thompson 1992, page 15).

6.4 Appendix

Table 6- 2: Percentage share of trade partners in Ethiopia's total foreign trade

	Aus	Bel	Can	Cey	Chi	Cze	Egy	Den	Fran	Dji	GFR
1964	0.50	1.07	NA	1.03	0.80	1.42	NA	0.42	3.06	2.01	8.21
1965	0.96	0.94	NA	0.53	0.88	1.15	NA	0.54	3.83	1.32	7.35
1966	0.66	1.00	NA	1.00	0.88	0.96	NA	0.45	3.34	1.66	8.61
1967	NA	NA	NA	NA	NA	NA	0.18	NA	3.44	1.47	10.11
1968	NA	NA	NA	NA	NA	NA	0.14	NA	4.03	1.33	9.84
1969	NA	NA	NA	NA	NA	NA	0.32	NA	4.15	2.95	12.18
1970	NA	NA	NA	NA	NA	NA	0.10	NA	2.50	2.62	10.50
1971	NA	NA	NA	NA	NA	NA	0.05	NA	2.88	2.88	9.64
1972	NA	NA	NA	NA	NA	NA	0.05	NA	3.43	2.72	9.14
1973	NA	NA	NA	NA	NA	NA	0.60	NA	3.86	3.85	10.08
1974	NA	NA	NA	NA	NA	NA	1.23	NA	3.60	3.94	11.71
1975	NA	NA	NA	NA	NA	NA	3.72	NA	3.64	5.14	9.22
1976	NA	NA	0.67	NA	NA	NA	NA	NA	2.83	4.19	7.45
1977	NA	NA	0.00	NA	NA	NA	NA	NA	2.54	2.22	8.60
1978	NA	NA	0.00	NA	NA	NA	NA	NA	2.38	2.30	10.90
1979	NA	NA	0.30	NA	NA	NA	NA	NA	2.43	2.95	8.88
1980	NA	NA	0.17	NA	NA	NA	NA	NA	4.00	5.26	9.08
1981	NA	NA	1.94	NA	NA	NA	NA	NA	4.62	2.40	9.93
1982	NA	0.33	0.57	NA	NA	NA	NA	NA	3.98	3.57	12.04
1983	NA	0.91	1.72	NA	NA	NA	NA	NA	4.55	3.18	12.31
1984	NA	0.81	1.29	NA	NA	NA	NA	NA	3.94	2.58	13.03
1985	NA	0.54	2.12	NA	NA	NA	NA	NA	3.47	1.33	12.86
1986	NA	1.48	NA	NA	NA	NA	NA	NA	2.54	1.81	18.52
1987	NA	0.61	NA	NA	NA	NA	NA	NA	2.40	3.45	12.06
1988	NA	0.97	NA	NA	NA	NA	NA	NA	2.03	2.22	14.62
1989	NA	1.22	NA	NA	NA	NA	NA	NA	3.26	2.71	15.42
1990	NA	1.16	NA	NA	NA	NA	NA	NA	2.82	5.44	12.41
1991	NA	1.48	NA	NA	NA	NA	NA	NA	4.10	4.56	16.71
1992	0.50	3.33	1.32	NA	0.45	0.11	0.85	0.11	4.73	2.64	10.03
1993	0.61	3.28	1.42	NA	1.45	NA	0.85	0.12	3.59	3.04	12.81

Aus = Austria, Bel = Belgium-Luxemburg, Can = Canada, Cey = Ceylon, Cha = China (mainland), Cze = Czechoslovakia, Egy = Egypt, Den = Denmark, Fra = France, Dji = Djibouti, GFR = Germany (FR),

Table 6.2: Percentage share of trade partners in Ethiopia's total foreign trade (... continued)											
	GDR	Gre	HK	Hun	Ind	Ira	Isr	Ita	Jap	Ken	Leb
1964	NA	0.81	0.71	0.40	1.38	2.48	1.08	12.77	8.85	0.35	0.38
1965	NA	0.70	0.61	0.40	1.07	2.04	0.96	12.55	9.22	0.17	0.43
1966	NA	0.66	0.60	0.32	0.72	2.10	1.32	14.73	9.06	0.23	0.58
1967	NA	NA	NA	NA	NA	2.30	NA	14.10	9.39	0.38	NA
1968	NA	NA	NA	NA	NA	1.68	NA	12.49	6.97	0.35	NA
1969	NA	NA	NA	NA	NA	2.80	NA	11.66	8.15	0.48	NA
1970	NA	NA	NA	NA	NA	3.05	NA	11.99	10.12	0.89	NA
1971	NA	NA	NA	NA	NA	3.58	NA	11.16	10.77	0.73	NA
1972	NA	NA	NA	NA	NA	3.19	NA	12.63	11.39	0.82	NA
1973	NA	NA	NA	NA	NA	3.07	NA	11.00	9.16	0.96	NA
1974	NA	NA	NA	NA	NA	3.27	NA	10.59	10.82	1.29	NA
1975	NA	NA	NA	NA	NA	0.57	NA	8.36	10.67	1.59	NA
1976	0.05	NA	NA	NA	NA	0.44	NA	7.88	9.75	0.61	NA
1977	6.39	NA	NA	NA	NA	2.82	NA	7.69	11.95	0.90	NA
1978	4.13	NA	NA	NA	NA	6.17	NA	9.89	11.77	1.06	NA
1979	0.04	NA	NA	NA	NA	0.22	NA	10.41	8.76	0.85	NA
1980	0.17	NA	NA	NA	NA	NA	NA	10.50	7.73	0.67	NA
1981	0.90	NA	NA	NA	NA	NA	NA	12.73	7.31	0.57	NA
1982	0.67	NA	NA	NA	NA	NA	NA	9.14	8.41	0.44	NA
1983	1.68	NA	NA	NA	NA	NA	NA	11.25	8.64	0.42	NA
1984	0.96	NA	NA	NA	NA	0.01	NA	8.95	6.85	0.42	NA
1985	NA	NA	NA	NA	NA	0.17	NA	7.90	7.45	0.31	NA
1986	NA	NA	NA	NA	NA	NA	NA	11.70	7.68	0.45	NA
1987	NA	NA	NA	NA	NA	0.03	NA	14.83	9.50	0.76	NA
1988	NA	NA	NA	NA	NA	NA	NA	13.89	9.34	0.60	NA
1989	NA	NA	NA	NA	NA	NA	NA	11.26	8.05	1.65	NA
1990	NA	NA	NA	NA	NA	NA	NA	13.06	9.74	1.20	NA
1991	NA	NA	NA	NA	NA	NA	NA	9.15	13.70	3.11	NA
1992	NA	0.17	0.17	NA	0.79	NA	0.11	10.07	9.28	0.68	NA
1993	NA	0.61	0.12	NA	1.04	NA	3.14	15.62	10.12	1.94	NA

GDR = Germany (DR), Gre = Greece, HK = Hong Kong, Hun = Hungary, Ind = India, Ira = Iran, Isr = Israel, Ita = Italy, Jap = Japan, Ken = Kenya, Leb = Lebanon

Table 6.2: Percentage share of trade partners in Ethiopia's total foreign trade (... continued)

	Mal	Net	Nor	Pak	Pol	SAr	Sin	Som	SYe	Sud	Swe
1964	0.02	3.22	0.56	0.25	0.24	0.92	0.17	0.10	2.38	0.63	1.04
1965	0.01	2.62	0.50	0.34	0.25	2.58	0.18	0.01	1.44	0.68	1.26
1966	0.02	6.33	0.61	0.23	0.30	2.81	0.24	NA	1.36	0.57	0.70
1967	NA	2.82	NA	NA	NA	2.76	NA	NA	NA	0.28	0.70
1968	NA	2.40	NA	NA	NA	3.05	NA	NA	NA	0.57	0.70
1969	NA	2.16	NA	NA	NA	3.38	NA	NA	NA	0.64	0.75
1970	NA	1.91	NA	NA	NA	3.15	NA	NA	NA	0.21	1.21
1971	NA	2.65	NA	NA	NA	3.20	NA	NA	NA	0.02	0.92
1972	NA	2.35	NA	NA	NA	2.72	NA	NA	NA	0.33	0.95
1973	NA	3.31	NA	NA	NA	3.45	NA	NA	NA	0.30	0.78
1974	NA	3.37	NA	NA	NA	5.28	NA	NA	NA	0.77	0.57
1975	NA	2.91	NA	NA	NA	14.21	NA	NA	NA	0.10	1.32
1976	NA	3.67	NA	NA	NA	10.23	NA	0.15	1.01	0.15	1.01
1977	NA	2.74	NA	NA	NA	9.31	NA	NA	NA	0.05	1.33
1978	NA	2.57	NA	NA	NA	4.28	NA	NA	0.08	NA	1.37
1979	NA	2.69	NA	NA	NA	3.62	NA	NA	0.73	NA	1.84
1980	NA	2.17	NA	NA	NA	3.28	NA	NA	0.55	0.50	0.87
1981	NA	1.46	NA	NA	NA	6.00	NA	NA	2.63	0.20	1.47
1982	NA	1.68	NA	NA	NA	3.18	NA	NA	2.19	0.07	1.51
1983	NA	2.57	NA	NA	NA	2.75	NA	NA	2.41	0.12	1.27
1984	NA	1.94	NA	NA	NA	1.81	NA	NA	2.05	0.44	0.84
1985	NA	6.30	NA	NA	NA	1.84	NA	NA	NA	0.63	2.06
1986	NA	3.00	NA	NA	NA	2.50	NA	NA	NA	0.01	1.94
1987	NA	2.24	NA	NA	NA	3.65	NA	NA	NA	0.03	2.52
1988	NA	5.87	NA	NA	NA	2.87	NA	NA	NA	0.10	3.06
1989	NA	4.25	NA	NA	NA	3.26	NA	NA	NA	0.10	2.14
1990	NA	2.72	NA	NA	NA	4.92	NA	NA	NA	0.03	1.11
1991	NA	2.99	NA	NA	NA	9.44	NA	NA	NA	NA	1.45
1992	0.17	3.35	0.28	0.06	0.45	10.94	NA	NA	NA	NA	1.08
1993	0.32	2.81	0.24	NA	0.36	5.92	NA	NA	NA	NA	2.42

Mal = Malaysia (West), Net = Netherlands, Nor = Norway, Pak = Pakistan, Pol = Poland, SAr = S. Arabia, Sin = Singapore, Som = Somalia, SYe = S. Yemen, Sud = Sudan, Swe = Sweden

Table 6.2: Percentage share of trade partners in Ethiopia's total foreign trade (... continued)

	Swi	USSR	U.A.R	UK	USA	Yug		Total
1964	0.89	0.79	0.32	6.42	28.08	2.96		96.69
1965	0.58	1.08	0.13	6.53	30.70	1.07		95.64
1966	0.75	1.78	0.26	7.07	24.13	0.63		96.67
1967	0.66	1.96	NA	6.12	24.70	NA		81.37
1968	0.60	1.94	NA	6.61	29.89	NA		82.58
1969	0.66	1.60	NA	6.99	24.48	NA		83.34
1970	0.71	0.61	NA	4.69	28.25	NA		82.49
1971	1.30	1.57	NA	6.11	25.13	NA		82.58
1972	0.97	1.38	NA	6.37	21.14	NA		79.59
1973	0.92	1.20	NA	5.93	20.21	NA		78.69
1974	1.15	1.25	NA	5.23	13.40	NA		77.47
1975	1.42	0.89	NA	5.80	12.80	NA		82.34
1976	NA	0.82	NA	4.80	24.31	NA		80.01
1977	NA	0.73	NA	4.36	16.36	NA		78.00
1978	NA	1.54	NA	5.02	14.52	NA		77.99
1979	NA	3.50	NA	4.80	18.39	NA		70.41
1980	NA	4.64	NA	4.70	12.10	NA		66.39
1981	NA	3.07	NA	4.86	13.25	NA		73.37
1982	NA	17.33	NA	5.53	12.03	NA		82.64
1983	NA	13.43	NA	5.42	10.36	NA		82.98
1984	NA	16.58	NA	4.96	16.75	NA		84.20
1985	NA	13.33	NA	6.84	14.21	NA		81.36
1986	NA	10.54	NA	5.38	15.42	NA		82.98
1987	NA	9.78	NA	5.61	13.35	NA		80.83
1988	NA	9.59	NA	5.98	10.53	NA		81.67
1989	NA	12.01	NA	6.26	8.85	NA		80.45
1990	NA	9.37	NA	5.80	7.48	NA		77.27
1991	NA	0.88	NA	4.87	10.57	NA		83.00
1992	0.78	NA	NA	9.25	16.81	NA		88.53
1993	0.79	NA	NA	8.07	11.84	NA		92.52

Swi = Switzerland, U.A.R = United Arab Republic, Yug = Yugoslavia,

Table 6- 3: Weighted percentage of Ethiopian trade with major trade partners

Trade weights (actual values)								Trade weights (normalized to 100%)					
	Ger	Italy	Japan	UK	USA	**Total**		Ger	Italy	Japan	UK	USA	**Total**
1964	8.21	12.77	8.85	6.42	28.08	**64.33**		13	2	14	1	44	**100%**
1965	7.35	12.55	9.22	6.53	30.70	**66.37**		11	19	14	1	46	**100%**
1966	8.61	14.73	9.06	7.07	24.13	**63.60**		14	23	14	11	38	**100%**
1967	10.11	14.10	9.39	6.12	24.70	**64.42**		16	22	15	9	38	**100%**
1968	9.84	12.49	6.97	6.61	29.89	**65.81**		15	19	11	1	45	**100%**
1969	12.18	11.66	8.15	6.99	24.48	**63.45**		19	18	13	11	39	**100%**
1970	10.50	11.99	10.12	4.69	28.25	**65.54**		16	18	15	07	43	**100%**
1971	9.64	11.16	10.77	6.11	25.13	**62.80**		15	18	17	1	4	**100%**
1972	9.14	12.63	11.39	6.37	21.14	**60.67**		15	21	19	1	35	**100%**
1973	10.08	11.00	9.16	5.93	20.21	**56.39**		18	2	16	11	36	**100%**
1974	11.71	10.59	10.82	5.23	13.40	**51.76**		23	2	21	1	26	**100%**
1975	9.22	8.36	10.67	5.80	12.80	**46.85**		2	18	23	12	27	**100%**
1976	7.45	7.88	9.75	4.80	24.31	**54.19**		14	15	18	9	45	**100%**
1977	8.60	7.69	11.95	4.36	16.36	**48.95**		18	16	24	9	33	**100%**
1978	10.90	9.89	11.77	5.02	14.52	**52.10**		21	19	23	1	28	**100%**
1979	8.88	10.41	8.76	4.80	18.39	**51.24**		17	2	17	9	36	**100%**
1980	9.08	10.50	7.73	4.70	12.10	**44.10**		21	24	18	11	27	**100%**
1981	9.93	12.73	7.31	4.86	13.25	**48.09**		21	26	15	1	28	**100%**
1982	12.04	9.14	8.41	5.53	12.03	**47.14**		26	19	18	12	26	**100%**
1983	12.31	11.25	8.64	5.42	10.36	**47.98**		26	23	18	11	22	**100%**
1984	13.03	8.95	6.85	4.96	16.75	**50.54**		26	18	14	1	33	**100%**
1985	12.86	7.90	7.45	6.84	14.21	**49.26**		26	16	15	14	29	**100%**
1986	18.52	11.70	7.68	5.38	15.42	**58.70**		32	2	13	9	26	**100%**
1987	12.06	14.83	9.50	5.61	13.35	**55.36**		22	27	17	1	24	**100%**
1988	14.62	13.89	9.34	5.98	10.53	**54.35**		27	26	17	11	19	**100%**
1989	15.42	11.26	8.05	6.26	8.85	**49.85**		31	23	16	13	18	**100%**
1990	12.41	13.06	9.74	5.80	7.48	**48.50**		26	27	2	12	15	**100%**
1991	16.71	9.15	13.70	4.87	10.57	**55.00**		3	17	25	9	19	**100%**
1992	10.03	10.07	9.28	9.25	16.81	**55.44**		18	18	17	17	3	**100%**
1993	12.81	15.62	10.12	8.07	11.84	**58.45**		22	27	17	14	2	**100%**
Avg	**11.14**	**11.33**	**9.35**	**5.88**	**17.67**	**55.37**		**2**	**21**	**17**	**11**	**31**	**100%**

Ger = Germany

Table 6- 4: Real effective exchange rate

Real exchange rate: (bilateral exchange rate over relative price)							Real effective exchange rate	
	Ger	Italy	Japan	UK	USA		Variable	Fixed
64	1.080	0.002	0.007	3.313	2.513		1.567	1.372
65	1.105	0.002	0.008	3.504	2.553		1.650	1.411
66	1.168	0.002	0.008	3.652	2.672		1.579	1.477
67	1.171	0.002	0.008	3.200	2.713		1.529	1.443
68	1.189	0.002	0.009	3.323	2.830		1.798	1.497
69	1.290	0.002	0.009	3.465	2.939		1.765	1.567
70	1.227	0.002	0.009	3.345	2.823		1.654	1.505
71	1.322	0.002	0.010	3.580	2.701		1.634	1.510
72	1.515	0.002	0.012	3.746	2.968		1.658	1.652
73	1.586	0.002	0.012	3.349	2.607		1.572	1.508
74	1.753	0.002	0.012	3.617	2.671		1.457	1.591
75	1.599	0.002	0.013	3.627	2.725		1.511	1.579
76	1.441	0.001	0.011	2.770	2.245		1.453	1.302
77	1.436	0.001	0.013	3.079	2.048		1.214	1.272
78	1.487	0.001	0.014	3.111	1.927		1.151	1.247
79	1.409	0.001	0.011	3.323	1.847		1.220	1.228
80	1.257	0.001	0.013	4.026	2.009		1.241	1.324
81	1.094	0.001	0.012	3.399	2.091		1.148	1.250
82	1.032	0.001	0.011	2.948	2.096		1.146	1.191
83	0.936	0.001	0.011	2.787	2.176		1.027	1.180
84	0.765	0.001	0.010	2.153	2.094		1.104	1.052
85	0.839	0.001	0.010	2.396	1.820		1.079	1.006
86	1.179	0.001	0.015	2.803	2.058		1.172	1.194
87	1.487	0.002	0.019	3.799	2.186		1.240	1.403
88	1.250	0.002	0.018	3.597	2.124		1.147	1.314
89	1.249	0.002	0.015	3.191	2.066		1.157	1.252
90	1.386	0.002	0.015	3.991	2.070		1.155	1.366
91	1.041	0.001	0.013	3.019	1.589		0.892	1.040
92	2.222	0.003	0.028	5.534	3.580		2.416	2.182
93	2.089	0.002	0.031	5.317	3.561		1.919	2.126

Ger = Germany

Table 6- 5: Variable weights of exports to major trade partners (normalized to 100%)

	Germany	Italy	Japan	UK	USA		Total
1964	5.5	10.7	3.5	6.1	74.3		100.00%
1965	6.1	0.9	3.4	0.5	76.5		100.00%
1966	8.3	13.5	6.3	6.8	65.1		100.00%
1967	8.3	12.7	6.6	6.4	6.6		100.00%
1968	12.4	9.5	6.3	5.1	66.7		100.00%
1969	14.4	10.6	7.2	4.8	6.3		100.00%
1970	10.5	8.9	7.8	2.7	70.1		100.00%
1971	12.1	8.1	9.2	3.4	67.2		100.00%
1972	12.1	13.6	11.4	4.6	58.3		100.00%
1973	15.9	14.1	0.1	5.4	54.5		100.00%
1974	22.8	13.4	18.2	6.4	39.1		100.00%
1975	18.1	10.4	19.5	6.7	45.2		100.00%
1976	10.8	12.4	12.4	5.5	58.8		100.00%
1977	17.7	9.9	14.4	5.2	52.8		100.00%
1978	17.5	9.3	12.7	4.3	56.2		100.00%
1979	1.3	20.2	11.2	0.4	51.6		100.00%
1980	18.8	22.3	14.2	4.6	0.4		100.00%
1981	21.4	14.4	15.2	6.5	42.5		100.00%
1982	28.3	9.4	13.1	3.6	45.6		100.00%
1983	30.8	1.4	14.0	0.3	38.1		100.00%
1984	3.3	13.5	13.7	4.3	35.5		100.00%
1985	36.9	15.3	20.5	6.3	20.9		100.00%
1986	48.1	11.7	12.5	2.4	25.3		100.00%
1987	29.4	14.4	18.5	6.4	31.3		100.00%
1988	43.1	13.1	22.5	3.2	18.1		100.00%
1989	4.1	11.6	18.8	3.1	25.4		100.00%
1990	32.2	14.2	27.9	5.5	20.2		100.00%
1991	43.1	10.2	34.5	4.9	7.4		100.00%
1992	23.7	15.8	35.1	18.4	0.7		100.00%
1993	28.9	20.1	26.4	11.3	13.2		100.00%

Table 6- 6: CPI of Ethiopia's major trade partners adjusted by their share in total export (1990 price = 100)

	Germany	Italy	Japan	UK	USA		Total (P_{FX})
1964	2.221	0.961	0.857	0.684	17.604		22.326
1965	2.550	0.847	0.899	0.595	18.426		23.317
1966	3.598	1.313	1.739	0.825	16.219		23.694
1967	3.639	1.246	1.903	0.804	16.831		24.422
1968	5.562	0.943	1.921	0.664	17.733		26.823
1969	6.539	1.074	2.307	0.661	17.710		28.290
1970	4.947	0.955	2.688	0.402	20.811		29.803
1971	6.001	0.909	3.381	0.542	20.841		31.674
1972	6.321	1.602	4.398	0.797	18.649		31.768
1973	8.912	1.851	4.284	1.022	18.540		34.609
1974	13.662	2.095	9.665	1.398	14.772		41.591
1975	11.474	1.900	11.538	1.823	18.640		45.376
1976	7.149	2.649	8.060	1.752	25.621		45.231
1977	12.110	2.486	10.087	1.917	24.513		51.112
1978	12.346	2.615	9.270	1.685	28.063		53.978
1979	9.551	6.541	8.475	1.803	28.622		54.992
1980	14.537	8.782	11.554	2.461	25.269		62.603
1981	17.591	6.776	13.027	3.847	29.546		70.787
1982	24.485	5.129	11.521	2.306	33.731		77.172
1983	27.535	8.788	12.558	2.027	29.049		79.957
1984	30.120	9.416	12.591	3.006	28.236		83.368
1985	34.439	11.648	19.195	4.743	17.223		87.248
1986	44.894	9.409	11.761	1.828	21.234		89.125
1987	27.489	12.128	17.395	5.204	27.234		89.450
1988	40.891	11.570	21.342	2.731	16.349		92.882
1989	39.979	10.918	18.284	2.840	24.074		96.094
1990	32.192	14.224	27.887	5.482	20.214		100.000
1991	44.565	10.872	35.614	5.132	7.687		103.871
1992	25.484	17.637	36.842	20.226	7.537		107.726
1993	32.403	23.487	28.106	12.623	14.608		111.225

Note that $P_{FX} = \sum w_{ij} (P_{ij})$; where w_{ij} and P_{ij} are as defined in equation 6.14.

Table 6- 7: Nominal GDP of major trade partners adjusted by their share in total exports (Billions of Ethiopian Birr at 1990 prices)

	Germany	Italy	Japan	UK	USA		Total
1964	14.484	15.546	7.125	14.233	1203.465		1254.854
1965	17.486	14.097	7.721	12.736	1343.127		1395.167
1966	25.499	22.975	16.470	18.100	1253.542		1336.586
1967	25.559	23.785	20.347	15.632	1343.657		1428.981
1968	41.477	19.323	23.318	13.238	1482.167		1579.523
1969	58.129	23.747	31.243	13.556	1511.787		1638.463
1970	48.609	24.056	39.835	8.469	1770.017		1890.987
1971	63.832	22.942	54.176	11.422	1695.925		1848.297
1972	71.468	42.055	80.385	16.188	1617.189		1827.286
1973	111.990	46.527	82.867	19.409	1522.797		1783.589
1974	193.107	52.298	168.388	26.144	1179.402		1619.339
1975	146.658	43.823	196.101	29.832	1484.233		1900.647
1976	106.185	51.464	146.471	24.468	2149.558		2478.146
1977	207.795	50.244	230.371	30.159	2158.805		2677.373
1978	254.900	58.639	276.111	30.194	2599.149		3218.993
1979	216.282	161.023	214.190	36.641	2656.742		3284.879
1980	292.507	192.728	346.783	53.130	2244.851		3130.000
1981	301.933	115.397	369.550	65.312	2663.124		3515.317
1982	391.559	77.227	312.055	33.393	2975.860		3790.094
1983	390.982	110.735	352.055	27.535	2687.087		3568.393
1984	379.402	105.141	340.191	33.164	2776.980		3634.878
1985	565.385	153.419	679.115	67.567	1749.578		3215.064
1986	988.086	160.709	544.106	27.699	2236.283		3956.883
1987	765.162	251.164	1078.389	105.645	2941.779		5142.139
1988	1051.217	226.524	1373.919	56.930	1832.467		4541.057
1989	1113.186	226.088	1077.656	53.332	2757.233		5227.495
1990	1081.730	341.852	1823.459	120.577	2310.624		5678.241
1991	1549.196	262.647	2572.483	107.752	873.919		5365.997
1992	2050.137	808.979	6523.222	828.977	2118.772		12330.087
1993	2373.054	915.480	5535.350	525.234	4211.821		13560.938

Table 6- 8: Results of stationarity test

	Name of variables in the model	Code	Dickey-Fuller statistic for :	
			Level 5% CV = -2.9665	First difference 5% CV = -2.9706
1	Private consumption	lrcp	-1.48	-4.88
2	Disposable income	lryd	-0.86	-4.04
3	Private financial wealth	lrw	-0.84	-4.80
4	Government consumption	lrcg	-2.78	-4.08
5	Deposit rate	lrdr2	-2.26	-4.43
6	Private investment	lrip	-2.13	-7.23
7	Imports	lrim	-3.03	-4.23
8	Real effective exchange rate	lreer	-2.60	-7.75
9	Premium on informal exchange rate	lprm	-1.98	-5.08
10	Foreign exchange reserves	lrfer	-1.99	-4.24
11	Ratio of external balance to GDP	lca	-0.53	-3.60
12	Credit restraint to private sector	lcrp	-1.49	-4.14
13	Growth of GDP	lrexdy2	-1.62	-4.89
14	Domestic credit to private sector	lrdcp	-1.28	-3.34
15	Exports	lrx	-2.86	-3.69
16	Foreign output	lryf	-0.96	-5.48
17	Price of exports	lpx	-1.04	-6.29
18	Volatility of informal exchange rate	lverb2	-2.49	-5.14
19	Government investment	lrig	-1.99	-7.05
20	Informal rate of exchange	lerb	-1.03	-5.34
21	Expected return on foreign assets	lif	-5.15	-6.75
22	Expected inflation	lexinf3	-1.58	-4.80
23	Broad money (M2)	lm2	-1.24	-5.16
24	Lending rate	lrlr2	-2.28	-5.04
25	GDP	lry	-1.08	-4.22
26	Treasury bill rate (proxy)	ltbr	-1.64	-7.95

Note:
In the second column the first letter (l) in the code of the variables stands for logarithm. The second letter (r) stands for real because the nominal values of the respective variable are discounted by the actual or expected price level.

Table 6- 9: Full data of the final model

	LRCP	LRYD	LRW	LRCG	LRDR2	LCRP	LRIP	LRIM	LREXDY2
1964	4.590	4.722	2.210	2.485	0.043	-0.055	2.510	2.767	0.090
1965	4.697	4.828	2.364	2.656	0.043	-0.054	2.686	2.961	0.090
1966	4.737	4.879	2.401	2.781	0.054	-0.063	2.725	3.060	0.042
1967	4.776	4.933	2.372	2.794	0.038	-0.063	2.877	2.963	0.047
1968	4.839	4.996	2.423	2.842	0.049	-0.070	2.923	3.002	0.049
1969	4.893	5.035	2.553	2.845	0.049	-0.076	2.932	3.014	0.045
1970	4.896	5.034	2.264	2.824	0.042	-0.091	2.733	2.953	0.039
1971	4.965	5.085	2.178	2.860	0.023	-0.093	2.746	3.047	0.023
1972	5.011	5.157	2.532	3.020	0.033	-0.098	2.927	3.149	0.026
1973	4.946	5.119	2.937	2.992	0.062	-0.099	2.764	3.018	0.034
1974	4.976	5.141	3.003	2.996	0.042	-0.103	2.619	3.107	0.014
1975	4.952	5.058	3.216	3.149	0.021	-0.088	2.336	3.354	0.017
1976	4.744	4.897	3.148	3.070	0.006	-0.081	2.008	3.013	-0.021
1977	4.757	4.844	3.140	3.026	-0.055	-0.087	1.685	3.089	-0.067
1978	4.699	4.769	3.048	3.141	-0.061	-0.106	0.813	3.166	-0.050
1979	4.656	4.695	3.306	2.933	-0.060	-0.053	1.043	3.091	-0.051
1980	4.650	4.701	3.379	2.990	-0.044	-0.035	0.850	3.235	-0.032
1981	4.600	4.664	3.402	3.042	-0.010	-0.043	1.200	3.171	-0.013
1982	4.565	4.639	3.452	3.121	0.007	-0.044	2.092	3.218	-0.013
1983	4.622	4.728	3.658	3.316	0.020	-0.040	1.445	3.313	-0.011
1984	4.549	4.635	3.671	3.174	0.039	-0.037	2.311	3.381	0.023
1985	4.388	4.478	3.656	3.040	0.024	-0.038	1.233	3.175	-0.007
1986	4.598	4.672	3.882	3.216	-0.015	-0.035	2.004	3.392	-0.059
1987	4.651	4.726	3.941	3.298	0.043	-0.046	2.254	3.429	0.018
1988	4.559	4.682	4.019	3.474	0.066	-0.033	2.475	3.381	0.042
1989	4.524	4.659	4.086	3.465	0.062	-0.032	1.653	3.283	0.036
1990	4.433	4.630	4.214	3.497	-0.013	-0.033	1.519	3.097	-0.003
1991	4.366	4.442	4.074	3.074	-0.033	-0.031	1.291	2.922	-0.026
1992	4.357	4.375	4.108	2.670	-0.094	-0.047	0.565	2.859	-0.087
1993	4.498	4.548	4.098	3.028	-0.005	-0.084	1.942	3.811	-0.094

Table 6-9: Full data of the final model (continuation ...)

	LRDCP	LREER	LPRM	LRX	LRYF	LPX	LVERB2	LRFER	LRIG
1964	1.902	0.449	0.077	2.686	4.029	3.653	-2.572	1.758	0.980
1965	1.975	0.501	0.095	2.805	4.092	3.664	-2.852	2.006	0.805
1966	2.184	0.457	0.131	2.838	4.033	3.711	-2.572	2.016	1.380
1967	2.237	0.425	0.131	2.773	4.069	3.611	-2.852	1.772	1.383
1968	2.404	0.587	0.131	2.832	4.076	3.617	-11.513	1.739	1.456
1969	2.523	0.568	0.131	2.818	4.059	3.661	-11.513	1.796	1.386
1970	2.689	0.503	0.172	2.923	4.150	3.835	-2.670	1.681	1.407
1971	2.765	0.491	0.225	2.877	4.067	3.729	-2.773	1.509	1.688
1972	2.885	0.506	0.059	2.986	4.052	3.761	-1.260	1.950	1.730
1973	2.863	0.452	0.065	3.187	3.942	3.939	-1.078	2.493	1.650
1974	2.923	0.376	0.334	3.341	3.662	4.224	-1.062	2.892	1.613
1975	2.696	0.413	0.936	3.081	3.735	4.220	0.478	2.878	2.099
1976	2.453	0.373	0.683	2.940	4.004	4.404	0.178	2.693	1.936
1977	2.494	0.194	0.371	2.864	3.959	4.884	0.131	2.200	2.019
1978	2.614	0.141	0.511	2.782	4.088	4.705	-0.592	1.776	2.068
1979	1.888	0.199	0.354	2.719	4.090	4.591	-1.290	1.746	2.128
1980	1.492	0.216	0.330	2.924	3.912	4.924	-1.168	0.869	2.379
1981	1.678	0.138	0.371	2.812	3.905	4.817	-2.809	2.035	2.309
1982	1.665	0.136	0.496	2.691	3.894	4.786	-1.301	1.621	1.906
1983	1.672	0.027	0.581	2.757	3.798	4.708	-1.046	1.224	2.554
1984	1.522	0.099	0.841	2.780	3.775	4.752	-0.305	0.086	2.292
1985	1.383	0.076	0.801	2.497	3.607	4.720	-0.531	1.184	2.567
1986	1.489	0.159	0.615	2.788	3.793	4.928	-0.665	1.815	2.407
1987	1.833	0.215	1.064	2.750	4.052	4.740	0.095	1.112	2.508
1988	1.471	0.137	1.182	2.693	3.890	4.911	0.416	0.410	2.236
1989	1.406	0.146	1.086	2.749	3.996	4.858	-0.914	0.001	2.505
1990	1.404	0.144	1.218	2.633	4.039	4.605	-0.803	-0.887	2.378
1991	1.106	-0.114	1.247	2.114	3.945	4.865	-0.564	-0.188	1.922
1992	1.424	0.882	0.374	1.935	4.740	4.981	-1.965	2.005	1.847
1993	2.160	0.652	0.342	3.015	4.803	*NONE*	-2.138	2.664	2.746

Table 6-9: Full data of the final model (continuation ...)

	LCA	LERB	LIF	LEXINF3	LM2	LRLR2	LRY	LTBR
1964	-0.010	0.993	0.053	0.001	2.814	0.061	4.822	0.008
1965	-0.020	1.012	0.074	0.001	2.955	0.061	4.927	0.002
1966	-0.030	1.047	0.048	-0.010	3.021	0.071	4.978	0.011
1967	-0.022	1.047	0.042	0.006	3.023	0.055	5.033	0.007
1968	-0.019	1.047	0.052	0.000	3.162	0.068	5.095	0.013
1969	-0.022	1.047	0.106	0.000	3.264	0.068	5.134	0.007
1970	-0.003	1.089	0.032	0.007	3.229	0.062	5.133	0.010
1971	-0.019	1.058	-0.122	0.036	3.241	0.046	5.184	0.011
1972	-0.019	0.892	-0.059	0.025	3.470	0.056	5.254	0.013
1973	0.020	0.793	0.336	-0.004	3.637	0.086	5.223	0.010
1974	0.031	1.061	0.678	0.016	3.750	0.066	5.244	0.008
1975	-0.040	1.664	-0.196	0.037	3.839	0.044	5.173	0.040
1976	-0.010	1.411	-0.264	0.053	3.740	0.029	5.006	0.053
1977	-0.031	1.099	0.191	0.113	3.705	-0.032	4.981	0.033
1978	-0.057	1.238	-0.087	0.119	3.730	-0.038	4.909	0.056
1979	-0.055	1.082	0.072	0.118	3.772	-0.036	4.855	0.031
1980	-0.053	1.058	0.151	0.103	3.775	-0.021	4.873	0.044
1981	-0.058	1.099	0.257	0.069	3.882	0.013	4.841	0.038
1982	-0.087	1.224	0.186	0.052	3.917	0.030	4.814	0.053
1983	-0.091	1.308	0.343	0.038	4.042	0.043	4.902	0.130
1984	-0.112	1.569	0.051	0.020	4.033	0.062	4.829	0.061
1985	-0.118	1.528	-0.113	0.034	3.993	0.048	4.664	0.083
1986	-0.110	1.343	0.507	0.076	4.225	-0.006	4.861	0.071
1987	-0.116	1.792	0.174	0.022	4.307	0.036	4.930	0.059
1988	-0.115	1.910	-0.032	-0.001	4.320	0.059	4.901	0.064
1989	-0.088	1.813	0.211	0.003	4.365	0.055	4.872	0.080
1990	-0.068	1.946	0.101	0.037	4.482	0.022	4.823	0.131
1991	-0.108	1.974	0.062	0.043	4.310	0.015	4.611	0.116
1992	-0.124	1.984	0.002	0.130	4.389	-0.053	4.500	0.100
1993	-0.260	1.952	0.098	0.113	4.521	0.018	4.684	0.106

CHAPTER SEVEN

ESTIMATION PROCEDURE AND RESULTS

In the previous chapter the data were analyzed. Most of the data were obtained from official publications while some had to be derived on the basis of theoretically-justifiable procedures. The order of stationarity of each data-series was also analyzed because in any linear combination of two or more variables, the variance of the higher-order series tends to dominate that of the lower series, potentially leading to a non-stationary result (see Holden and Thompson 1992, p. 7).

The data will be used to estimate the equations of the macroeconomic model in this chapter. The first section will present the estimation technique and its underlying theory. In section two the results of the estimation will be discussed while section three presents the conclusions. The treatment of the equations as parts of a macro-system is deferred to chapter eight.

7.1 Estimation procedure.

In this chapter an error correction model (ECM) is estimated on the basis of the theory of cointegration. We opted for the ECM approach because it offers statistical criteria by which one can link the short-run dynamics with the long-run relationship, and when the regression is based on the theory of cointegration it produces estimates that are consistent with economic theory and produce better forcasting performance (Engle and Granger, 1987). The procedure can be demonstrated using the "general-to-specific" modelling approach, proposed by Hendry and his associates (see Gilbert, 1986)[1]. It starts with a general model that has a large number of lagged variables and parameters. For a two-variable system (i.e., X and Y), for example, the unrestricted dynamic model can be specified as

$$Y_t = \alpha + \sum\beta_i Y_{t-i} + \sum\gamma_j X_{t-j} + \varepsilon_t \quad \text{...} 7.1$$

where i = 1, 2 ...n and j = 0, 1, 2, ...m and ε is a random disturbance. The residuals (ε_t) must be a white noise; if not, new variables and/or extra lagged values are added. There are no clear-

[1] For criticism of the alternative approach to modelling, i.e., the "specific-to-general" methodology, see Hendry and Mizon (1978), and Sims (1980).

cut criteria for the levels of 'n' and 'm' in the literature and, thus, are mainly left to researchers as an empirical matter. For simplicity, let us assume the search resulted in the general model.

$$Y_t = \alpha + \beta_1 Y_{t-1} + \gamma_0 X_t + \gamma_1 X_{t-1} + \varepsilon_t \quad \text{...7.2}$$

where coefficients α, β_1, γ_0, and γ_1 are significant, satisfy the statistical diagnostic tests and the size and sign of each parameter accords with the underlying economic theory. The general model (7.2) incorporates both the long-run equilibrium relationship and the short-run dynamics which show the direction and speed of movements between different equilibria. This can be demonstrated by rewriting equation 7.2 as

$$\Delta Y_t = \delta_0 + \delta_1 \Delta X_t + \delta_2 Y_{t-1} + \delta_3 X_{t-1} + \varepsilon_t \quad \text{...7.3}$$

where $\delta_0 = \alpha$, $\delta_1 = \gamma_0$, $\delta_2 = (\beta_1 - 1)$, $\delta_3 = (\gamma_1 + \gamma_0)$. In the long-run we have $\Delta Y_t = 0 = \Delta X_t$, and thus, equation 7.3 becomes

$$Y_t = -[\delta_0 + \delta_3 X_t + \varepsilon_t] / \delta_2 \quad \text{...7.4}$$

Equation 7.4 is therefore the portion of the general model (7.3) that represents the long-run relationship between X and Y.

Alternatively, the general model can be estimated as a two-step procedure where the long-run relationship is first established and then the general model is estimated. The procedure requires the variables to be cointegrated. In other words, the long-run function is usually a relationship between trended variables in levels of $X \sim I(d)$ and $Y \sim I(k)$ where $d, k > 0$. This is because most economic variables grow over time and the stationarity is achieved from their linear combination

$$Y = \alpha + \beta X + u \quad \text{...7.5}$$

where $u \sim I(0)$ implies that there is no systematic divergence between the two series over time and thus the error term

$$u = Y - (\alpha + \beta X) \quad \text{...} 7.6$$

is stationary with constant mean of zero, a constant variance and constant covariances even though the means of the underlying series of X and Y increase over time. As discussed in chapter six such non-stationary series with a linear combination which is stationary are said to be cointegrated. In the long-run X and Y will not drift apart although both of them are growing over time.

In the short-run, however, X and Y may not follow the same trend and the traditional method of modelling such short-run disequilibrium is the partial adjustment procedure, where the trend is first eliminated by differencing the levels of variables and then a function is estimated between the stationary variables. If, for example, X and Y are I(1) then the first differences ΔX and ΔY will be stationary and the short-run dynamics will be specified as

$$\Delta Y_t = \Sigma\beta_i \Delta Y_{t-i} + \Sigma\alpha_j \Delta X_{t-j} + \varepsilon_t \quad \text{...} 7.7$$

where i = 1, 2 ...n and j = 0, 1, 2, ...m and ε is a random disturbance. To link the long-run equilibrium to the short-run dynamics, however, we need to include the error correction term ($u = Y - (\alpha + \beta X)$) from equation 7.6 in equation 7.7; otherwise, it may result in spurious relationships and poor forcasting performance (see Engle and Granger, 1987). Moreover, for cointegrated I(1) variables the ECM approach is said to be superior in yielding interpretations consistent with economic theory, compared with simple regressions in first difference form. Granger (1986), and Engle and Granger (1987) demonstrated that the exclusion of the ECM term is likely to lead to the drifting-apart of cointegrated variables and thereby reduce the explanatory power and forcasting performance of the model. In other words, the inclusion of an ECM term would prevent spurious relationships that would have resulted from model specifications such as equation 7.7.

In the following sections a brief and simplified discussion of the estimation technique is presented on the basis of the articles by Holden and Thompson (1992), Johansen (1988, 1992), Johansen and Juselius (1990).

7.1.1 The theory of cointegration

The theory of cointegration was first developed by Granger (1981). It was further elaborated by Engle and Granger (1987) where they proposed a two-stage approach to cointegration analysis to link the short-run dynamics with long-run equilibrium. The formal definition of cointegration (presented in equations 7.5 and 7.6 above) was given by Granger and Weiss (1983).

In equation 7.5, β is said to be the constant of cointegration and, in the case of more than two variables, it becomes the cointegrating vector. In addition to its economic interpretation as the long-run elasticity, the estimate of β yields an important statistical property known as "super-consistency". In other words, the value of β obtained from the cointegrating regression converges more rapidly to its true value compared to the alternative value obtained from standard OLS regression, especially when the variables are non-stationary and the sample size is small (Stock 1987).

Granger (1983) and Engle and Granger (1987) have demonstrated that if *X* and *Y* are both I(1) variables and are cointegrated, then the following error correction models exists[2],

$$\Delta Y_t = -\rho_1 u_{t-1} + \text{lagged}\,(\Delta Y, \Delta X) + \varepsilon_{1t} \quad \text{..............................} 7.8$$

$$\Delta X_t = -\rho_2 u_{t-1} + \text{lagged}\,(\Delta Y, \Delta X) + \varepsilon_{2t} \quad \text{..............................} 7.9$$

with $|\rho_1| + |\rho_2| \neq 0$ and u_{t-1} is the error term derived in equation 7.6 lagged one period. ε_{it} are the two error terms which may be correlated or may exhibit autocorrelation. This result is called the '*Granger Representation Theorem*' and states that cointegration implies the existence of an error correction model and vice versa.

As demonstrated in equations 7.2 to 7.4 above, equation 7.8 gives the short-run dynamics of the relationship between Y and X. In the long-run $\Delta Y = \Delta X = 0$ and so $u = 0$ or $Y = \alpha + \beta X$. This is the long-run or equilibrium relationship. Note that equation 7.8 is a combination of the ECM term derived in equation 7.6 with a version of the short-run dynamics presented in

[2]See also Holden and Thompson 1992, pp. 8-9.

equation 7.7. Given that X and Y are I(1) variables and cointegrated, all the variables in equation 7.8 are stationary series.

In estimating ECMs Engle and Granger (1987) suggested a two-step estimation procedure. This procedure is based on the "Granger Representation Theorem". First, a levels-regression is performed which allows the hypothesis of cointegration to be tested (see equation 7.5). From this the error correction term is calculated as in equation 7.6.

The second step involves the specification of the general model by including the ECM term in the short-run dynamics as

$$\Delta Y_t = -\rho_1 u_{t-1} + \text{lagged}\,(\Delta Y, \Delta X) + \varepsilon_{1t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 7.8$$

This specification utilizes Hendry's "general-to-specific" methodology and the "super-consistent" argument discussed above.

However, the Engle-Granger two-step procedure suffers from a number of shortcomings especially in a multivariate regression with non-unique cointegrating vector. When more than one cointegrating vector exists, the statistical test becomes difficult because the Engle-Granger two-step procedure does not give well-defined limiting distributions for testing significance of the cointegration of the vectors.

To remedy such shortcomings alternative estimation procedures have been proposed. The latest and (possibly 'current-best') contribution is that of Johansen (1988) and Johansen and Juselius (1990). They devised a 'maximum likelihood' procedure for estimating the cointegrating vectors in a multivariate system. Moreover, Johansen (1988) suggested a statistical test for the weak exogeneity of variables intended to be used as explanatory variables in a dynamic model. The next section elaborates these.

7.1.2 The Johansen procedure

The procedure suggested by Johansen (1988) is a unified framework for determining the maximum number of cointegrating vectors and providing the maximum-likelihood estimates of the cointegrating vectors and adjustment parameters in a multivariate cointegrating system. In addition to the original articles by Johansen (1989) and Johansen and Juselius (1990), more simplified outlines of the procedure are published in Pesaran and Pesaran (1991) and Holden and Thompson (1992). The discussion in this section is based mainly on the latter article.

The procedure employs canonical correlation methods intended to find those linear combinations of the multivariate system which show the highest correlation. The estimation method is based on the error correction representation of the vector autoregressive (VAR) model with Gaussian errors under a deficient rank condition:

$$\Delta X_t = \mu + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{1-\rho} \Delta X_{t-(1-\rho)} + \Pi X_{t-\rho} + \varepsilon_t \ldots\ldots\ldots 7.10$$

where X_t is an m-by-1 vector of I(1) variables (containing both endogenous and exogenous variables), Γ_1, Γ_2, ... $\Gamma_{1-\rho}$, Π are respectively the dynamic and static m-by-m matrices of unknown parameters, $\varepsilon_t \sim N(0,\sigma^2)$ is the error term and ρ is the maximum lag.[3] Equation 7.10 can be presented in matrices as

$$\begin{bmatrix} \Delta X_1 \\ \Delta X_2 \\ \cdot \\ \cdot \\ \cdot \\ \Delta X_m \end{bmatrix} = \begin{bmatrix} \Gamma_{11} & \Gamma_{12} & \ldots \Gamma_{1m} \\ \Gamma_{21} & \Gamma_{12} & \ldots\ldots \Gamma_{2m} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \Gamma_{m1} & \Gamma_{m2} & \ldots\ldots \Gamma_{mm} \end{bmatrix} \cdot \begin{bmatrix} \Delta X_{1t-1} \\ \Delta X_{2t-1} \\ \cdot \\ \cdot \\ \cdot \\ \Delta X_{mt-1} \end{bmatrix} + \begin{bmatrix} \Pi_{11} & \Pi_{12} & \ldots \Pi_{1m} \\ \Pi_{21} & \Pi_{22} & \ldots \Pi_{2m} \\ \cdot & \cdot & \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \Pi_{m1} & \Pi_{m2} & \ldots \Pi_{mm} \end{bmatrix} \begin{bmatrix} X_{1t-2} \\ X_{1t-2} \\ \cdot \\ \cdot \\ \cdot \\ X_{mt-2} \end{bmatrix} + \begin{bmatrix} \mu_1 \\ \mu_2 \\ \cdot \\ \cdot \\ \cdot \\ \mu_m \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \cdot \\ \ldots \\ \cdot \\ \varepsilon_{mt} \end{bmatrix} \ldots 7.11$$

Equation 7.11 is a stationary error-correction VAR model which combines first differences (ΔX_t) and linear combinations (ΠX) of the levels of the variables. The model is a unified framework of both the long-run equilibrium relationship ($\Pi X_{t-\rho}$) and the short-run dynamics ($\Gamma_1 \Delta X_{t-i}$). Since all the variables are $X_t \sim I(1)$ then their first differences (ΔX_t) are stationary. For the model to be consistent with the stationary VAR, therefore, the variables must be

[3] As demonstrated in equation 7.2 to 7.4, the VAR(ρ) model in equation 7.10 is derived from a general polynomial distributed lag process generating X as: $X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \ldots + \Pi_\rho X_{t-\rho} + \varepsilon_t$ (For a detailed algebraic transformation see Holden and Thompson 1992).. Alternatively the system can be modelled as $\Delta X_t = \mu + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{1-\rho} \Delta X_{t-(1-\rho)} + \Pi X_{t-\rho} + BZ_t + \varepsilon_t$; where Z_t is an s-by-1 vector of I(0) variables that are included in the model to ensure that the disturbances ε_t are as close to being Gaussian as possible. It may include seasonal dummies or innovations in variables that are exogenous to the VAR system under consideration (see Pesaran and Pesaran 1991, p. 85).

cointegrated so that their linear combinations (ΠX) become stationary. In other words, the system results in statistically-acceptable Gaussian errors only if the variables are cointegrated.

7.1.2.1 Decomposition of the Π *matrix*

The Johansen procedure decomposes the Π matrix as a product of the cointegrating matrix (β) and the adjustment matrix (α) both of which are m-by-r

$$\begin{bmatrix} \Pi_{11} & \Pi_{12} & \ldots \Pi_{1m} \\ \Pi_{21} & \Pi_{12} & \ldots\ldots \Pi_{2m} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \Pi_{m1} & \Pi_{m2} & \ldots\ldots \Pi_{mm} \end{bmatrix} = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \ldots \alpha_{1r} \\ \alpha_{21} & \alpha_{22} & \ldots \alpha_{2r} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \alpha_{m1} & \alpha_{m2} & \ldots \alpha_{mr} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{12} & \ldots \beta_{1m} \\ \beta_{11} & \beta_{12} & \ldots \beta_{1m} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \beta_{r1} & \beta_{r2} & \ldots \beta_{rm} \end{bmatrix}$$

$\Pi = \alpha\beta'$ 7.12

Note that such a decomposition is consistent with the Granger Representation Theorem presented in equation 7.8 and 7.9. Thus, the Johansen procedure uses a Granger-version ECM to estimate the static and feed-back parameters if the variables are cointegrated. The Johansen test for cointegration is discussed below.

7.1.2.2 Tests for cointegration

Johansen's test for cointegration is based on the rank of the Π matrix. As discussed above, Π is an m-by-m square matrix which bears information on the long-run relationship of the variables in the model. The rank of the Π matrix is r such that $0 \leq r \leq m$ represents the number of distinct cointegrating vectors which exist between the variables in the model. Johansen (1988) and Johansen and Juselius (1990) derived the following two likelihood-ratio statistics to test the hypothesis that there are r cointegrating vectors in the model:

(a) Maximal Eigenvalue test:

$-2\ln Q = -T\ln(1-\lambda_i)$ 7.13

(b) Trace of stochastic matrix test:

$-2\ln Q = -T\ln\Sigma(1-\lambda_i)$ 7.14

where T is the number of observations and λ_i is the eigenvalue. The critical values for these statistics can be tabulated and Microfit provides it at 5% and 10% level of significance. Three outcomes are expected from the test on the rank of Π.

(a) **Null rank matrix (r = 0)**: In this case the variables are not cointegrated and, thus, no long-run cointegration exists in the model.

(b) **Full rank matrix (r = m)**: The model is stationary in levels because the vector process of the level-variables is stationary.

(c) **Reduced rank matrix (0 < r < m)**: The model has r cointegrating vectors with m-by-r dimensional long-run matrix (β) and feed-back matrix (α).

Once a vector passes the cointegration test the size and sign of the elements of each vector are examined. Since the β-vector represents the coefficients of the long-run function, the size and sign of each β_i element will be evaluated on the basis of the underlying economic theory, while the adjustment coefficients (α_{ij}) are expected to be less than one in absolute value.

7.1.3 Estimation of the dynamic model

Having identified the unique vector, the next step is to calculate the error correction term as in equation 7.8. The ECM term is then included in the general over-parameterized dynamic model which is estimated using the general-to-specific approach.

In addition to the ECM term and the lagged first differences, the general dynamic model can also include contemporaneous first differences of I(1) explanatory variables of the long-run model. However, in the Johanson procedure, the cointegrating vectors are obtained from a reduced form of a system where all variables are assumed as endogenous. Consequently, Johansen (1992) suggests that the inclusion of such contemporaneous variables should be based on what he calls 'the weak exogeneity test'.

The procedure is basically an OLS regression of the ECM equation 7.8 for all the variables in the model and followed by checking whether the adjustment coefficient is significantly different from zero. Consider, for example, a three-variable system (X, Y, Z) which is cointegrated at a VAR lag of two. By normalising on Z, the long-run function becomes

$Z = \beta_1 Y + \beta_2 X_i$ 7.15

Assume also that the size and sign of β_1 and β_2 are consistent with the underlying economic theory. By definition, the existence of cointegration implies stationary residuals i.e., ECM = Z - (β_1 Y + β_2 X_i) ~ I(0). Then the equations regressed for the weak exogeneity test can be presented as:

$\Delta Z = C + \delta_1 \Delta X_{t-1} + \delta_2 \Delta Y_{t-1} + \delta_3 \Delta Z_{t-1} + \alpha_z ECM_{t-2}$ 7.16

$\Delta Y = C + \delta_4 \Delta X_{t-1} + \delta_5 \Delta Y_{t-1} + \delta_6 \Delta Z_{t-1} + \alpha_y ECM_{t-2}$ 7.17

$\Delta X = C + \delta_7 \Delta X_{t-1} + \delta_8 \Delta Y_{t-1} + \delta_9 \Delta Z_{t-1} + \alpha_x ECM_{t-2}$ 7.18

where C is constant, δ_i are coefficients of lagged first differences and α_i are the adjustment coefficients which link the short-run dynamics to the long-run equilibrium function. If the adjustment coefficient is (statistically speaking) equal to zero, it implies that the dependent variable does not react to disequilibrium errors. In other words, if $\alpha_y = 0$ it means Z does not Granger-cause Y and thus ΔY_t can be included in the Z-function as an exogenous variable. In some studies, the significance of the adjustment coefficients is interpreted in relative terms. The level of significance (T-ratio) of α_z is compared to those of α_x and α_y and if the latter are less significant than the former then X, and Y are assumed as weakly exogenous and their contemporaneous values are included in the short-run dynamic specification (see Atingi-Ego 1996 p. 192). However this method is not recommended.

Given Z as the variable of interest and X and Y as exogenous variables, the over-parameterized short-run dynamic function is specified as

$\Delta Z = C + \gamma_1 \Delta X_t + \gamma_2 \Delta Y_t + \gamma_3 \Delta X_{t-1} + \gamma_4 \Delta Y_{t-1} + \gamma_5 \Delta Z_{t-1} + \alpha_z ECM_{t-2}$ 7.19

This model is then estimated using the OLS method.

7.1.3.1 The Ordinary Least Square Method

Before proceeding to the diagnostic tests of the results it is worth introducing the estimation method. The general model is estimated using the ordinary least square (OLS) method. Given a dependent variable (Y) explained by one independent variable (X) the OLS regression can be presented as

$$Y_i = \alpha + \beta X_i + u_i \quad \ldots\ldots \quad 7.20$$

where u_i is a random error. It is estimated on the basis of the following standard OLS assumptions: (i) mean of residuals is zero $E(u_i) = 0$

(ii) residuals are not serially correlated $E(u_i u_j) = 0$ for $i \neq j$

(iii) variance of residuals must be constant $E(u_i^2) = \sigma_u^2$

(iv) residuals are normally distributed $u_i \sim N(0, \sigma_u^2)$

(v) Xs are fixed or uncorrelated with u $E(u_i X_i) = 0$

If these assumptions are satisfied then u is a purely random error or white noise. From these it can be demonstrated that the OLS estimates of the parameters α and β are unbiased and consistent (i.e., have minimum variance).

7.1.3.2 The diagnostic tests

Once the general dynamic model is specified, it is estimated using the OLS method with the objective of reducing it to a more manageable model. In doing so one should, of course, not compromise the underlying economic principles and the final model should serve the purpose of the study. Furthermore, the final model will have passed a set of statistical tests. These include: (a) the t-test for significance of the parameters, (b) the serial correlation test, (c) the test for functional mis-specification, (d) the test for normality, (e) the heteroscedasticity test, (f) the predictive failure test and (g) the test for structural stability [4].

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[4]For more detailed discussion see basic econometrics text books such as Gujarati (1988). The Microfit manual (Pesaran and Pesaran 1991, pp. 65-67) also gives a brief description of the diagnostic tests.

7.1.4 Summary of the estimation procedure

In this study the long-run relationship is estimated using the maximum-likelihood procedure proposed by Johansen and included in Microfit (Pesaran and Pesaran, 1991). Various combinations of the variables discussed in chapter five were used in the systematic search for a theoretically-sound relationship. Since the data are annual with a maximum of 30 observation points (i.e., 1964 to 1993), a VAR with lags of 1 to 3 was used.

Our search for cointegrating vectors is biased in favour of vectors which include variables from the informal economy. This is because other studies have applied conventional estimation procedures to model the formal sector of the Ethiopian economy[5] and one of the main objectives of this study is to provide some empirical evidence on the relationship between the formal and informal sectors of the Ethiopian economy, thereby allowing comments on its implications for regional co-operation in the Horn of Africa.

The weak exogeneity test will be used only as a general guide to the selection of variables. The ultimate decision on whether a variable should be included in the general model will depend on economic theory. In a situation where economic theory gives a clear indication that a certain variable is exogenous (e.g. domestic credit in a financially-repressed economy) we accept that the variable is exogenous irrespective of the significance of its α_i coefficient in equations 7.16 to 7.18. It is also possible to add new variables ($Z \sim I(0)$) if their inclusion in the short-run function can be justified by economic theory.

In order to achieve the convergence of the short-run dynamics to the long-run equilibrium the value of the coefficient on the error term must be between zero and minus one (i.e., $-1<\alpha_y<0$). Otherwise the model is explosive and must be rejected. The appearance of a variable in the final model will depend on the agreement of the size and sign of its coefficient with economic theory, the statistical significance of each coefficient, and the diagnostic tests discussed above.

The final step is testing for predictive failure. This is done by re-estimating the final version of equation 7.19 for a shorter sample period and testing the ability of the model to forecast the remaining part of the period. All the models will be re-estimated for the periods 1964-90 and

[5]See for example Tsegaye (1987) and Kidane, and Kocklaeuner (1985).

1964-84 which respectively give the predictive failure test for the period 1991-93 and 1985-93. The results are presented in the next section.

7.2 Estimation results

In this section the long-run functions and their respective dynamic equations are presented. The full list of the equations of the model and their graphs are presented in the next chapter, section 8.16. All the coefficients are consistent with the underlying economic theory and in most cases the models have good diagnostic results and successful predictions. One would also tend to tolerate the significance of the predictive failure of some equations because we are using a model estimated on the basis of data for a relatively stable period to forecast a period of extreme upheaval in the economic and political system of Ethiopia. As discussed in detail in chapter two, there were two major shocks during the sample period: the socialist revolution (1974) which led to widespread nationalization of land, industry, housing, financial institutions and educational establishments; and the reforms towards the market economy (1992) which were designed to undo what had been done in the past 17 years. Other shocks, also, are concentrated in the latter part of the sample period. These include the major famine (1984-85), intensification of the civil war (1987-91), an attempted coup d'etat (1989), overthrow of government (1991), devaluation and privatization (1992). Therefore, in view of these special events, any adverse results for the prediction tests must be viewed with caution.

7.2.1 Consumption function

The search for a long-run consumption function was conducted on the basis of the variables discussed in section 5.2.1.1. Our search was biased in favour of those vectors which include disposable income because, as low-income consumers, Ethiopians would have very little savings and the value of bank credit for consumers is expected to be negligible. The government also actively discouraged the importation of consumer goods during the sample period, using exchange rate rationing and other commercial policy instruments. Thus, our search was conducted on the presumption that consumption is a function of income and possibly some combination of the other variables in equation 5.12. In short, any equation with an insignificant coefficient for disposable income was automatically rejected regardless of the variables in the equation.

A theoretically-interpretable consumption function was selected as a combination of real private consumption (lrcp), real disposable income (lryd), real financial wealth (lrw), real deposit rate (lrdr2), and credit restraint to private sector (lcrp) with a lag of 2 on the VAR. The short-run equation includes an additional variable, (real consumption by the public sector (lrcg)). Attempts to include the latter in the long-run equation failed to give a theoretically-plausible equation. The weak-exogeneity requirement for the inclusion of lrcg in the dynamic model was overlooked because public sector expenditure is a truly exogenous variable.[6]

Table 7.2 suggests that, using both the maximum eigenvalues and the trace of stochastic matrix at 5% level of significance, the null hypothesis indicating at most two cointegrating vectors is rejected in favour of the alternative of there being three cointegrating vectors. Table 7.3 presents the vectors of the long-run relationship (β-vectors) and their corresponding feed-back (α) vectors. Both vectors point to the second vector (β2) as the long-run private consumption function.

$$lrcp = 0.52744\, lryd + .0047798\, lrw + .10787\, lrdr2 - 3.3844\, lcrp \quad ....7.21$$

The result suggests disposable income, financial wealth and deposit rate have a positive impact on private consumption; while credit restraint has a negative impact on private consumption. All coefficients are broadly consistent with the **a priori** theory. As expected, Ethiopian private consumption is largely financed by disposable income with a very low dependence on private savings held in the banking system. In a well-developed financial system, one would expect the deposit rate to induce more savings and thereby reduce private consumption. In this respect, we suggest the following two possible explanations for the positive coefficient of lrdr2.

(i) Interest rate is part of the income households earn from savings. Since the ultimate aim of any savings is consumption, the effect of such interest income can increase consumption in the long run.

(ii) Under financial repression, interest rates are fixed below the market rate in order to channel cheap loans to the public sector and related priority sectors selected by the

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[6]For similar reasoning see Atingi-Ego (1996, p. 192).

government. In such a situation private agents become reluctant to respond to bank interest rates and look for alternative assets in the informal market. In our model the informal market rate is proxied by the credit restraint variable (lcrp) which has a strong negative impact on private consumption. Under financial liberalization one would expect the bank interest rates to converge to the informal market rates and thereby negatively affect private consumption. (For similar reasoning see Atingi-Ego 1996, p. 207).

Consumption functions in the literature for LDCs which have roughly similar variables are listed in table 7.1. The equations by Al-Meshal (1996), Soludo (1995), Tegene (1989), respectively used country data of Saudi Arabia, Nigeria and Ethiopia; while Haque et al (1990 & 1993) used pooled data of 56 developing countries. One should, however, be very careful in drawing any comparative conclusions from these equations because none of them tally in the definition of variables, sample period or estimation technique.

Table 7- 1: Comparison of consumption functions estimated for LDCs

Reference	Coefficients in the consumption function associated with:		
	Income	Wealth	Deposit rate
Al-Meshal (1996)	0.14*	0.24* & 0.58***	
Soludo (1995)	0.65	0.135* & -0.088***	-0.015**
Tegene (1989)	0.95		
Haque et. al. (1990)	.143 & -.149***	.	-.076
Haque et. al. (1993)	.334 & -.330***		-.12
This study	**0.527**	**0.005**	**0.108 & -3.38**

* First difference of the variable ** Coefficients with insignificant t-ratio *** Lagged variable

The statistical test for weak exogeneity is conducted on the α-coefficients in the second vector of the adjustment matrices by regressing the first difference of each variable (x) on the first lag of the first difference of all variables and the second lag of the ECM term as follows (note that the first difference is indicated by including the letter 'd' at the beginning of the notation for all variables):

$$x = c + \alpha_c dlrcp(-1) + \alpha_y dlryd(-1) + \alpha_w dlrw(-1) + \alpha_{dr} dlrdr2(-1) + \alpha_{cr} dlcrp(-1) + \alpha_x ecm(-2) \quad ....7.22$$

Using the significance of the adjustment coefficient of private consumption as a threshold we conclude that only disposable income can be considered as weakly exogenous and thus we include its contemporaneous variable in the short-run dynamic equation. Moreover, public consumption, which is theoretically exogenous, is included in the short-run dynamic equation. This suggests the use of the following overparameterized equation from which the short-run consumption function is to be found using the general-to-specific approach suggested by Engle & Granger (1987).

$$dlrcp = c + \alpha_{0y}dlryd + \alpha_{0g}dlrcg + \alpha_{c}dlrcp(-1) + \alpha_{y2}dlryd(-1) + \alpha_{w}dlrw(-1) + \alpha_{dr}dlrdr2(-1) + \alpha_{cr}dlcrp(-1) + \alpha_{g}dlrcg(-1) + \alpha_{x}\, ecm(-2) \quad \ldots\ldots 7.23$$

The OLS estimation of this equation is reported in table 7.4[7]. Following a series of variable deletions on the basis of the set of statistical tests (see section 7.1.2.2), the final dynamic equation for the short-run consumption function is reported in table 7.5. All the coefficients are significant and the diagnostics are satisfactory. The predictive failure test indicates that the equation can adequately predict consumer behaviour over both the 1990-93 and 1984-1993 periods.

[7] We note that the residuals in table 7.4 are not normally distributed. Examination of their plot shows excessively large positive values for 1975 and negative for 1990. Since these respectively correspond to the rise and fall of the 'socialist' government in Ethiopia, we ignore the non-normality.

Table 7- 2 Cointegration test for private consumption

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
<u>Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix</u>

28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrcp lryd lrw lrdr2 lcrp
List of eigenvalues in descending order:
.80097 .63365 .55865 .28861 .0021841

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	45.2011	33.3190	30.8410
r<= 1	r = 2	28.1170	27.1360	24.7830
r<= 2	r = 3	22.9014	21.0740	18.9040
r<= 3	r = 4	9.5349	14.9000	12.9120
r<= 4	r = 5	.061223	8.1760	6.5030

Conclusion: r = 3

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
<u>Cointegration LR Test Based on Trace of the Stochastic Matrix</u>
28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrcp lryd lrw lrdr2 lcrp
List of eigenvalues in descending order:
.80097 .63365 .55865 .28861 .0021841

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	105.8155	70.5980	66.4860
r<= 1	r>= 2	60.6145	48.2800	45.2290
r<= 2	r>= 3	32.4975	31.5250	28.7090
r<= 3	r>= 4	9.5961	17.9530	15.6630
r<= 4	r = 5	.061223	8.1760	6.5030

Conclusion: r = 3.

Table 7-3: Cointegrating vectors for real private consumption

Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 3.

	Vector 1	Vector 2	Vector 3
lrcp	-6.2191	-7.8369	-5.1615
	(-1.0000)	(-1.0000)	(-1.0000)
lryd	7.1354	4.1334	6.1843
	(1.1473)	(.52744)	(1.1981)
lrw	.11371	.037459	.31642
	(.018284)	(.0047798)	(.061302)
lrdr2	-2.2639	.84540	-8.9060
	(-.36403)	(.10787)	(-1.7255)
lcrp	7.9256	-26.5228	2.3731
	(1.2744)	(-3.3844)	(.45976)

Estimated Adjustment Matrix in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 3.

	Vector 1	Vector 2	Vector 3
lrcp	-.13869	.079016	-.16797
	(-.86251)	(.61924)	(-.86701)
lryd	-.20779	.021376	-.23615
	(-1.2923)	(.16752)	(-1.2189)
lrw	-.22045	.24172	-.024095
	(-1.3710)	(1.8944)	(-.12437)
lrdr2	-.10984	-.040808	.034420
	(-.68312)	(-.31981)	(.17766)
lcrp	-.014968	.043743	.019018
	(-.093087)	(.34281)	(.098160)

Table 7- 4: Dynamic Modelling of real private consumption :Overparameterized version

Ordinary Least Squares Estimation
Dependent variable is dlrcp
28 observations used for estimation from 1966 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	.72631	.41720	1.7409[.099]
dlrcp(-1)	-.72502	.22901	-3.1659[.005]
dlryd	.93195	.088448	10.5366[.000]
dlryd(-1)	.71665	.24563	2.9176[.009]
dlrw(-1)	-.060460	.044574	-1.3564[.192]
dlrdr2(-1)	-.22355	.25326	-.88270[.389]
dlcrp(-1)	-.64912	.50624	-1.2822[.216]
dlrcg	-.096587	.045731	-2.1121[.049]
dlrcg(-1)	-.087278	.057280	-1.5237[.145]
ecm122(-2)	-.37008	.21465	-1.7241[.102]

R-Squared	.93674	F-statistic F(9, 18)	29.6133[.000]
R-Bar-Squared	.90510	S.E. of Regression	.026341
Residual Sum of Squares	.012489	Mean of Dependent Variable	-.0071231
S.D. of Dependent Variable	.085507	Maximum of Log-likelihood	68.2813
DW-statistic	1.9378	Durbin's h-statistic	*NONE*

Diagnostic Tests

* Test Statistics *	F-Version *	
* A:Serial Correlation	*F(1, 17)=	.0028713[.958]
* B:Functional Form	*F(1, 17)=	.28171[.602]
* C:Normality	*CHI-SQ(2)=	12.2755[.002]
* D:Heteroscedasticity	*F(1, 26)=	.060910[.807]

Table 7- 5: Dynamic Modelling of real private consumption :Final version

Ordinary Least Squares Estimation

Dependent variable is dlrcp

28 observations used for estimation from 1966 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	.94073	.32753	2.8722[.009]
dlrcp(-1)	-.59333	.20700	-2.8663[.009]
dlryd	.99687	.086451	11.5311[.000]
dlryd(-1)	.44025	.18737	2.3496[.029]
dlcrp(-1)	-1.0879	.47030	-2.3132[.031]
dlrcg	-.10755	.048579	-2.2138[.038]
ecm122(-2)	-.48345	.16921	-2.8572[.009]

R-Squared	.91427	F-statistic F(6, 21)	37.3280[.000]
R-Bar-Squared	.88978	S.E. of Regression	.028388
Residual Sum of Squares	.016923	Mean of Dependent Variable	-.0071231
S.D. of Dependent Variable	.085507	Maximum of Log-likelihood	64.0278
DW-statistic	2.3076		

Diagnostic Tests

* Test Statistics *	F-Version *	
* A:Serial Correlation	*F(1, 20)=	2.3606[.140]
* B:Functional Form	*F(1, 20)=	.037064[.849]
* C:Normality	*CH-SQ(2)=	1.5367[.464]
* D:Heteroscedasticity	*F(1, 26)=	.13590[.715]
* E:Predictive Failure	*F(3, 18)=	1.4169[.270]
* E:Predictive Failure	*F(9, 12)=	2.0430[.124]
* F:Chow Test	*F(7, 14)=	1.5527[.229]

7.2.2 Investment function

As discussed in section 5.2.1.2, expected profit (proxied by the expected growth in aggregate demand, lrexdy2) is the main incentive for private investment. Such investments are financed from current disposable income (lryd), savings (lrw) and domestic bank credit to the private sector (lrdcp). To represent the cost of borrowing, we include the lending rate of the banking system (lrlr2), the informal rate of interest (proxied by credit restraint, lcrp), and the foreign rate of interest (lrif2) in our search for cointegrating vectors.

As a developing economy, Ethiopian private investment is highly dependent on imported inputs. All variables which affect the country's ability to import and the distribution of imports between private and public sectors, are expected to affect private investment. Inclusion of all these variables in an investment function (such as the one described in equation 5.17) would, however, make the equation too cumbersome and difficult to estimate using a sample period of 30 observations. Instead, the dependence of private investment on imported inputs is emphasized in our model by including imports (lrim). In doing so, we are presuming a bi-causality relationship where the supply of imported inputs act as a bottleneck to private investment, while at the same time accepting that the demand for imported inputs is directly affected by the demand for investment goods.

An investment function explained by lrexdy2, lryd, lrw, lrdcp, lrim, resulted in a theoretically-sound cointegrating vector with lag of 2 on the VAR. Table 7.6 reports the cointegration tests where the maximum eigenvalues suggest the existence of 5 cointegrating vectors, while only 4 cointegrating vectors are suggested by the trace of stochastic matrix. To maximize our options we accept the significance of 5 cointegrating vectors.

Table 7.7 presents the static relationship (β-vectors) suggested by each of the 5 cointegrating vectors and their corresponding adjustment feed-back matrix (α-vectors). On the basis of the **a priori** theory and statistical tests, the third vector (i.e., β_3) emerged as the best model of private investment in the long-run.

lrip = 10.1729 lrexdy2 + .054099 lryd - .80233 lrw + .0099219 lrdcp + 2.8678 lrim 7.24

As expected, private investment is motivated by expected demand and financed from current disposable income and bank credit extended to the private sector. The small coefficient on disposable income can be explained by the subsistence production structure which dominates low-income countries such as Ethiopia. Ideally, private investment should have a positive relationship with bank savings (lrw). In a financially-repressed economy, however, banks are primarily used to channel private savings to the public sector. The negative coefficient of lrw and the nearly-zero coefficient associated with bank credits (lrdcp) are, therefore, indicative of the crowding-out effect of a repressive credit policy which prevailed in Ethiopia for most of the sample period. The stronger effect of imports on private investment is confirmed by the result. It implies that imports play a crucial role in accelerating the investment process by enabling more domestic resources to engage in gainful employment.

For the weak exogeneity test, the significance of the adjustment coefficients (α_X) of each of the variables in the cointegrating vector was checked by replacing x with their first difference in the following OLS-regression.

$$x = c + \alpha_{ip}\text{dlrip}(-1) + \alpha_{ye}\text{dlrexdy2}(-1) + \alpha_{yd}\text{dlryd}(-1) + \alpha_{w}\Delta\text{dlrw}(-1) + \alpha_{dc}\text{dlrdcp}(-1) + \alpha_{im}\text{dlrim}(-1) - \alpha_{x}\text{ecm}(-2) \quad \ldots\ldots 7.25$$

The test indicates that all five explanatory variables are weakly exogenous vis-à-vis private investment and thus, the overparameterized version of the short-run dynamic equation (reported in table 7.8) is specified as

$$\begin{aligned}\text{dlrip} = {} & c + \alpha_{0ye}\text{dlrexdy2} + \alpha_{0yd}\text{dlryd} + \alpha_{0w}\text{dlrw} + \alpha_{0dc}\text{dlrdcp} + \alpha_{0im}\text{dlrim} + \alpha_{ip}\text{dlrip}(-1) + \\ & \alpha_{ye}\text{dlrexdy2}(-1) + \alpha_{yd}\text{dlryd}(-1) + \alpha_{w}\text{dlrw}(-1) + \alpha_{dc}\text{dlrdcp}(-1) \\ & + \alpha_{im}\text{dlrim}(-1) - \alpha_{x}\text{ecm}(-2) \quad \ldots\ldots 7.26\end{aligned}$$

The OLS regression of this equation is subjected to the set of statistical tests (see section 7.1.2.2) to yield the final version of the short-run dynamic function for private investment reported in table 7.9. All the coefficients are significant. The functional form specification test can, however, be accepted only at 2.5% level of significance. At this stage we will accept this because the data of private investment were more sensitive to the adverse shocks discussed in section 2.3.4. Investment declined sharply following the 1974 socialist revolution, the drought of 1984 and the intensification of the war in the late 1980s. The linear model, therefore, seems to have difficulties in picking up these fluctuations (see figures 2.8/9). We return to this equation in chapter 8. The rest of the diagnostics are satisfactory. The predictive failure test indicates that the equation can adequately predict investors' behaviour over both the 1990-93 and 1984-1993 periods.

Table 7- 6: Cointegration test for private investment

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrip lrexdy2 lryd lrw lrdcp
lrim
List of eigenvalues in descending order:
.90476 .76329 .65069 .55018 .42567 .0041199

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	65.8392	39.4260	36.3460
r<= 1	r = 2	40.3463	33.3190	30.8410
r<= 2	r = 3	29.4506	27.1360	24.7830
r<= 3	r = 4	22.3696	21.0740	18.9040
r<= 4	r = 5	15.5274	14.9000	12.9120
r<= 5	r = 6	.11560	8.1760	6.5030

Conclusion: r = 5

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrip lrexdy2 lryd lrw lrdcp
lrim
List of eigenvalues in descending order:
.90476 .76329 .65069 .55018 .42567 .0041199

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	173.6487	95.1770	90.3920
r<= 1	r>= 2	107.8095	70.5980	66.4860
r<= 2	r>= 3	67.4632	48.2800	45.2290
r<= 3	r>= 4	38.0127	31.5250	28.7090
r<= 4	r>= 5	15.6430	17.9530	15.6630
r<= 5	r = 6	.11560	8.1760	6.5030

Conclusion: r = 4

Table 7- 7: Cointegrating vectors for real private investment

Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5
lrip	-.14361	.21516	-.61484	.70959	-.23007
	(-1.0000)	(-1.0000)	(-1.0000)	(-1.0000)	(-1.0000)
lrexdy2	9.7900	-6.0278	6.2547	-8.4348	2.3895
	(68.1699)	(28.0150)	(10.1729)	(11.8868)	(10.3859)
lryd	-2.1691	3.9795	.033263	-2.1005	-.81823
	(-15.1043)	(-18.4953)	(.054099)	(2.9602)	(-3.5564)
lrw	.21227	-.32547	-.49331	-.60434	.098414
	(1.4781)	(1.5127)	(-.80233)	(.85167)	(.42776)
lrdcp	.92663	-1.9009	.0061004	-.13001	.21282
	(6.4524)	(8.8348)	(.0099219)	(.18322)	(.92504)
lrim	-.27404	-.33729	1.7633	.47506	-1.3174
	(-1.9082)	(1.5676)	(2.8678)	(-.66949)	(-5.7263)

Estimated Adjustment Matrix in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5
lrip	-.81326	.10136	.95130	.25167	1.0623
	(-.11679)	(-.021808)	(.58490)	(-.17858)	(.24440)
lrexdy2	-.091737	-.042265	-.0010334	.011210	-.0021069
	(-.013174)	(.0090937)	(-.6354e-3)	(-.0079544)	(-.4847e-3)
lryd	.041277	-.0097618	.039119	.27298	.11591
	(.0059278)	(.0021004)	(.024052)	(-.19371)	(.026667)
lrw	-.014009	-.18941	.091789	.11953	-.052701
	(-.0020118)	(.040753)	(.056436)	(-.084819)	(-.012125)
lrdcp	-.065906	.70166	-.34695	.36162	.34222
	(-.0094649)	(-.15097)	(-.21332)	(-.25660)	(.078734)
lrim	-.15975	-.27230	-.23188	.22551	.53328
	(-.022941)	(.058588)	(-.14257)	(-.16002)	(.12269)

Table 7- 8: Dynamic Modelling of real private investment: Overparameterized version

Ordinary Least Squares Estimation
Dependent variable is dlrip
28 observations used for estimation from 1966 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	-4.3514	1.0627	-4.0948[.001]
dlrexdy2	4.1794	3.2026	1.3050[.212]
dlryd	-.36353	1.1845	-.30690[.763]
dlrw	-.10779	.47782	-.22558[.825]
dlrdcp	.57059	.37647	1.5157[.150]
dlrim	1.2793	.45477	2.8131[.013]
dlrip(-1)	-1.1220	.19613	-5.7209[.000]
dlrexdy2(-1)	7.1661	2.6869	2.6671[.018]
dlryd(-1)	.55506	1.4355	.38668[.704]
dlrw(-1)	.054887	.48750	.11259[.912]
dlrdcp(-1)	.94554	.36820	2.5680[.021]
dlrim(-1)	.94571	.65132	1.4520[.167]
ecm29v23(-2)	-.90650	.22156	-4.0915[.001]

R-Squared	.82840	F-statistic F(12, 15)	6.0343[.001]
R-Bar-Squared	.69112	S.E. of Regression	.30980
Residual Sum of Squares	1.4397	Mean of Dependent Variable	-.026556
S.D. of Dependent Variable	.55743	Maximum of Log-likelihood	1.8189
DW-statistic	1.8839	Durbin's h-statistic	*NONE*

Diagnostic Tests

* Test Statistics	* F-Version *
* A:Serial Correlation	*F(1, 14)= .10371[.752]
* B:Functional Form	*F(1, 14)= 7.3429[.017]
* C:Normality	*CHI-SQ(2)= 5.3464[.069]
* D:Heteroscedasticity	*F(1, 26)= .35610[.556]

Table 7- 9: Dynamic Modelling of real private investment: Final version

Ordinary Least Squares Estimation

Dependent variable is dlrip

28 observations used for estimation from 1966 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	-3.5975	.82185	-4.3774[.000]
dlrexdy2	7.1035	2.2441	3.1654[.005]
dlrdcp	.58585	.29264	2.0019[.059]
dlrim	.93965	.33336	2.8187[.011]
dlrip(-1)	-1.0121	.17271	-5.8602[.000]
dlrexdy2(-1)	6.9231	2.5001	2.7691[.012]
dlrdcp(-1)	1.0114	.28412	3.5599[.002]
ecm29v23(-2)	-.75452	.17275	-4.3677[.000]

R-Squared	.78800	F-statistic F(7, 20)	10.6197[.000]
R-Bar-Squared	.71379	S.E. of Regression	.29821
Residual Sum of Squares	1.7786	Mean of Dependent Variable	-.026556
S.D. of Dependent Variable	.55743	Maximum of Log-likelihood	-1.1411
DW-statistic	1.8834		

Diagnostic Tests

* Test Statistics	* F-Version *
* A:Serial Correlation	*F(1, 19)= .045865[.833]
* B:Functional Form	*F(1, 19)= 5.9314[.025]
* C:Normality	*CH-SQ(2)= 4.5290[.104]
* D:Heteroscedasticity	*F(1, 26)= .81045[.376]
* E:Predictive Failure	*F(3, 17)= .92759[.449]
* E:Predictive Failure	*F(9, 11)= 1.5033[.258]
* F:Chow Test	*F(8, 12)= 1.3756[.298]

7.2.3 Export function

The variables in equation 5.28 were used in the test for cointegrating vectors. Export taxes (Tx) was dropped due to lack of data for the period 1964 -1972. Since the main effect of Tx is to encourage informal exports (at the expense of their official counterpart) however, its impact is expected to be catered for by the movements in the premium on the parallel exchange rate. Experiments with the remaining variables yielded a theoretically-sound vector when exports (lrx) is specified as a function of foreign demand (lryf), the real effective exchange rate (lreer), the premium on the informal market exchange rate (lprm), export prices (lpx) and the volatility of informal exchange rates (lverb) at a VAR lag of 2.[8]

Table 7.9 presents the cointegration tests where at 5% level of significance both the maximal eigenvalues and the trace of stochastic matrix suggest the presence of one cointegrating vector. However, at 10% level of significance the trace of stochastic matrix suggests the presence of two cointegrating vectors. We conclude there are two cointegrating vectors. There are other researchers who used the 10% level of significance for exchange rate equations (see Atingi-Ego 1996 p. 199). These vectors are presented in Table 7.10. Considering the underlying economic theory and statistical tests, vector 2 emerges as the long-run export function.

$$lrx = -.64323\ lryf + 1.7653\ lreer - .20070\ lprm + .22771\ lpx + .047958\ lverb \quad ....7.27$$

All the coefficients are consistent with the **a priori** theory discussed in section 5.2.3. Ethiopia exports primary goods such as coffee, hides and skins, pulses and oil-seeds and its export market is predominantly restricted to a few countries in western Europe and the USA. The negative coefficient of lryf is therefore a confirmation of the fact that the proportion of income of the developed world spent on such primary agricultural exports declined during the sample period. As the old colonial ties weaken over time, compounded by the growth of income (and thus more demand for luxury goods at the expense of basic necessities) in the developed world, the share of primary exports in the world market is bound to decline. In this respect our

[8]For the long-run function the sample period is restricted to 1968-1992 due to missing data points for lpx and lverb. Filling the missing data points on the basis of some assumptions failed to yield satisfactory results. The short-run dynamics, however succeeded in capturing the period 1968-1993 after the cancellation of dlpx and smoothing of one missing observation in dlverb.

results agree with Tegene (1989) who obtained a foreign demand coefficient of -0.21 for Ethiopia and either very small or negative coefficients for other sub-Saharan African countries. Even those researchers who used pooled data of 56 developing countries from Africa, Asia and Latin America [Haque et al. (1990 and 1993)] found the foreign demand coefficient to be very small i.e., 0.084 and 0.106 respectively. This can be contrasted with a coefficient of 1.02 for Saudi Arabia found by Al-Meshal (1996) confirming the strong interdependence between the size of world trade and oil exports.

The policy implication of a negative coefficient of foreign demand points towards the need for diversification of the Ethiopian export base and/or her export markets at both regional and international level. The need for improving the competitiveness of Ethiopian exports in the world market and for the integration of the informal exchange market to the formal economy are confirmed by the coefficients of lreer and lprm. Discarding the policy of an overvalued exchange rate (which prevailed during most of the sample period) would in the long run boost exports by increasing lreer and decreasing lprm. In other words, the government can promote exports by allowing flexibility of the official exchange rate combined with a credible anti-inflationary policy. An important finding of this research is the confirmation of our analysis of the informal market, where the high premium on the informal exchange rate is likely to tempt exporters to cash their earnings in the informal market; while the volatility of this premium is unlikely to have a strong long-run effect on official exports. The positive coefficient associated with export prices (lpx) is consistent with economic theory and the findings of other researchers (see Tegene (1989), Al-Meshal (1996), Soludo (1995), and Tsegaye (1987)).

The weak exogeneity test results were obtained by substituting the first difference of each of the variables in the long-run function for "x" in the following OLS-regression.

$$x = c + \alpha_{rx}dlrx(-1) + \alpha_{yf}dlryf(-1) + \alpha_{r}dlreer(-1) + \alpha_{im}dlprm(-1) + \alpha_{px}dlpx(-1) + \alpha_{v}dlverb(-1) + \alpha_{x}ecm(-2) \quad \text{......} 7.28$$

The test indicates that all five explanatory variables are weakly exogenous vis-à-vis exports and thus, the overparameterized version of the short-run dynamic equation (reported in table 7.11) is specified as

$$\text{dlrx} = c + \alpha_{0yf}\text{dlryf} + \alpha_{0r}\text{dlreer} + \alpha_{0im}\text{dlprm} + \alpha_{0px}\text{dlpx} + \alpha_{0v}\text{dlverb} + \alpha_{rx}\text{dlrx}(-1) + \alpha_{yf}\text{dlryf}(-1)$$
$$+ \alpha_{r}\text{dlreer}(-1) + \alpha_{im}\text{dlprm}(-1) + \alpha_{px}\text{dlpx}(-1) + \alpha_{v}\text{dlverb}\,(-1) + \alpha_{x}\text{ecm}(-2) \;\ldots\ldots\ldots\ldots 7.29$$

The OLS regression of this equation is subjected to the set of statistical tests (see section 7.1.2.2) to yield the final version of the short-run dynamic function for real exports reported in table 7.12. The coefficient of dlryf(-1) is accepted at 15% level of significance; while the rest are accepted at a level of significance below 6%.[9] The problems with the functional form and heteroscedasticity for the overparameterized version are eliminated in the final version. The diagnostics are satisfactory. The predictive failure test indicates that the equation can adequately predict the behaviour of agents engaged in the export business over the longer period (1984-93). The model's prediction for the 1990-93 period is rather weak and the Chow test shows some evidence of instability of regression coefficients. This is not surprising given the sensitivity of exports to political instability. As discussed in section 2.3.2.2, exports collapsed at the climax and immediate aftermath the war (1991/92) followed by a sharp recovery in 1993. On balance, therefore, we accept the model as a satisfactory export function for Ethiopia (see also chapter 8, figure 8-3).

[9]We accepted such a level of significance in order to avoid an ECM coefficient of -1.039 because in spite of its highly significant coefficients such an equation suggested non-converging dynamics. We have therefore opted for cancelling the next "less significant" variable to maintain an adjustment coefficient of -0.85431. (For similar reasoning see Al-Meshal (1996) p. 127, and Atingi-Ego (1996) p.216).

Table 7- 10: Cointegration test for real exports

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

25 observations from 1968 to 1992. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrx lryf lreer lprm lpx
lverb
List of eigenvalues in descending order:
.85704 .64415 .50630 .38418 .25815 .15310

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	48.6304	39.4260	36.3460
r<= 1	r = 2	25.8308	33.3190	30.8410
r<= 2	r = 3	17.6457	27.1360	24.7830
r<= 3	r = 4	12.1201	21.0740	18.9040
r<= 4	r = 5	7.4653	14.9000	12.9120
r<= 5	r = 6	4.1544	8.1760	6.5030

Conclusion: r = 1

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

25 observations from 1968 to 1992. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrx lryf lreer lprm lpx
lverb
List of eigenvalues in descending order:
.85704 .64415 .50630 .38418 .25815 .15310

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	115.8467	95.1770	90.3920
r<= 1	r>= 2	67.2163	70.5980	66.4860
r<= 2	r>= 3	41.3855	48.2800	45.2290
r<= 3	r>= 4	23.7397	31.5250	28.7090
r<= 4	r>= 5	11.6197	17.9530	15.6630
r<= 5	r = 6	4.1544	8.1760	6.5030

Conclusion: r = 2 (at 10% level of significance)

Table 7- 11: Cointegrating vectors for real exports

Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
25 observations from 1968 to 1992. Maximum lag in VAR = 2, chosen r = 2.

	Vector 1	Vector 2
lrx	.24254	2.7181
	(-1.0000)	(-1.0000)
lryf	1.3582	1.7483
	(-5.6002)	(-.64323)
lreer	-3.8558	-4.7982
	(15.8979)	(1.7653)
lprm	-.11184	.54552
	(.46112)	(-.20070)
lpx	-1.2129	-.61893
	(5.0011)	(.22771)
lverb	.038105	-.13035
	(-.15711)	(.047958)

Estimated Adjustment Matrix in Johansen Estimation (Normalized in Brackets)
25 observations from 1968 to 1992. Maximum lag in VAR = 2, chosen r = 2.

	Vector 1	Vector 2
lrx	-.096262	-.41065
	(.023347)	(1.1162)
lryf	.039598	-.10580
	(-.0096041)	(.28758)
lreer	.51567	-.087192
	(-.12507)	(.23699)
lprm	-.35207	.015174
	(.085389)	(-.041244)
lpx	-.030147	-.071270
	(.0073118)	(.19372)
lverb	-7.5613	4.8200
	(1.8339)	(-13.1010)

Table 7- 12: Dynamic Modelling of real exports: Overparameterized version

Ordinary Least Squares Estimation

Dependent variable is dlrx

25 observations used for estimation from 1968 to 1992

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	6.5291	1.8586	3.5129[.004]
dlryf	-.66020	.35066	-1.8827[.084]
dlreer	.47559	.28632	1.6611[.123]
dlprm	.016775	.22793	.073596[.943]
dlpx	-.13345	.21645	-.61654[.549]
dlverb2	.029410	.014115	2.0835[.059]
dlrx(-1)	-1.2895	.54640	-2.3600[.036]
dlryf(-1)	-1.0511	.32380	-3.2461[.007]
dlreer(-1)	2.0431	.69854	2.9248[.013]
dlprm(-1)	-.38229	.17872	-2.1391[.054]
dlpx(-1)	.022780	.26301	.086612[.932]
dlverb2(-1)	.047631	.016270	2.9276[.013]
ecmx14v22(-2)	-1.6052	.45674	-3.5144[.004]

R-Squared	.66490	F-statistic F(12, 12)	1.9841[.125]
R-Bar-Squared	.32979	S.E. of Regression	.14279
Residual Sum of Squares	.24468	Mean of Dependent Variable	-.033488
S.D. of Dependent Variable	.17442	Maximum of Log-likelihood	22.3602
DW-statistic	2.0221		

Diagnostic Tests

* Test Statistics *	F-Version *
* A:Serial Correlation	*F(1, 11)= .032959[.859]
* B:Functional Form	*F(1, 11)= 6.9186[.023]
* C:Normality	*CHI-SQ(2)= .96192[.618]
* D:Heteroscedasticity	*F(1, 23)= 4.8496[.038]

Table 7- 13: Dynamic Modelling of real exports: Final version

Ordinary Least Squares Estimation

Dependent variable is dlrx

26 observations used for estimation from 1968 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	3.4578	1.5701	2.2023[.039]
dlrx(-1)	-.52120	.25974	-2.0066[.058]
dlryf(-1)	-.50458	.32539	-1.5507[.136]
dlreer(-1)	1.2806	.28545	4.4863[.000]
ecmx14v22(-2)	-.85431	.38668	-2.2094[.038]

R-Squared	.65549	F-statistic F(4, 21)	9.9891[.000]
R-Bar-Squared	.58987	S.E. of Regression	.17750
Residual Sum of Squares	.66164	Mean of Dependent Variable	.0093062
S.D. of Dependent Variable	.27717	Maximum of Log-likelihood	10.8322
DW-statistic	2.0540		

Diagnostic Tests

* Test Statistics *	F-Version *
* A:Serial Correlation	*F(1, 20)= .070336[.794]
* B:Functional Form	*F(1, 20)= 2.7159[.115]
* C:Normality	*CHI-SQ(2)= .90469[.636]
* D:Heteroscedasticity	*F(1, 24)= .12186[.730]
* E:Predictive Failure	*F(3, 18)= 4.4313[.017]
* E:Predictive Failure	*F(9, 12)= 2.3568[.084]
* F:Chow Test	*F(5, 16)= 3.6131[.022]

7.2.4 Import function

The demand for imports arises due to the demand for goods and services by both consumers and investors. The variables which affect private consumption and investment are specified and estimated in sections 7.2.1 and 7.2.2. above. Government demand for imports is assumed to follow its expenditure which is generally assumed to be exogenous. In this section, therefore, private consumption (lrcp), private investment (lrip), government consumption (lrcg) and government investment (lrig) are included as explanatory variables in the import function.

In economies where governments heavily regulate the external trade, the size of official reserves of foreign exchange (lrfer) is a key constraint in the realization of import demand by the domestic economy. The real effective exchange rate (lreer) and the premium on the parallel exchange rate (lprm) are included as the main determinants of the price of imports in the official and informal markets respectively.

Table 7.14 presents the cointegration tests based on the maximal eigenvalues and the trace of stochastic matrix with a lag of 2 in the VAR. At the 5% level of significance the maximal eigenvalues and the trace of the stochastic matrix respectively suggest the existence of 3 and 6 cointegrating vectors. On the basis of the trace of the stochastic matrix we accept the alternative hypothesis of there being 6 cointegrating vectors. These vectors are presented in Table 7.14. Based on economic theory and statistical tests we accept vector 5 as the long-run function for imports.[10]

$$lrim = .30425\ lrig + .44157\ lrip + .17363\ lrcg - 1.1769\ lrcp + .17377\ lrfer - 1.2346\ lreer - .59300\ lprm \quad \text{......7.30}$$

The size and sign of all the coefficients are consistent with economic theory. As discussed above, government expenditure and private investment have a positive impact on the demand for imports; while private consumption is negatively related to imports. The latter can be attributed to government policy which actively discouraged the importation of consumer goods during most of the sample period. Central banks were very reluctant to sell foreign

[10] All the remaining vectors were followed through to the dynamic specification and tested on the basis of economic and statistical theory. The result was found to be inferior to that of vector 5.

exchange to private importers of "non-essential" consumer goods. There was also an intensive propaganda campaign in favour of consuming local products during the austerity program of the 1980's, in which all politicians and senior public servants were obliged to wear locally-produced uniform during office hours. The overall impact of this was to reduce consumption of official imports and thereby reduce total imports and/or replace official imports by informal imports.

The result confirms the role of official foreign reserves as determinants of the country's capacity to import; while increases in real effective exchange rate and the premium on the informal exchange rate respectively increase the price of imports in the formal and informal markets and, thereby, reduce their demand. These results lend support to the effectiveness of the exchange rate as a policy instrument in external trade, provided that the government can demonstrate its anti-inflationary credentials.

For the weak exogeneity test, the adjustment coefficients were obtained by substituting the first difference of each of the variables of the long run function for "x" in the following OLS-regression.

$$\begin{aligned} x = c &+ \alpha_{im}\text{dlrim}(-1) + \alpha_{ig}\text{dlrig}(-1) + \alpha_{ip}\text{dlrip}(-1) + \alpha_{cg}\text{dlrcg}(-1) + \alpha_{cp}\text{dlrcp}(-1) \\ &+ \alpha_{fer}\text{dlrfer}(-1) + \alpha_{reer}\text{dlreer}(-1) + \alpha_{prm}\text{dlprm}(-1) + \alpha_{x}\text{ecm}(-2) \quad \ldots\ldots\ldots\ldots 7.31 \end{aligned}$$

The test indicated that, with the exception of lrig and lrcp, the remaining five explanatory variables are weakly exogenous vis-à-vis imports and, thus, the overparameterized version of the short-run dynamic equation (reported in table 7.16) is specified as

$$\begin{aligned} \text{dlrim} = c &+ \alpha_{0ip}\text{dlrip} + \alpha_{0cg}\text{dlrcg} + \alpha_{0fer}\text{dlrfer} + \alpha_{0reer}\text{dlreer} + \alpha_{0prm}\text{dlprm} \\ &+ \alpha_{im}\text{dlrim}(-1) + \alpha_{ig}\text{dlrig}(-1) + \alpha_{ip}\text{dlrip}(-1) + \alpha_{cg}\text{dlrcg}(-1) + \alpha_{cp}\text{dlrcp}(-1) \\ &+ \alpha_{fer}\text{dlrfer}(-1) + \alpha_{reer}\text{dlreer}(-1) + \alpha_{prm}\text{dlprm}(-1) + \alpha_{x}\text{ecm}(-2) \quad \ldots\ldots\ldots 7.32 \end{aligned}$$

The OLS regression of this equation is subjected to the statistical tests discussed in section 7.1.2.2 to yield the final version of the short-run dynamic function for real imports reported in table 7.17. All coefficients are significant at 5% level of significance and the diagnostics are satisfactory. The functional form of the final version improved significantly vis-a-vis the overparameterized version. The predictive failure test indicates that the equation can adequately predict the dynamic behaviour of real imports over both the 1990-93 and 1984-1993 periods.

Table 7- 14: Cointegration test for real imports

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrim lrig lrip lrcg lrcp
lrfer lreer lprm
List of eigenvalues in descending order:
.97418 .87655 .75660 .54846 .50196 .49018 .43442
.049547

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	102.3849	51.0710	48.4320
r<= 1	r = 2	58.5727	44.9120	42.0610
r<= 2	r = 3	39.5655	39.4260	36.3460
r<= 3	r = 4	22.2624	33.3190	30.8410
r<= 4	r = 5	19.5182	27.1360	24.7830
r<= 5	r = 6	18.8634	21.0740	18.9040
r<= 6	r = 7	15.9575	14.9000	12.9120
r<= 7	r = 8	1.4229	8.1760	6.5030

Conclusion: r = 3

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrim lrig lrip lrcg lrcp
lrfer lreer lprm
List of eigenvalues in descending order:
.97418 .87655 .75660 .54846 .50196 .49018 .43442
.049547

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	278.5475	157.1090	151.3800
r<= 1	r>= 2	176.1626	124.2530	118.9890
r<= 2	r>= 3	117.5898	95.1770	90.3920
r<= 3	r>= 4	78.0243	70.5980	66.4860
r<= 4	r>= 5	55.7619	48.2800	45.2290
r<= 5	r>= 6	36.2438	31.5250	28.7090
r<= 6	r>= 7	17.3804	17.9530	15.6630
r<= 7	r = 8	1.4229	8.1760	6.5030

Conclusion: r = 6

Table 7- 15: Cointegrating vectors for real imports

Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 6.

	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5	Vector 6
lrim	-.019796	-2.1293	3.8516	4.2937	1.3646	-.48980
	(-1.0000)	(-1.0000)	(-1.0000)	(-1.0000)	(-1.0000)	(-1.0000)
lrig	.74757	1.0844	-1.8183	-.26045	-.41517	.042576
	(37.7630)	(.50927)	(.47208)	(.060660)	(.30425)	(.086925)
lrip	-.094057	.25702	-.49190	-.26749	-.60254	-.34934
	(-4.7512)	(.12071)	(.12771)	(.062299)	(.44157)	(-.71322)
lrcg	-.84484	-2.2541	-1.6667	.10859	-.23693	.44258
	(-42.6766)	(-1.0587)	(.43272)	(-.025290)	(.17363)	(.90358)
lrcp	-.73752	.41551	2.3586	-1.4269	1.6060	-.80941
	(-37.2555)	(.19514)	(-.61236)	(.33234)	(-1.1769)	(-1.6525)
lrfer	-.033420	-.18447	-.20587	-.046028	-.23712	.24298
	(-1.6882)	(-.086638)	(.053450)	(.010720)	(.17377)	(.49608)
lreer	.56817	-.0041301	-2.3290	3.7933	1.6846	1.7365
	(28.7009)	(-.0019397)	(.60468)	(-.88346)	(-1.2346)	(3.5454)
lprm	-.46678	.55285	.80954	-.60864	.80917	-.024129
	(-23.5789)	(.25964)	(-.21018)	(.14175)	(-.59300)	(-.049263)

Estimated Adjustment Matrix in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 6.

	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5	Vector 6
lrim	.12220	-.044530	-.023068	-.041802	-.29615	.20169
	(.0024191)	(-.094816)	(.088850)	(.17948)	(.40412)	(.098788)
lrig	-.41323	-.092572	.39918	.10020	-.56692	.20897
	(-.0081804)	(-.19711)	(-1.5375)	(-.43021)	(.77360)	(.10236)
lrip	1.3572	.17710	.29214	-.17917	.057087	.18299
	(.026867)	(.37710)	(-1.1252)	(.76929)	(-.077898)	(.089628)
lrcg	.067700	-.033215	.036441	.32846	-.23665	.11372
	(.0013402)	(-.070723)	(-.14036)	(-1.4103)	(.32292)	(.055701)
lrcp	.066623	.13721	.055255	.0045376	-.17685	.0031636
	(.0013189)	(.29216)	(-.21282)	(-.019483)	(.24132)	(.0015495)
lrfer	.18390	2.0806	-.49856	-.29656	.23696	-.94189
	(.0036406)	(4.4301)	(1.9203)	(1.2733)	(-.32335)	(-.46134)
lreer	.0048245	.0091795	.28767	-.21705	.072956	-.25946
	(.9551e-4)	(.019546)	(-1.1080)	(.93194)	(-.099552)	(-.12708)
lprm	.20982	-.54567	-.42860	.26982	-.30398	.11092
	(.0041536)	(-1.1619)	(1.6508)	(-1.1585)	(.41480)	(.054330)

Table 7- 16: Dynamic Modelling of real imports: Overparameterized version

Ordinary Least Squares Estimation

Dependent variable is dlrim

28 observations used for estimation from 1966 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	1.8584	1.1503	1.6157[.130]
dlrip	.13224	.073387	1.8020[.095]
dlrcg	.33922	.19421	1.7467[.104]
dlrfer	-.022109	.042957	-.51466[.615]
dlreer	-.032279	.24556	-.13145[.897]
dlprm	.084282	.14563	.57874[.573]
dlrim(-1)	.060974	.33439	.18234[.858]
dlrig(-1)	-.21401	.14458	-1.4802[.163]
dlrip(-1)	-.035569	.076145	-.46713[.648]
dlrcg(-1)	-.54096	.32644	-1.6571[.121]
dlrcp(-1)	-.38503	.59497	-.64715[.529]
dlrfer(-1)	.027496	.050778	.54150[.597]
dlreer(-1)	.031878	.24427	.13050[.898]
dlprm(-1)	-.23643	.13880	-1.7034[.112]
ecmim2v5(-2)	-.25956	.16324	-1.5900[.136]

R-Squared	.88875	F-statistic F(14, 13)	7.4179[.000]
R-Bar-Squared	.76894	S.E. of Regression	.10774
Residual Sum of Squares	.15091	Mean of Dependent Variable	.030344
S.D. of Dependent Variable	.22414	Maximum of Log-likelihood	33.3955
DW-statistic	2.3890		

Diagnostic Tests

* Test Statistics *	F-Version *
* A:Serial Correlation	*F(1, 12)= 1.4187[.257]*
* B:Functional Form	*F(1, 12)= 5.4312[.038]*
* C:Normality	*CHI-SQ(2)= .67785[.713]*
* D:Heteroscedasticity	*F(1, 26)= .096685[.758]*

Table 7- 17: Dynamic Modelling of real imports: Final version

Ordinary Least Squares Estimation

Dependent variable is dlrim

28 observations used for estimation from 1966 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	1.4611	.66476	2.1979[.039]
dlrip	.15638	.042630	3.6683[.001]
dlrcg	.43573	.13130	3.3185[.003]
dlrig(-1)	-.18076	.084685	-2.1345[.045]
dlrcg(-1)	-.52740	.14552	-3.6241[.002]
dlprm(-1)	-.25627	.095014	-2.6972[.013]
ecmim2v5(-2)	-.20226	.094444	-2.1416[.044]

R-Squared	.86194	F-statistic F(6, 21)	21.8506[.000]
R-Bar-Squared	.82249	S.E. of Regression	.094435
Residual Sum of Squares	.18728	Mean of Dependent Variable	.030344
S.D. of Dependent Variable	.22414	Maximum of Log-likelihood	30.3729
DW-statistic	2.2470		

Diagnostic Tests

* Test Statistics *	F-Version *
* A:Serial Correlation	*F(1, 20)= .75855[.394]*
* B:Functional Form	*F(1, 20)= 2.4824[.131]*
* C:Normality	*CHI-SQ(2)= .45822[.795]*
* D:Heteroscedasticity	*F(1, 26)= .0043413[.948]*
* E:Predictive Failure	*F(3, 18)= 1.0811[.382]*
* E:Predictive Failure	*F(9, 12)= 1.6238[.214]*
* F:Chow Test	*F(7, 14)= 1.4636[.257]*

7.2.5 Demand for real broad money (M2)

The specification of the equation for the demand for broad money is based on the theoretical arguments discussed in section 5.3. The variables in equation 5.58 are used in the search for a cointegrating vector which yields a theoretically-sound relationship when real broad money (lm2) is specified as a function of real income (lry), real deposit rate (lrdr2), real lending rate (lrlr2) and a proxy for the treasury bill rate (ltbr)[11] with a lag of 3 on the VAR.

The maximal eigenvalues reported in table 7.18 suggest that the alternative hypothesis of there being 4 cointegrating vectors can be accepted at 5% level of significance, while the trace of the stochastic matrix accepts the 4 vectors at 10% level of significance. We accept the existence of four cointegrating vectors whose β and α matrices are reported in table 7.19. Based on economic theory and statistical tests we accept vector 4 as the long-run function of the demand for real broad money in Ethiopia.

$$lm2 = 1.1888lry + 20.0131lrdr2 - 27.3113lrlr2 + 14.6151ltbr \quad \text{.......................} 7.33$$

The size and sign of all the coefficients are consistent with economic theory and comparable studies by other researchers. Real income increases the transactions demand for money. Many researchers on developing countries failed to get results consistent with the homogenous relationship between real income and real demand. These include +1.9 by Darat (1985), +0.571 & +0.203 by Haque et al. (1990 & 1993), +1 by Adam (1991), +0.65 by Soludo (1995), +1.49 and +1.58 by Fielding (1993), +1.3 by Al-Meshal (1996), +1.8 by Atingi-Ego (1996). Our coefficient of +1.1888 can therefore be accepted as supporting a homogenous relationship.

[11]The bond market is at its rudimentary stage in Ethiopia. The banking system is therefore, almost the only institution through which the government raises funds to satisfy the public sector borrowing requirement (PSBR). Data on the rate of Treasury Bills is incomplete and what is available is mostly kept fixed and probably below their market rates. To capture the behaviour of the yields from holding Ethiopian treasury bills under financial deregulation, we have used a proxy of the treasury bill rate as the ratio of PSBR to GDP (i.e., TBR = PSBR/GDP). This is based on the fact that the risk of default increases as the PSBR/GDP increases. This decline in credit-worthiness of the government is likely to scare private savings from the banking system unless the deposit rate increases in proportion to the additional risk. Under such circumstances the banks are expected to demand an increase in the rate for which they voluntarily hold treasury bills. A similar line of argument can be followed in order to use the DEBT/GDP as an explanatory variable in a money demand function. It would reflect the likelihood of the government accepting a structural adjustment program which

The coefficients of interest rates suggest that the demand for real broad money is directly related to its own rate and the treasury bill rate; while lending rates reduce the demand for broad money. These are correct relationships because higher deposit rates induce the private sector to increase its savings held in the banking system. A similar line of argument can be used to justify the sign on the treasury bills rate when these are sold through the banking system. Even in a situation where government paper is auctioned in the open market, the argument holds because, in their efforts to attract customers out of the bond market to the bank deposits, the banking system is likely to link interest rates to the returns on treasury bills. The lending rate on the other hand, increases the cost of bank loans and thereby the size of domestic credit extended by the banking system. Since broad money is defined as the sum of domestic credit and foreign assets, the negative impact of the lending rate on domestic credit reduces the demand for broad money. Adam (1991) reported an interest rate coefficient of +18.17 for in his demand for broad money (M3) for Kenya. Atingi-Ego (1996) estimated a demand function for the Ugandan M2 and reported coefficients of +16.5397 for real deposit rate and -17.8674 for real lending rate despite using actual inflation (instead of expected inflation) in defining his real interest rates.

The α_X - coefficients used in the weak exogeneity test were obtained by substituting the first difference of each of the variables in the long-run function for "x" in the following OLS-regression.

$$\begin{aligned} x = c &+ \alpha_{m1}\text{dlm2}(-1) + \alpha_{y1}\text{dlry}(-1) + \alpha_{dr1}\text{dlrdr2}(-1) + \alpha_{lr1}\text{dlrlr2}(-1) + \alpha_{tb1}\text{dltbr}(-1) \\ &+ \alpha_{m2}\text{dlm2}(-2) + \alpha_{y2}\text{dlry}(-2) + \alpha_{dr2}\text{dlrdr2}(-2) + \alpha_{lr2}\text{dlrlr2}(-2) + \alpha_{tb2}\text{dltbr}(-2) \\ &+ \alpha_x\text{ecm}(-3) \quad \ldots\ldots\ldots\ldots\ldots\ldots 7.34 \end{aligned}$$

The test indicates that the deposit rates (dlrdr2) and the lending rate (dlrlr2) are weakly exogenous vis-à-vis broad money. Thus, the overparameterized version of the short-run dynamic equation (reported in table 7.19) is specified as

involves radical measures such as devaluation and privatization. However we were unable to get reliable data on the debt accumulated by the Ethiopian Government during the sample period.

$$dlm2 = c + \alpha_{0dr1}dlrdr2 + \alpha_{0lr1}dlrlr2 + \alpha_{m1}dlm2(-1) + \alpha_{y1}dlry(-1) + \alpha_{dr1}dlrdr2(-1) + \alpha_{lr1}dlrlr2(-1) + \alpha_{tb1}dltbr(-1) + \alpha_{m2}dlm2(-2) + \alpha_{y2}dlry(-2) + \alpha_{dr2}dlrdr2(-2) + \alpha_{lr2}dlrlr2(-2) + \alpha_{tb2}dltbr(-2) + \alpha_{x}ecm(-3) \quad \text{...........} 7.35$$

The OLS regression of this equation is subjected to the statistical tests (see section 7.1.2.2) to yield the final version of the short-run dynamic function for the demand for real broad money reported in table 7.21. All coefficients are significant at the 5% level of significance and the diagnostics are satisfactory. However, some evidence of instability of the parameters over time is detected from the Chow test. The predictive failure test indicates that the equation can adequately predict the dynamic behaviour of real demand for broad money over both the 1990-93 and 1984-1993 periods. On balance, therefore, we accept the equation in table 7.21 as a satisfactory model for the Ethiopian broad-money demand.

Table 7- 18: Cointegration test for demand for real broad money

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

27 observations from 1967 to 1993. Maximum lag in VAR = 3.
List of variables included in the cointegrating vector:
lm2 lry lrdr2 lrlr2 ltbr
List of eigenvalues in descending order:
.90447 .64309 .55252 .44846 .0011090

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	63.4039	33.3190	30.8410
r<= 1	r = 2	27.8174	27.1360	24.7830
r<= 2	r = 3	21.7111	21.0740	18.9040
r<= 3	r = 4	16.0661	14.9000	12.9120
r<= 4	r = 5	.029960	8.1760	6.5030

Conclusion = 4

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)

Cointegration LR Test Based on Trace of the Stochastic Matrix

27 observations from 1967 to 1993. Maximum lag in VAR = 3.
List of variables included in the cointegrating vector:
lm2 lry lrdr2 lrlr2 ltbr
List of eigenvalues in descending order:
.90447 .64309 .55252 .44846 .0011090

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	129.0285	70.5980	66.4860
r<= 1	r>= 2	65.6245	48.2800	45.2290
r<= 2	r>= 3	37.8072	31.5250	28.7090
r<= 3	r>= 4	16.0961	17.9530	15.6630
r<= 4	r = 5	.029960	8.1760	6.5030

Conclusion: r = 3

Table 7- 19: Cointegrating vectors for demand for real broad money

Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
27 observations from 1967 to 1993. Maximum lag in VAR = 3, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
lm2	-.52066	.25480	-.88646	2.1099
	(-1.0000)	(-1.0000)	(-1.0000)	(-1.0000)
lry	-.39455	2.4758	2.4258	-2.5081
	(-.75778)	(-9.7168)	(2.7364)	(1.1888)
lrdr2	19.9172	10.9719	-9.6256	-42.2254
	(38.2534)	(-43.0616)	(-10.8584)	(20.0131)
lrlr2	-11.7318	-15.4229	9.7010	57.6238
	(-22.5324)	(60.5304)	(10.9435)	(-27.3113)
ltbr	1.7097	6.4142	23.0434	-30.8363
	(3.2837)	(-25.1738)	(25.9947)	(14.6151)

Estimated Adjustment Matrix in Johansen Estimation (Normalized in Brackets)
27 observations from 1967 to 1993. Maximum lag in VAR = 3, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
lm2	.11771	.075756	.063826	.088112
	(.061286)	(-.019302)	(.056580)	(-.18591)
lry	.095633	-.17654	.020119	.013544
	(.049793)	(.044981)	(.017835)	(-.028576)
lrdr2	-.095397	-.035273	.015294	.0054981
	(-.049670)	(.0089873)	(.013558)	(-.011600)
lrlr2	-.081592	-.015852	-.0049925	-.0037830
	(-.042482)	(.0040391)	(-.0044257)	(.0079818)
ltbr	-.0045761	.021662	-.064660	.027697
	(-.0023826)	(-.0055194)	(-.057319)	(-.058438)

Table 7- 20: Dynamic Modelling of demand for real broad money: Overparameterized version

Ordinary Least Squares Estimation

Dependent variable is dlm2

27 observations used for estimation from 1967 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	-.044067	.23576	-.18692[.855]
dlrdr2	-1.3067	1.4633	-.89298[.388]
dlrlr2	3.1156	2.0284	1.5360[.149]
dlm2(-1)	-.45890	.22646	-2.0264[.064]
dlm2(-2)	-.25327	.22458	-1.1277[.280]
dlry(-1)	.20288	.24523	.82731[.423]
dlry(-2)	-1.6733	.49434	-3.3850[.005]
dlrdr2(-1)	-.42679	2.6263	-.16251[.873]
dlrdr2(-2)	-2.0506	.65960	-3.1088[.008]
dlrlr2(-1)	7.0066	3.9349	1.7806[.098]
dlrlr2(-2)	3.6205	.84490	4.2850[.001]
dltbr(-1)	-1.9878	1.0001	-1.9877[.068]
dltbr(-2)	-2.4326	1.2589	-1.9323[.075]
ecm19v34(-3)	-.018778	.10224	-.18367[.857]

R-Squared	.80170	F-statistic F(13, 13)	4.0428[.009]
R-Bar-Squared	.60339	S.E. of Regression	.058070
Residual Sum of Squares	.043837	Mean of Dependent Variable	.055546
S.D. of Dependent Variable	.092208	Maximum of Log-likelihood	48.4006
DW-statistic	2.0703		

Diagnostic Tests

* Test Statistics *	F-Version *
* A:Serial Correlation	*F(1, 12)= .043232[.839]*
* B:Functional Form	*F(1, 12)= .84835[.375]*
* C:Normality	*CHI-SQ(2)= .31699[.853]*
* D:Heteroscedasticity	*F(1, 25)= .46685[.501]*

Table 7- 21: Dynamic Modelling of demand for real broad money: Final version

Ordinary Least Squares Estimation

Dependent variable is dlm2

27 observations used for estimation from 1967 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	-.31845	.11428	-2.7866[.010]
dlrdr2(-1)	4.4882	1.5667	2.8648[.009]
dlrlr2(-1)	-5.0391	1.7316	-2.9100[.008]
ecm19v34(-3)	-.17188	.051745	-3.3217[.003]

R-Squared	.42004	F-statistic F(3, 23)	5.5526[.005]
R-Bar-Squared	.34439	S.E. of Regression	.074661
Residual Sum of Squares	.12821	Mean of Dependent Variable	.055546
S.D. of Dependent Variable	.092208	Maximum of Log-likelihood	33.9129
DW-statistic	1.6442		

Diagnostic Tests

* Test Statistics *	F-Version *	
* A:Serial Correlation	*F(1, 22)=	.64109[.432]
* B:Functional Form	*F(1, 22)=	1.5931[.220]
* C:Normality	*CHI-SQ(2)=	3.7340[.155]
* D:Heteroscedasticity	*F(1, 25)=	.74391[.397]
* E:Predictive Failure	*F(3, 20)=	.71961[.552]
* E:Predictive Failure	*F(9, 14)=	1.7140[.177]
* F:Chow Test	*F(4, 19)=	3.5163[.026]

7.2.6 Informal exchange rate and foreign exchange reserves

So far we have estimated the functions for the four behavioural equations of the aggregate income identity (the real sector) and the demand function for broad money to represent the monetary sector of the macroeconomy. The links between the real and monetary sectors have been established mainly by the inclusion of aggregate income in the demand-for-money function and that of prices in all variables of the model. The objective of this section is to strengthen this link by introducing some degree of endogeneity of the informal rate of exchange and foreign exchange reserves vis-à-vis the real and monetary sectors of the economy.

7.2.6.1 Informal rate of exchange

The model estimated here and its theoretical arguments are discussed chapter 5, section 5.3.3.3. Various combinations of the variables in equation 5.59 were used in the search for a cointegrating vector. Whenever a cointegrating vector was found its coefficients were evaluated on the basis of the underlying economic theory. On this basis we have accepted the vector of the informal exchange rate, the current account balance and expected inflation. The maximal eigenvalue and trace of the stochastic matrix presented in table 7.22 indicate the existence of one cointegrating vector with a lag of 2 in the VAR. The long-run function is estimated in table 7.23 as follows.

lerb = -6.4092 lca + 2.5249 lexinf3 ....7.36

From this the error correction term was calculated as

ecm = lerb+6.4092lca-2.5249lexinf3 ....7.37

and the overparameterized version of the short-run dynamic function is specified as

dlerb = f[dlerb, erb(-1), dlca, dlca(-1), dlexinf3, dlexinf3(-1), lif, lif(-1), ecm(-2)]...7.38

The lag structure is based on the long-run function obtained from a cointegrating vector with 2 lags in the VAR. Returns on foreign assets (lif) is included as a stationary [i.e., I(0)] variable and on balance it can be treated as an exogenous variable that is determined by fluctuations in the international financial markets. Thus it is included (as a level) in the short-run dynamic function in spite of its absence from the long-run cointegrating vector. Then, equation 7.38 is subjected to the statistical test (discussed in section 7.1.2.2) resulting in to the following short-run dynamic function for informal rate of exchange.

dlerb = -.10433 + .98200 lif(-1) + .045414 ecm1(-2) 7.39

The result of the statistical tests is presented in table 7.24. The DW-statistic is low and first-order serial correlation cannot be rejected at the 5% level of significance[12]. The model passes all the other tests very comfortably. All coefficients are highly significant and the correlation coefficient is almost 1. The rest of the diagnostic tests are very good and predictive failure is rejected for both short period (3 years) and longer period (9 years). Figure 8.5 (in chapter 8) also shows that the model provides an almost perfect fit. Thus, despite the first order autocorrelations, we accept equations 7.36 and 7.39 as models of the informal rate of exchange.

[12] Attempts were made to improve the DW-statistic and remove serial correlation by including lagged dependent variables and by changing the lag structure of the ECM term. The result was rejected because the R^2 deteriorated.

Table 7- 22: Cointegration test for informal rate of exchange

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lerb lca lexinf3
List of Eigenvalues in descending order:
.61275 .21198 .6810E-5

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	26.5635	21.0740	18.9040
r<= 1	r = 2	6.6705	14.9000	12.9120
r<= 2	r = 3	.1907E-3	8.1760	6.5030

Conclusion: r = 1

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)

Cointegration LR Test Based on Trace of the Stochastic Matrix

28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lerb lca lexinf3
List of Eigenvalues in descending order:
.61275 .21198 .6810E-5

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	33.2342	31.5250	28.7090
r<= 1	r>= 2	6.6707	17.9530	15.6630
r<= 2	r = 3	.1907E-3	8.1760	6.5030

Conclusion: r = 1

Table 7- 23: Cointegrating vectors for informal rate of exchange

Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
lerb	-.86416
	(-1.0000)
lca	-5.5386
	(-6.4092)
lexinf3	2.1819
	(2.5249)

Estimated Adjustment Matrix in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
lerb	.35214
	(.30431)
lca	-.038154
	(-.032971)
lexinf3	-.11302
	(-.097671)

Table 7- 24: Dynamic Modelling of informal rate of exchange: Final version

Ordinary Least Squares Estimation
Dependent variable is dlerb
28 observations used for estimation from 1966 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	-.10433	.013306	-7.8406[.000]
lif(-1)	.98200	.019309	50.8563[.000]
ecm1(-2)	.045414	.013786	3.2941[.003]

R-Squared	.99120	F-statistic F(2, 25)	1407.9[.000]
R-Bar-Squared	.99050	S.E. of Regression	.018980
Residual Sum of Squares	.0090063	Mean of Dependent Variable	.033572
S.D. of Dependent Variable	.19469	Maximum of Log-likelihood	72.8582
DW-statistic	.79632		

Diagnostic Tests

Test Statistics	F-Version
A: Serial Correlation	F (1, 24) = 11.1189[.003]
B: Functional Form	F (1, 24) = .12823[.723]
C: Normality	CHI-SQ (2) = .55020[.759]
D: Heteroscedasticity	F (1, 26) = .48246[.493]
E: Predictive Failure	F(3, 22) = .94951[.434]
E:Predictive Failure	F(9, 16) = 1.4796[.237]
F: Chow Test	F(3, 22) = 2.1851[.118]

7.2.6.2 Foreign exchange reserves

The theoretical model for foreign exchange reserves (lrfer) is discussed in chapter 5, section 5.3.3.4. In the search for the long-run cointegrating vector various combinations of the variables in equation 5.60 were tested and the vector with the ratio of external balance to aggregate income (lca) was the nearest to the underlying economic theory. The result of the test for cointegrating vectors is presented in table 7.25. Both the maximal eigenvalues and the trace of the stochastic matrix suggest the presence of one cointegrating vector. The vector is presented in table 7.26 from which we get the long-run function for foreign exchange reserve as

lrfer = 14.2970 lca 7.40

The result is consistent with economic theory where an increase in the ratio of net export to GDP leads to increase in foreign exchange reserves. From this we calculate the error correction term as

ecm2 = lrfer - 14.2970 lca 7.41

The following overparameterized version of the short-run dynamic equation was specified on the basis of the variables in equation 5.60 and the lag structure of the long-run cointegrating vector.

dlrfer = f[dlrfer(-1), dlca, dlca(-1), lpsfb, lpsfb(-1), ecm2(-2)] 7.42

Equation 7.42 was used as a basis in the search for a dynamic equation that is consistent with economic theory and statistical tests. The resulting final version of the short-run dynamic equation for foreign exchange reserves is

dlrfer = 1.9300 -.23916 dlrfer(-1) -.85116 ecm22(-2) 7.43

The result of the statistical tests is presented in table 7.27. The coefficient for the lagged dependent variable is accepted at 16% level of significance. However, it is worth commenting on the sign of this coefficient. As discussed in section 5.3.3.4, such a negative relationship between current reserves and its past values indicate the impact of the government's present willingness to supply foreign exchange on its ability to supply foreign exchange in subsequent periods. The correlation coefficient is rather low (0.52091). This is improved when the constant term is re-estimated in chapter 8 (see figure 8.6). All other coefficients are highly significant and the diagnostic tests are good. Predictive failure is rejected for both short period (3 years) and longer period (9 years). Thus, we accept equations 7.40 and 7.43 as the models for foreign exchange reserves.

Table 7- 25: Cointegration test for foreign exchange reserves

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrfer lca
List of Eigenvalues in descending order:
.50054 .016238

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	19.4382	14.9000	12.9120
r<= 1	r = 2	.45839	8.1760	6.5030

Conclusion: r = 1

Johansen Maximum Likelihood Procedure (Trended Case, no trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

28 observations from 1966 to 1993. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
lrfer lca
List of Eigenvalues in descending order:
.50054 .016238

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	19.8966	17.9530	15.6630
r<= 1	r = 2	.45839	8.1760	6.5030

Conclusion: r = 1

Table 7- 26: Cointegrating vectors for foreign exchange reserves

Estimated Cointegrated Vectors in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
lrfer	-.32460
	(-1.0000)
lca	4.6408
	(14.2970)

Estimated Adjustment Matrix in Johansen Estimation (Normalized in Brackets)
28 observations from 1966 to 1993. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
lrfer	2.5558
	(.82962)
lca	-.0036022
	(-.0011693)

Table 7- 27: Dynamic Modelling of foreign exchange reserves: Final version

Ordinary Least Squares Estimation
Dependent variable is dlrfer
28 observations used for estimation from 1966 to 1993

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
c	1.9300	.38887	4.9631[.000]
dlrfer(-1)	-.23916	.16165	-1.4795[.152]
ecm22(-2)	-.85116	.16780	-5.0726[.000]

R-Squared	.52091	F-statistic F(2, 25)	13.5911[.000]
R-Bar-Squared	.48258	S.E. of Regression	.52216
Residual Sum of Squares	6.8163	Mean of Dependent Variable	.023492
S.D. of Dependent Variable	.72591	Maximum of Log-likelihood	-19.9499
DW-statistic	2.3040	Durbin's h-statistic	-1.5528[.120]

Diagnostic Tests

Test Statistics	F-Version
A: Serial Correlation	F(1, 24)= 2.0680[.163]
B: Functional Form	F(1, 24)= .78265[.385]
C: Normality	CHI-SQ(2)= .48497[.785]
D: Heteroscedasticity	F(1, 26)= .12215[.730]
E:Predictive Failure	F(3, 22)= 1.1844[.339]
E:Predictive Failure	F(9, 16)= 2.1313[.089]
F: Chow Test	F(3, 22)= .88059[.466]

7.3 Conclusion

The equations of the model estimated in this chapter provide a reasonably good fit of the economic sectors they represent. When considered simultaneously, the equations provide a quite comprehensive macroeconomic model of the economy (see the flow-chart in chapter 8). To the best of my knowledge it is the first of its kind for the Ethiopian economy. Furthermore, it demonstrates the following innovations that can be seen as a contribution to applied macroeconomic research in developing countries:

(i) The implications of the informal sector for the effectiveness of macroeconomic policy are well-explored in the financial-repression/liberalization literature. The bulk of the literature is, however, confined to qualitative discussion. This study takes the analysis of the informal sector further. It establishes an empirical link from the informal exchange rate to the real and monetary sectors of the domestic economy and the international financial market.

(ii) The issue of expectation is another less-emphasized part of economic modelling in developing countries. The economies are mostly fragmented with a large subsistence sector which persistently co-exists alongside small enclaves of modern economic activity. One may, therefore, envisage the need to recognize the disparity of access to market information that exists between these groups of society. This is recognized in this study in the derivation of expected inflation and the expected returns on foreign assets.

(iii) In many developing countries the interest rates are kept artificially low in order to subsidize the public sector. The negative impact of such distortions is well-emphasized in the financial-liberalization literature. Given the lack of data on market-determined interest rates, however, the merits of financial-liberalization have been very difficult to quantify. This study has tried to overcome this difficulty by creating a proxy for the treasury bill rate that links the PSBR to the government's credit-worthiness, assuming a liberalized banking system scenario.

Nevertheless, the model is far from perfect. The quality of the data is likely to be biased in line with the objective/resource of the reporting institution, i.e., Government, IMF, World Bank (see Degefe, 1992). Secondly, the incorporation of three fundamentally divergent policy regimes in the sample period may have biased the signs or sizes of the coefficients (see Lucas

(1976) critique). Thirdly, although the estimation technique followed has provided coefficients that are consistent with the underlying economic theory, one may argue that the long lag structures of some equations are more appropriate for models based on quarterly data. More will be said on this matter in chapter nine, and possible ways of modifying the model as more data are released in the future will be suggested in chapter ten. The next chapter will examine the goodness-of-fit of the overall macroeconomic model by treating the single equations estimated here as part of a system of simultaneous equations.

CHAPTER EIGHT

THE MODEL AS A SYSTEM AND THE WITHIN-SAMPLE FIT

We have so far analyzed the economic and statistical properties of each of the equations of the model separately. They were evaluated on the basis of their ability to explain the specific characteristics of agents and institutions of a given section of the macroeconomy, assuming no change in the operations of other sections of the economy. The objective of this chapter is to relax this assumption and examine the economy as a system by analyzing the behaviour of all equations of the model simultaneously.

The discussion in this chapter is organized as follows. Section 8.1 presents the full listing of the model as a system of difference equations. Section 8.2 gives a brief review of the criteria used to evaluate the overall goodness-of-fit of the macro-model and presents the results. Section 8.3 will present the conclusion on the performance of the macro-model.

8.1 The full model and flow-chart

The estimated parameters of the equations of the model are the short-run dynamic coefficients from chapter 7. To run the model as a system of simultaneous equations, we change the statistical package from MICROFIT to TSP and adopt a common sample period of 1968 to 1992 for all the equations. Since the coefficients of each of the behavioural equations accord with economic fundamentals (see chapter 7), we accept them as they are. We then allow the constant term of each equation to change in response to the effect of the new sample period [1].

8.1.1 The equations of the model

In this section we will list the seven behavioural equations of the model and the price equation. This will be followed by the list of the variables, identities and technical relationships used in the estimation of the model. The plots of the actual and fitted values of each equation of the model when run as single equations are presented in figures 8.1 to 8.8. The goodness-of-fit of

[1]The only exception in this case was the coefficient of imports when used as an explanatory variable in the private investment function (see equations 7.24 and 8.2). The size of the coefficient (i.e., the 2.16 calculated as a product of -0.75 adjustment coefficient and 2.87 coefficient of LRIM) was too large thus yielding an explosive adjustment process. To remedy this we allowed both parameters (the constant term and the coefficient associated with imports) to change in response to the new sample period. This yielded a smaller coefficient (.802) for imports and enabled the model to converge without affecting the fundamental economic properties of the equation.

the equations will be compared with the goodness-of-fit when the model is run as a system in section 8.2.

Consumption: This function is based on the final version of the consumption function reported in table 7.5. The only difference between equation 8.1 and table 7.5 is that in the latter the constant term is re-estimated and the ECM term is disaggregated into its components. With an adjusted R-squared of 0.98, the new function gives a good fit of the underlying data (see figure 8.1).

dlrcp = 0.9419069 - .59333 dlrcp(-1) -.48345 lrcp(-2) + .99687 dlryd + .44025 dlryd(-1) + 0.25499 lryd(-2) + 0.00231 lrw(-2) -.10755 dlrcg + 0.05215 lrdr2(-2) -1.0879 dlcrp(-1) - 1.636188 lcrp(-2) 8.1

Investment: Equation 8.2 is the new equation for private investment. It is based on table 7.9 with the only difference being the re-estimation of the constant term and the coefficient associated with imports. The fundamental economic properties of the equation are the same as discussed in section 7.2.2 and its goodness-of-fit, i.e., the adjusted R-squared is 0.86 (see figure 8.2).

dlrip = 0.0753057 - 1.0121 dlrip(-1) -.75452 lrip(-2) + 7.1035 dlrexdy2 + 6.9231 dlrexdy2(-1) + 7.67566 lrexdy2(-2) + .58585 dlrdcp + 1.0114 dlrdcp(-1) + 0.00749 lrdcp(-2) + .93965 dlrim + .8019642 lrim(-2) + 0.04082 lryd(-2) - 0.605374 lrw(-2) 8.2

Exports: The new model for exports is reported in equation 8.3 and figure 8.3. The economic properties of the coefficients are as discussed in section 7.2.3. The only difference between the coefficients reported in table 7.1.3 and equation 8.3 is seen in the constant terms. Also note that the adjusted R-squared (0.68) in figure 8.3 is larger than the R-Bar squared (0.59) in table 7.13.

dlrx = 2.460233 -.52120 lrx(-1) -.85431 lrx(-2) -.50458 dlryf(-1) - 0.549518 lryf(-2) + 1.2806 dlreer(-1) + 1.50811 lreer(-2) - 0.17146 lprm(-2) + 0.19453 lpx(-2) + 0.04097 lverb2(-2) 8.3

Imports: With the exception of the constant term, all the coefficients in equation 8.4 are the same as those reported in table 7.17. Thus, the theoretical arguments discussed in section 7.2.4 remain unchanged. The new model for real imports is plotted in figure 8.4 and its adjusted R-squared (0.74) is R-Bar squared (0.82) reported in table 7.17.

dlrim = 1.458812 - .20226 lrim(-2) + .15638 dlrip + .43573 dlrcg -.52740 dlrcg(-1) + 0.03512 lrcg(-2) -.18076 dlrig(-1) + 0.06154 lrig(-2) - .25627 dlprm(-1) - 0.11994 lprm(-2) + 0.08931 lrip(-2) - 0.23804 lrcp(-2) + 0.03515 lrfer(-2) - 0.24971 lreer(-2) 8.4

Money demand: Equation 8.5 is based on the discussion in section 7.2.5. It differs from table 7.21 only in the constant terms. The new model for the demand for M2 is plotted in figure 8.7. Its adjusted R-squared (0.97) is significantly larger than the R-Bar squared reported in table 7.21.

dlm2 = -0.315304 - .17188 lm2(-3) + 0.20433 lry(-3) + 4.4882 dlrdr2(-1) + 3.43985 lrdr2(-3) - 5.0391 dlrlr2(-1) - 4.694266 lrlr2(-3) + 2.51204 ltbr(-3) 8.5

Price equation: The theoretical arguments for the specification of equation 8.6 as a price equation is discussed in section 8.1.6.1. The price level is assumed to follow discrepancies between the supply and demand in both the monetary and the real sectors. On this basis the coefficients were then estimated using TSP. The result plotted in figure 8.8 shows the model has an adjusted R-squared of 0.99.

lp = .983(log(nm2) - log(rm2)) + .836E-05(log(ngdp)-log(rgdp)) 8.6

Informal exchange rate: The new equation for informal rate of exchange is reported in equation 8.7 and figure 8.5. All the coefficients (including the constant term) are the same as in table 7.24. Thus, the economic interpretation discussed in section 7.2.6.1 remains unchanged. In both cases the estimated models provide a near-perfect fit to the actual data.

dlerb = -.10433 + .98200 lif(-1) + .045414 lerb(-2) + .29107 lca(-2) - .1146658 lexinf3(-2) 8.7

Foreign exchange reserve: Equation 8.8 is based on the theoretical discussion of section 7.2.6.2 and the model reported in table 7.27. The fundamental economic properties remain the same. A comparison of the R-Bar squared in table 7.27 and the adjusted R-squared in figure 8.6, however, indicates that the new model gives a better fit between actual and estimated values of the foreign exchange reserves.

dlrfer = 1.09300 -.23916 dlrfer(-1) -.85116 lrfer(-2) + 12.169 lca(-2) 8.8

Furthermore figure 8.6 must be seen in the context of the political crisis of the time. Following the defeat of elite northern command (Nadew-Eze) of Ethiopian army in 1987, the balance of power shifted in favour of the Eritrean people's Army. This was followed by the capture of Massawa-port in 1990 which heralded the inevitable fall of the government. These events have particular significance to the countries foreign exchange reserves. They led to the collapse of export earnings (see section 2.3.2.2) and capital flight as indicated by the sharp increase in informal exchange rate (see section 2.3.8) during 1987-91.

8.1.2 Notation

cc	currency in circulation
cg	consumption by government sector
cp	consumption private
dd	demand deposits
dc	domestic credit (total)
dcp	domestic credit to the private sector
dr2	deposit rate
ero	exchange rate (official)
erb	exchange rate (informal)
exdy3	expected growth of output
exinf3	expected inflation
fer	foreign exchange reserve

i	investment (total)
ig	investment by government sector
im	imports
ip	investment by the private sector
lr2	lending rate
Iusa	US Treasury Bill rate
oin	other items (net) included in the supply of money
p	price (cpi)
pfw	price of trade partners (weighted average)
psbr	public sector borrowing requirement
px	price of exports
reer	real effective exchange rate
t	tax revenue (total)
td	time deposits
verb	volatility of informal exchange rate
x	exports
yf	income of Ethiopia's trade partners

8.1.3 Identities

nm2= m2 = cc + dd + td + oin .... supply of broad money

rm2 = m2/p .... demand for real broad money

rgdp = exp(lrcp) + exp(lrip) + exp(lrcg) + exp(lrig)

+ exp(lrx) - exp(lrim) .... demand for real output

w = (cc + dd + td) - dcp .... financial wealth of the private sector

y = ngdp = cp + ip + cg + ig + x - im .... nominal output

yd = y - t .... disposable income

8.1.4 Technical relationships

crp = 1 - (dcp/y) .... credit restraint on the private sector

prm = erb/ero .... premium on informal exchange rate

tbr = 1 + (1*psbr)/y .... treasury bill rate (proxy)

if = $(1 + Iusa) * (ERB_{t+1}/ERB_t)$ .... expected return on foreign assets.

8.1.5 Logarithmic transformations

All nominal variables are as described above. The transformations in this section will be indicated by the following additional notations preceding each variable: 'r' for real, 'l' for logarithms, and 'd' for first difference operator. We have, for example, the notation 'cp' for private consumption. This will be transformed as rcp for real private consumption, 'lrcp' for logarithm of real private consumption and dlrcp for the first difference of real private consumption.

Consumption function

```
lcrp     =   log(crp) ;
lrcp     =   log(cp/p) ;
lrdr2    =   log((1+dr/100)/(1+exinf3)) ;
lrw      =   log(w/p) ;
lryd     =   log(yd/p) ;

dlcrp    =   lcrp-lcrp(-1)  ;
dlrcg    =   lrcg-lrcg(-1)  ;
dlrcp    =   lrcp-lrcp(-1) ;
dlrlr2   =   lrlr2-lrlr2(-1)  ;
dlrw     =   lrw-lrw(-1)   ;
dlryd    =   lryd-lryd(-1) ;
```

Investment function

```
lrdcp    =   log(dcp/p)  ;
lrexdy2 =    log((1+exdy3)/(1+exinf3))  ;
lrim     =   log(im/p) ;
lrip     =   log(ip/p)  ;
lrw      =   log(w/p) ;
lryd     =   log(yd/p) ;

dlrdcp    =   lrdcp-lrdcp(-1) ;
dlrexdy2 =    lrexdy2-lrexdy2(-1) ;
```

```
dlrim   =  lrim-lrim(-1)    ;
dlrip   =  lrip-lrip(-1)  ;
dlryd   =  lryd-lryd(-1)  ;
```

Export function

```
lprm    =  log(prm)  ;
lpx     =  log(px)   ;
lreer   =  log(reer) ;
lrx     =  log(x/p)     ;
lryf    =  log(yf/pfx) ;
lverb   =  log(verb)  ;

dlprm   =  lprm -lprm(-1)  ;
dlpx    =  lpx-lpx(-1)  ;
dlreer  =  lreer-lreer(-1)    ;
dlrx    =  lrx-lrx(-1);
dlryf   =  lryf-lryf(-1)  ;
dlverb2 =  lverb2-lverb2(-1)    ;
```

Import function

```
lprm    =  log(prm)  ;
lrcg    =  log(cg/p)  ;
lrcp    =  log(cp/p) ;
lreer   =  log(reer)  ;
lrfer   =  log(fer/p)  ;
lrig    =  log(ig/p)  ;
lrim    =  log(im/p)   ;
lrip    =  log(ip/p) ;

dlprm   =  lprm-lprm(-1)  ;
dlrcg   =  lrcg-lrcg(-1)  ;
dlrcp   =  lrcp-lrcp(-1)   ;
```

dlreer = lreer-lreer(-1) ;

dlrfer = lrfer-lrfer(-1) ;

dlrig = lrig-lrig(-1) ;

dlrim = lrim-lrim(-1) ;

dlrip = lrip-lrip(-1) ;

Informal exchange rate

lif = log(if)

lerb = log(erb)

lca ....= log(1 + (x-m)/y)

lexinf3 = log(1+ exinf3)

dlerb = log(erb) - log((erb(-1))

Foreign exchange reserve

lca ....= log((x-m)/y)

dlfer = log(fer) - log((fer(-1))

Money demand function

lm2 = log(m2/p) ;

lrdr2 = log((1+dr/100)/(1+exinf3)) ;

lrlr2 = log((1+lr/100)/(1+exinf3)) ;

lry = log(y/p) ;

ltbr = log(tbr);

dlm2 = lm2-lm2(-1) ;

dlrdr2 = lrdr2-lrdr2(-1) ;

dlrlr2 = lrlr2-lrlr2(-1) ;

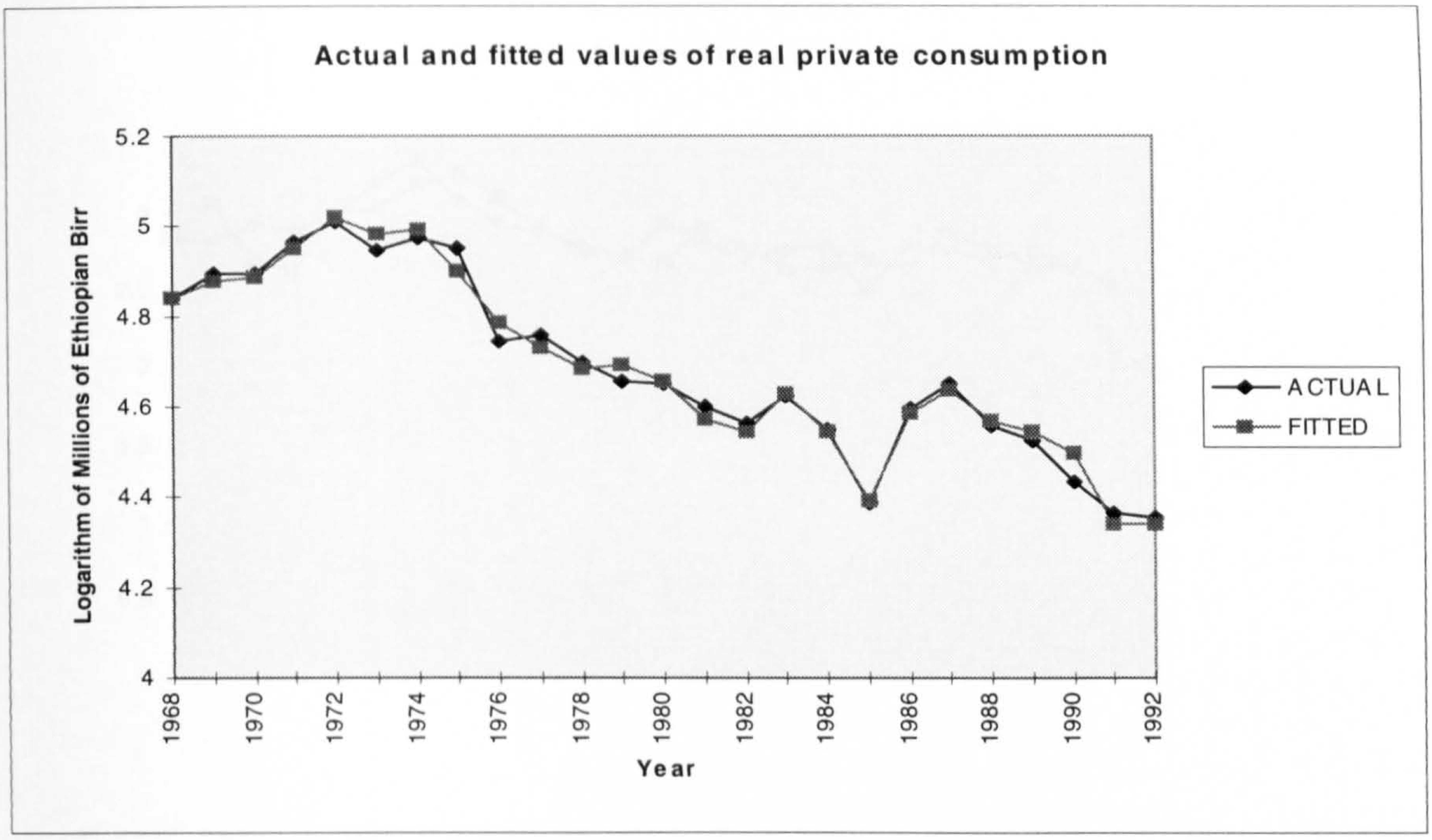
dlry = lry-lry(-1) ;

dltbr = ltbr-ltbr(-1) ;

Price

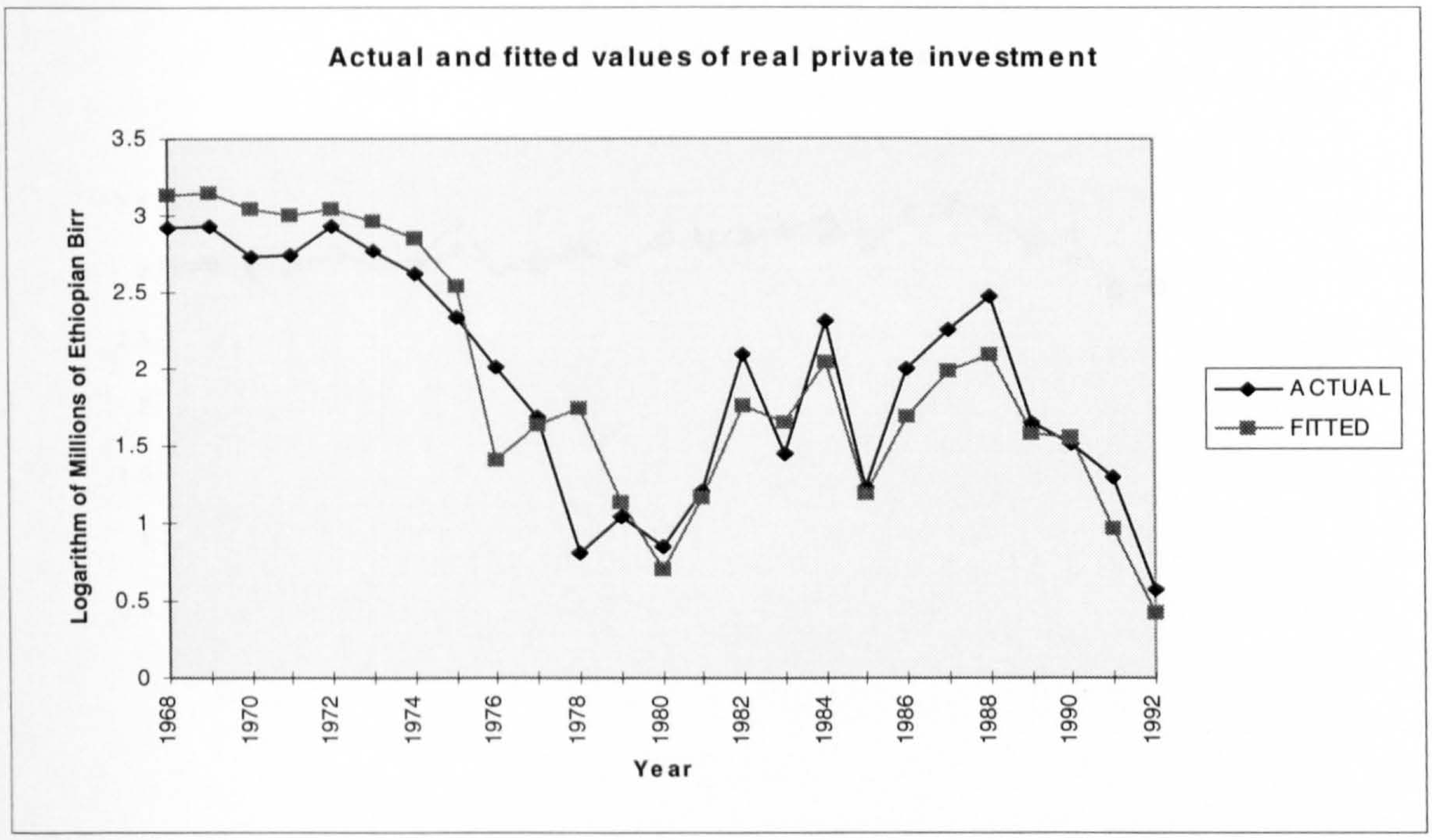
lp = log(p) .

Figure 8- 1: Private consumption function



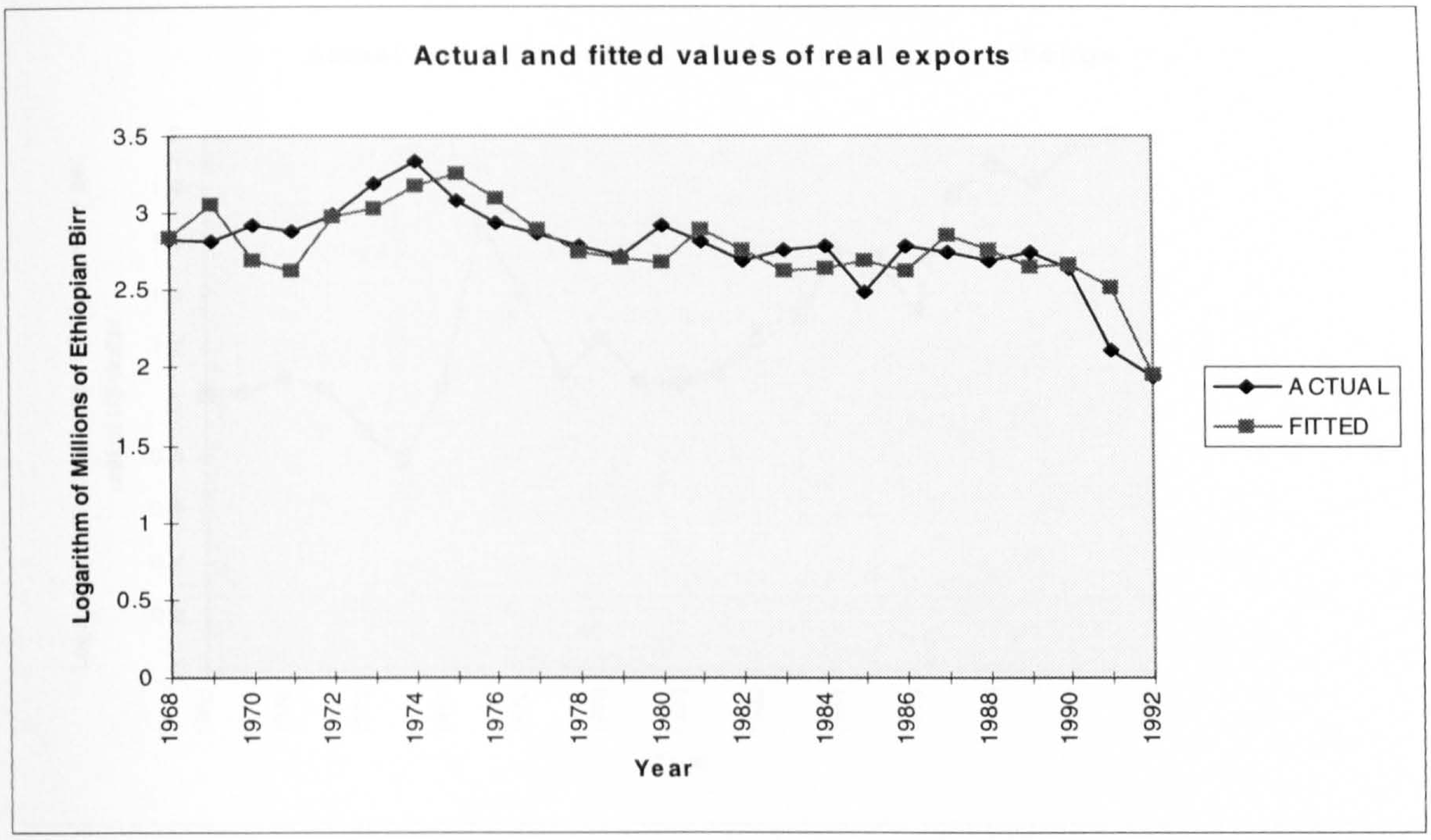
Mean of dependent variable = 4.68770 Std. error of regression = .026172
Std. dev. of dependent var. = .202798 R-squared = .983393
Sum of squared residuals = .016440 Adjusted R-squared = .983393
Variance of residuals = .684986E-03 Durbin-Watson statistic = 2.29346

Figure 8- 2: Private investment function



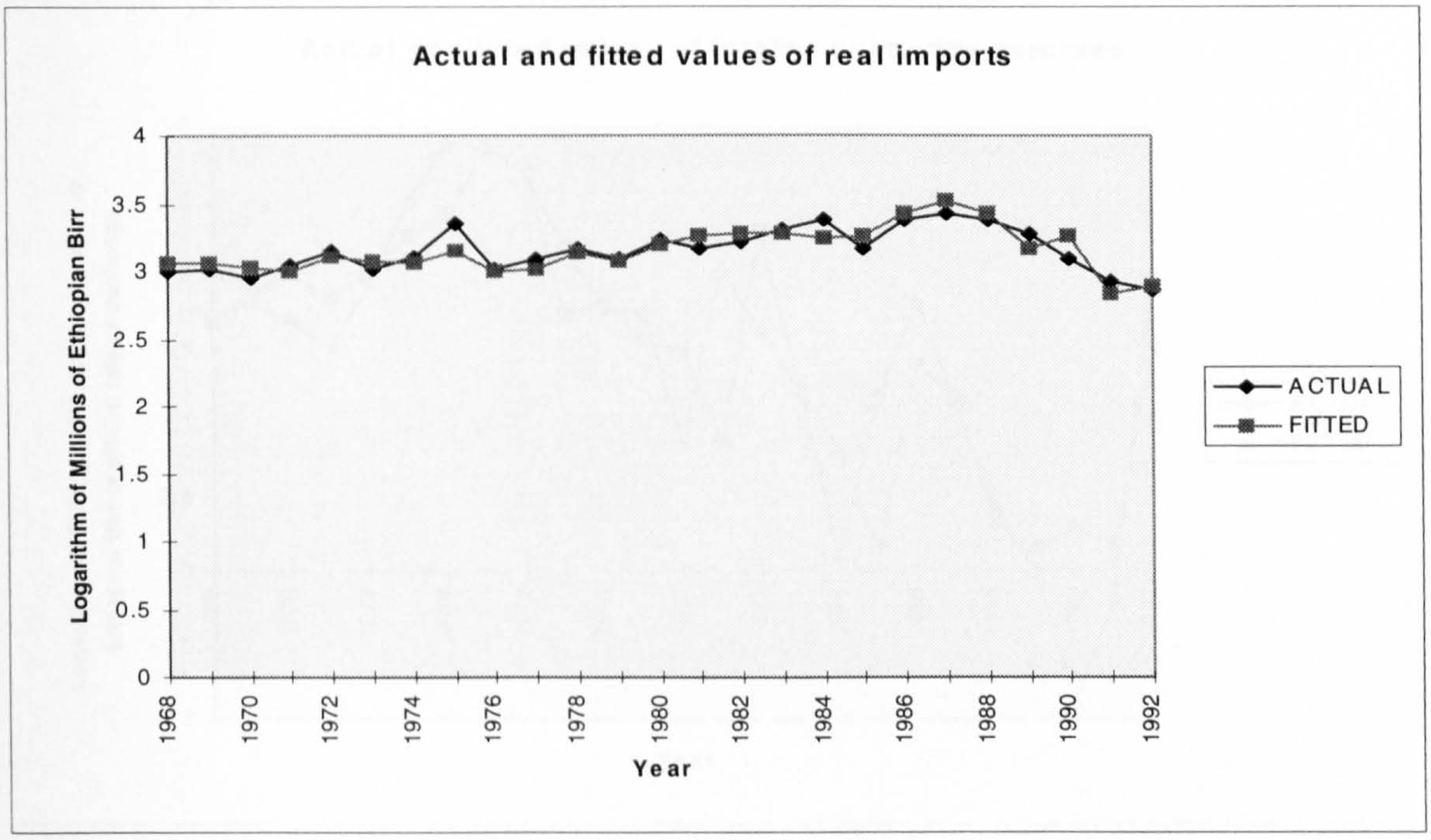
Mean of dependent variable = 1.93685 Std. error of regression = .312240
Std. dev. of dependent var. = .742847 R-squared = .855959
Sum of squared residuals = 2.33986 Adjusted R-squared = .855959
Variance of residuals = .097494 Durbin-Watson statistic = 1.60520

Figure 8- 3: Exports function



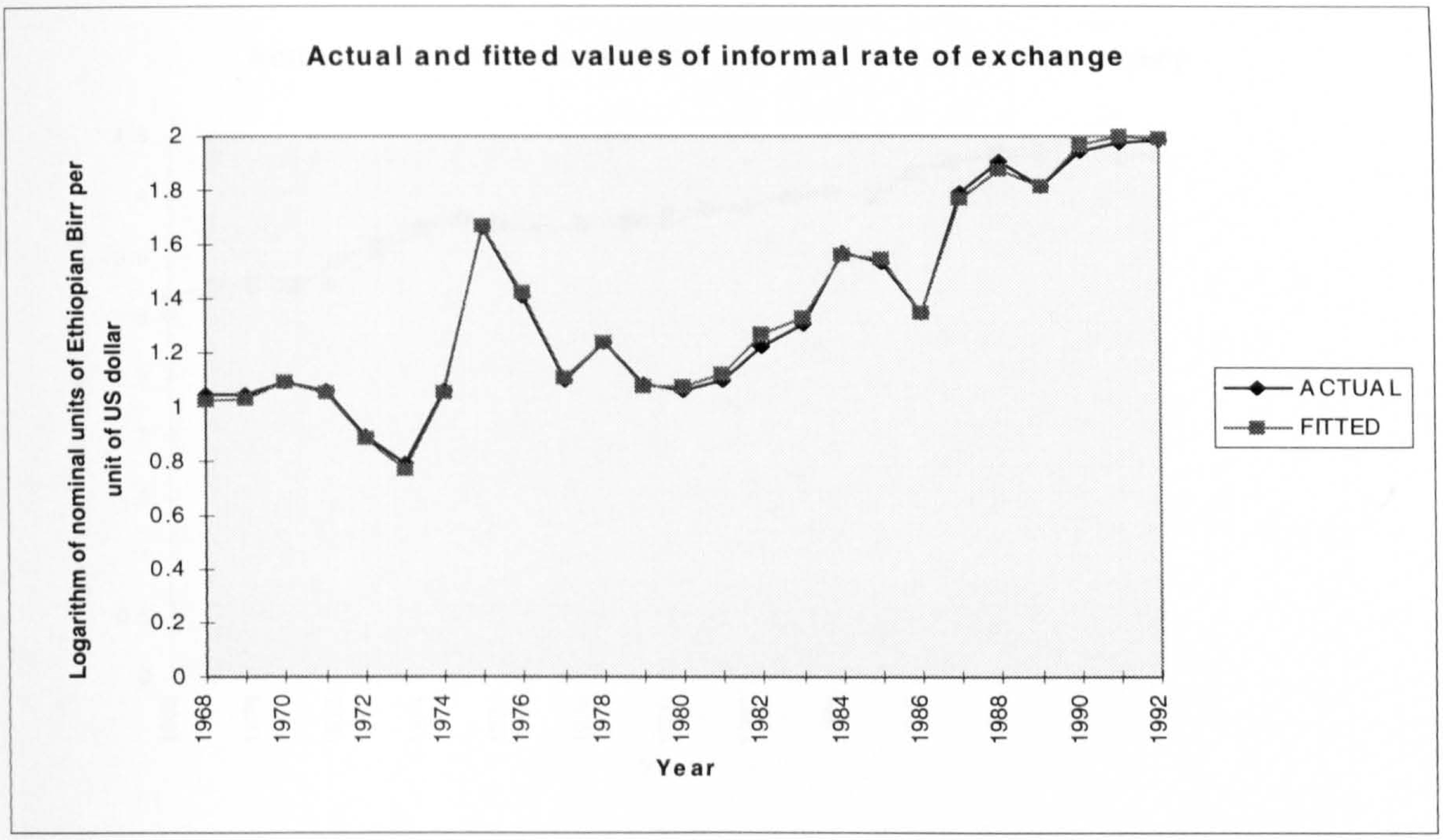
Mean of dependent variable = 2.77888	Std. error of regression = .164971
Std. dev. of dependent var. = .287414	R-squared = .676398
Sum of squared residuals = .653172	Adjusted R-squared = .676398
Variance of residuals = .027216	Durbin-Watson statistic = 2.05963

Figure 8- 4: Imports function



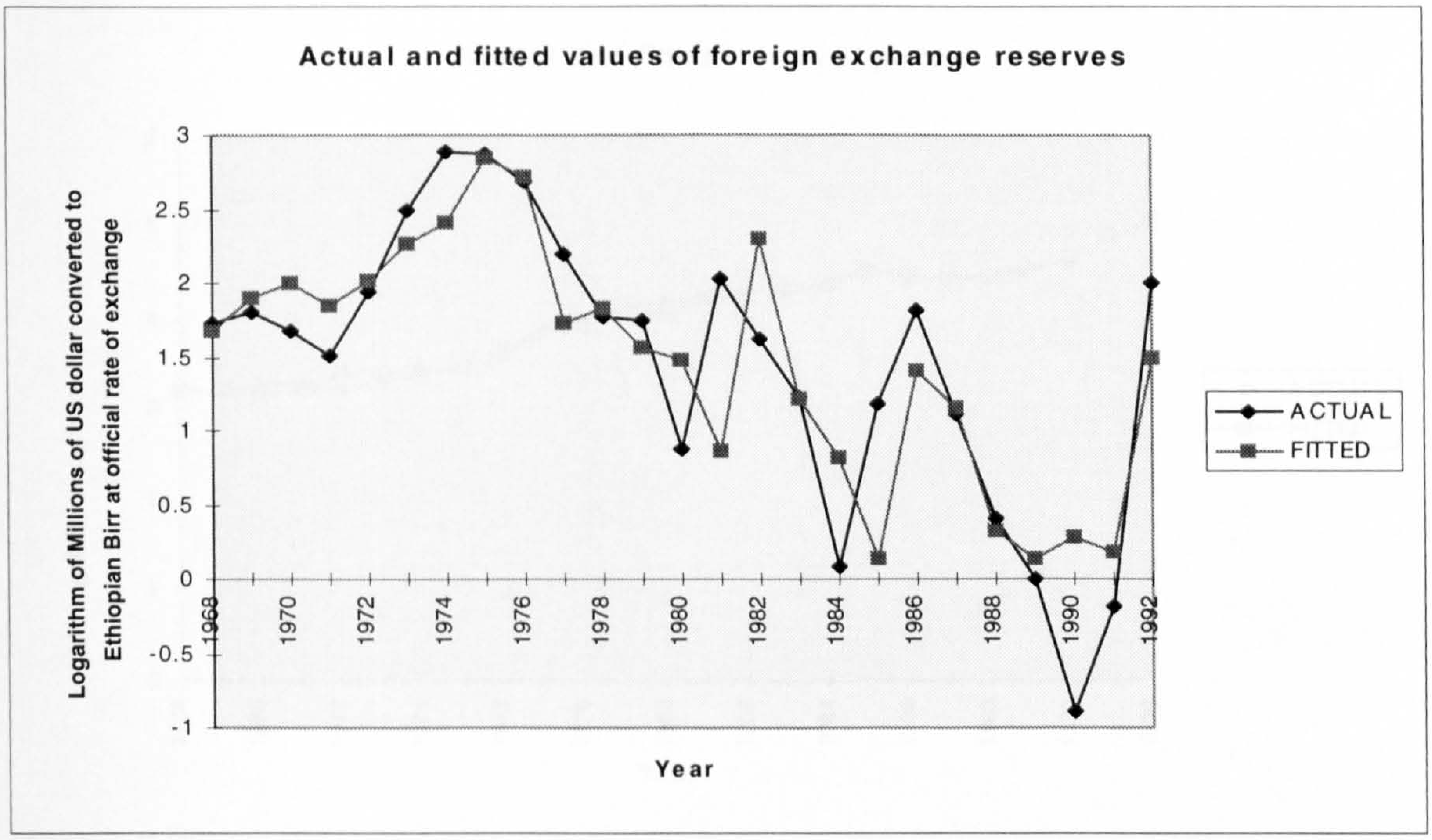
Mean of dependent variable = 3.15435	Std. error of regression = .086479
Std. dev. of dependent var. = .160184	R-squared = .740265
Sum of squared residuals = .179487	Adjusted R-squared = .740265
Variance of residuals = .747861E-02	Durbin-Watson statistic = 2.23687

Figure 8- 5: Informal rate of exchange function



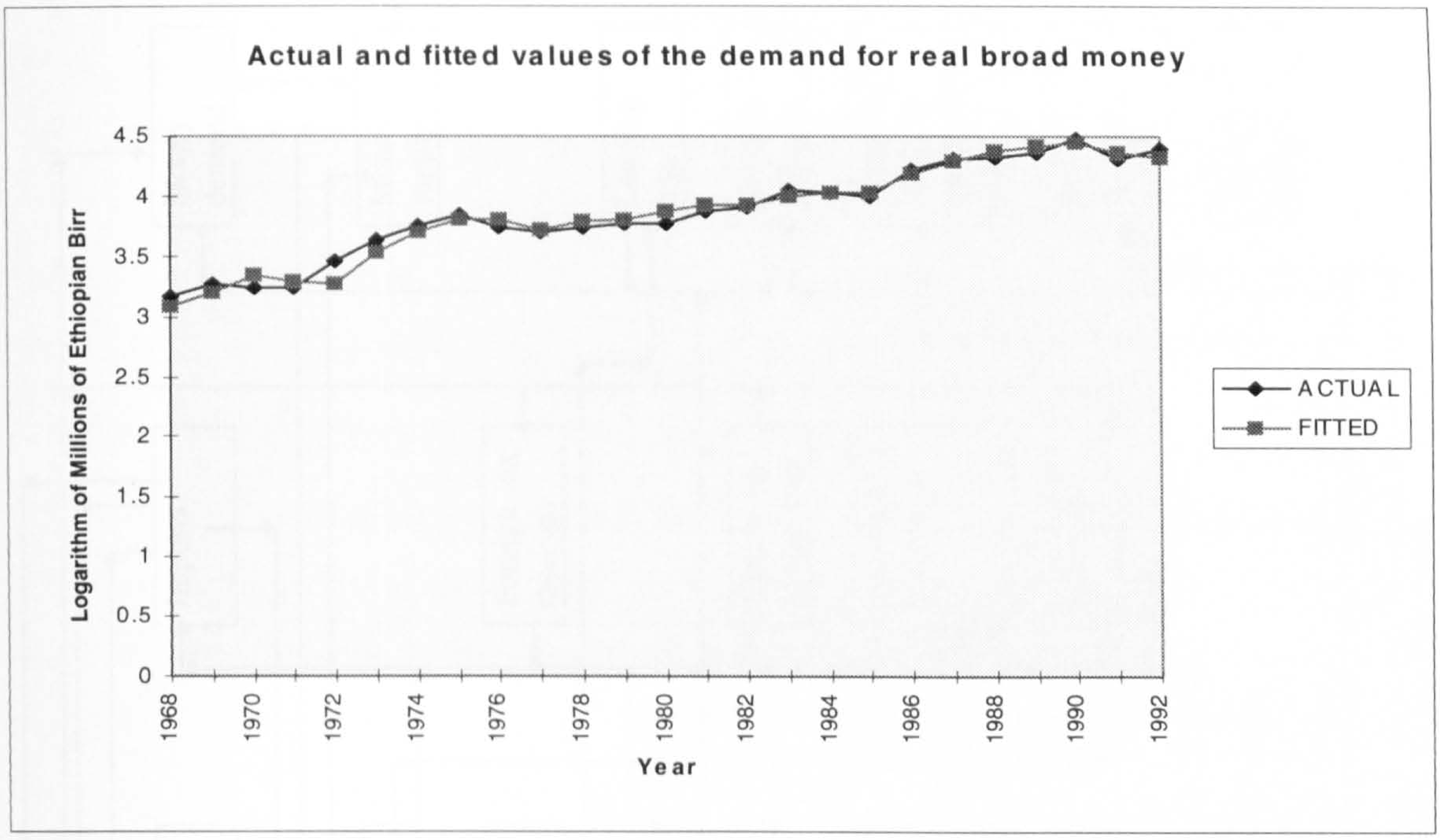
Mean of dependent variable = 1.35977 Std. error of regression = .018264
Std. dev. of dependent var. = .377496 R-squared = .997766
Sum of squared residuals = .900660E-02 Adjusted R-squared = .997766
Variance of residuals = .333578E-03 Durbin-Watson statistic = .796291

Figure 8- 6: Foreign exchange reserve function



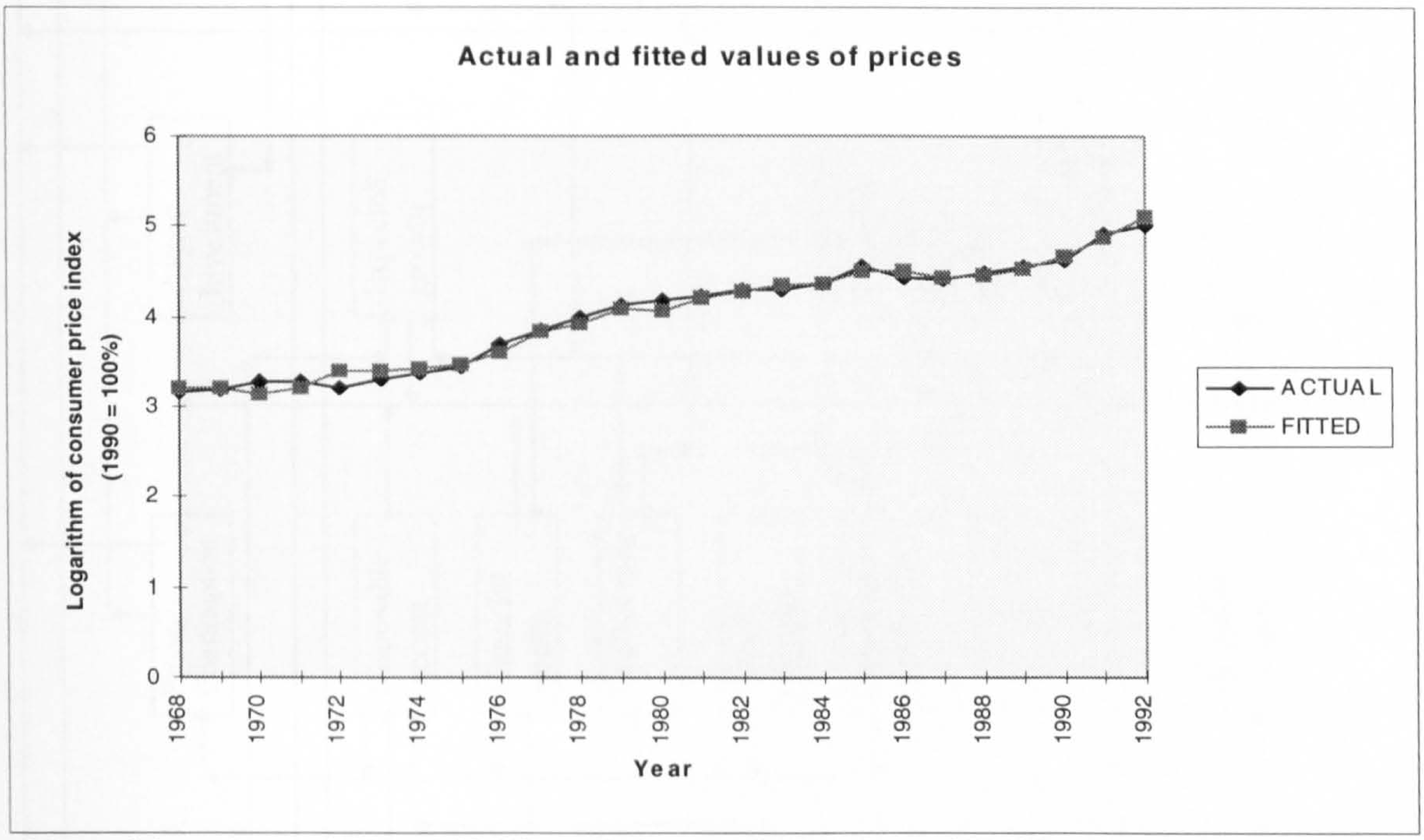
Mean of dependent variable = 1.53897 Std. error of regression = .502450
Std. dev. of dependent var. = .947953 R-squared = .719138
Sum of squared residuals = 6.81630 Adjusted R-squared = .719138
Variance of residuals = .252456 Durbin-Watson statistic = 2.30401

Figure 8- 7: Broad money function



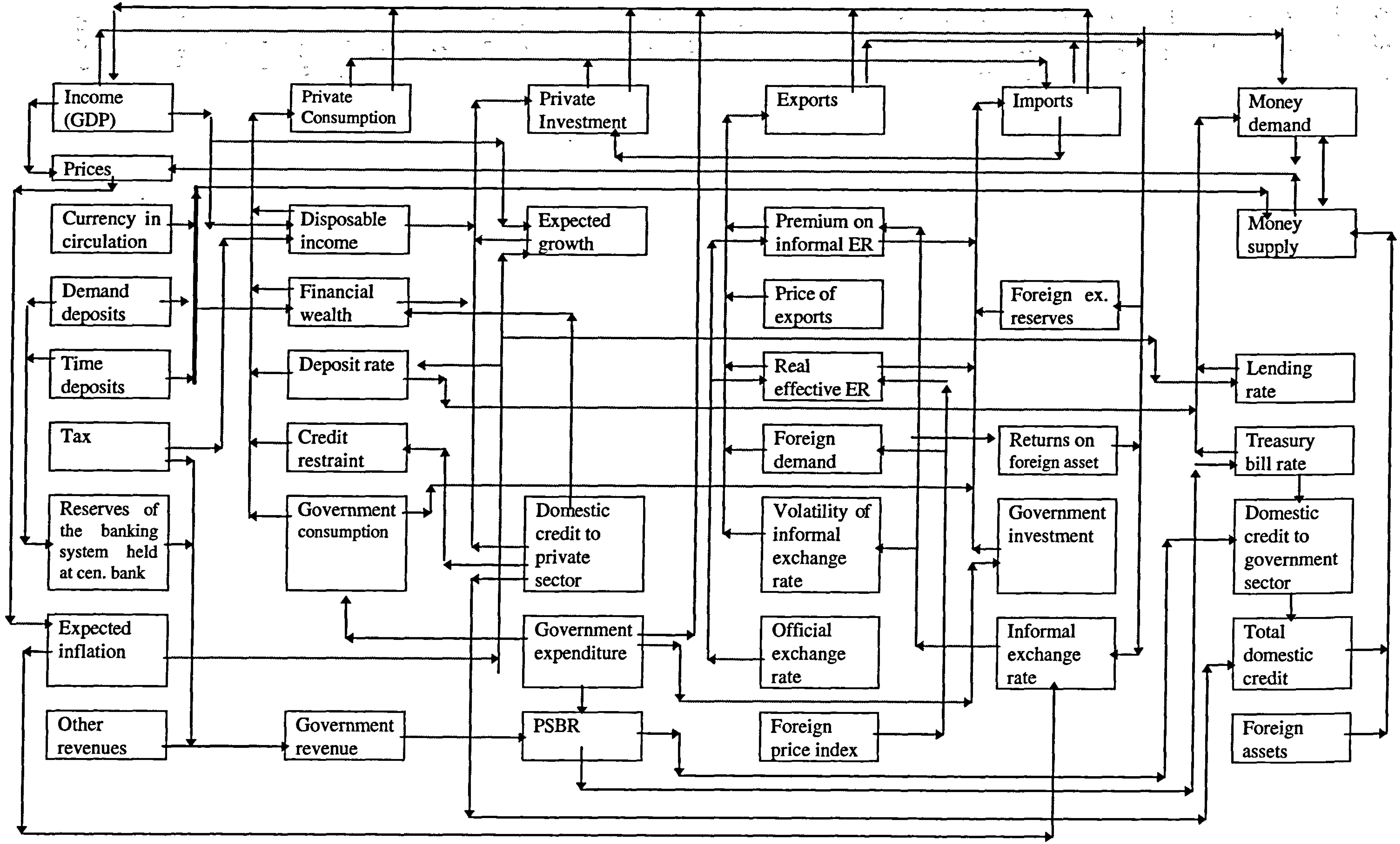
Mean of dependent variable = 3.86310	Std. error of regression = .071923
Std. dev. of dependent var. = .390557	R-squared = .968610
Sum of squared residuals = .124151	Adjusted R-squared = .968610
Variance of residuals = .517296E-02	Durbin-Watson statistic = 1.48884

Figure 8- 8: Price function



Mean of dependent variable = 4.00592	Std. error of regression = .071408
Std. dev. of dependent var. = .584158	R-squared = .985696
Sum of squared residuals = .117278	Adjusted R-squared = .985074
Variance of residuals = .509906E-02	Durbin-Watson statistic = 1.52806

Figure 8- 9: Flow Chart of the Macroeconomic Model



8.1.6 The flow-chart[2]

In this section we will discuss the links between the variables of the model in order to understand the effect of a change in a given variable on the rest of the model. By following the arrows of the flow-chart (figure 8.9) we can track down the path of the effect. This and our information on the size, sign and lags of each of the relevant coefficients listed in section 8.1.1 gives a rough estimate of the effect in the first and subsequent periods.

8.1.6.1 Prices and expected inflation

Prices depend upon effects from both the monetary and real sectors. This relationship is specified by the price equation listed in section 8.1 (see equation 8.6). Any supply of nominal money balance in excess of its real demand as well as the excess of nominal GDP over its real demand are expected to boost inflationary pressures. The flow-chart indicates this relationship by the arrows running from GDP and money supply to the price level (see below for the determinants of GDP, and money balances).

All variables in the model are real variables at 1990 prices. They are calculated from their nominal values deflated by the price index. Consequently, prices are linked to all real variables of the model. This can be shown by arrows which link prices to all real variables. In the interest of simplicity we have refrained from including all such arrows in the flow-chart.

Expected inflation is determined by past values of actual inflation on the basis of the adaptive expectations model developed in chapter six (equation 6.7). This relationship is reflected in the chart by an arrow linking prices to the expected inflation box.

8.1.6.2 Income and expected growth

Income is defined by the income identity as the sum of private consumption, private investment, government expenditure and exports net of imports (see equation 5.30). With the exception of government expenditure, all other components of aggregate income are endogenous to the model. Government expenditure is assumed to be exogenously determined by the government's decision to consume and invest. In the flow-chart the income identity is shown by arrows pointing to the income box from each of its five components.

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[2] Note that the solid dot (*) indicates an actual junction in the line-of-flow. All other apparent line-junctions are merely cross-overs that do not affect flow-lines or causalities.

The three arrows which exit out of income indicate the dependence of the demand for real money, the disposable income and the expected growth of future incomes on current income. Prices are also assumed to respond to the balance between the supply and real demand for goods and services.

Expected growth is determined by past values of actual growth on the basis of the adaptive expectation model developed in chapter 6. In the chart the arrow linking GDP to the expected growth box reflects this causality.

8.1.6.3 Money supply

The monetary aggregate considered in this model is M2 and is defined as the sum of currency in circulation, demand deposits and time deposits.[3] In our flow-chart this is indicated by arrows pointing to money supply from its three components. Alternatively, the arrows which point to the money supply box from total domestic credit and foreign asset boxes represent the definition of broad money from the asset side of the balance sheet. Finally, the double-pointed arrow linking money supply and money demand is an indicator of their equality in such an equilibrium model.

Money supply is assumed to be a **policy instrument** in this analysis. This is based on the role of the central bank in setting the rules governing the supply and cost of credit and its ability to finance public expenditure by printing money.

8.1.6.4 Disposable income

This is income after tax and is indicated in the chart by arrows originating from the income and tax boxes which link to the disposable income box. The two arrows which exit out of the disposable income box indicate the dependence of private consumption and private investment on disposable income.

Tax is assumed to be a **policy instrument** because the government sets the rate at which the economy is taxed.

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[3]The bank balance sheets include some residuals as other items net (OIN) merely to maintain the accounting identity which requires the equality of assets and liabilities. This residual element is not explicitly represented in our flow-chart as we cannot attach a fundamental economic argument to it.

8.1.6.5 Financial wealth

The private sector financial portfolio in a developing economy like Ethiopia is assumed to be limited to cash and bank deposits net of bank loans. This of course excludes other forms of financial assets such as government bonds, foreign currency and deposits held in the informal sector for which data are unavailable. The chart indicates this link by arrows from the boxes of currency in circulation, demand deposits, time deposits and domestic credit to the private sector pointing to the financial wealth box. The two arrows which exit out of the financial wealth box indicate the dependence of private consumption and private investment on the financial wealth of the private sector.

8.1.6.6 Deposit rate, lending rate and expected growth of real output

Real interest rates are defined as the nominal rates deflated by expected inflation. Similarly, expected growth of real output is defined as the expected growth of nominal output deflated by expected inflation. These links are indicated in the chart by arrows pointing from the expected inflation box to those of deposit rate, lending rate and expected growth.

The two arrows originating from the deposit rate box indicate that the deposit rate is an explanatory variable in the functions for private consumption and money demand. The arrow originating from the lending rate box indicates that the lending rate is an explanatory variable in the money demand function. Similarly, an arrow points from expected growth to private investment to indicate the direction of causality.

Both the nominal deposit rate and nominal lending rates are assumed to be **policy instruments**. This is based on the role of the central bank in the determination of interest rates and the direct control of Ethiopian financial institutions by the government during most of the sample period.

8.1.6.7 Credit restraint

Data for the informal rate of interest are not available. We have, therefore, used a credit restraint variable - calculated as one minus the ratio domestic credit to the private sector to GDP - (i.e, 1 - dcp/GDP) - to proxy the informal rate of interest. The chart indicates this link by an arrow linking domestic credit to private sector to the credit restraint variable. The arrow linking credit restraint to private consumption and the one which links domestic credit (to the private sector) to private investment indicate the direction of causality.

In a financially-repressed economy the authorities decide the supply of credit extended to the private sector by their credit rationing policy. Thus, we will treat credit restraint as a **policy instrument** in our policy experiments.

8.1.6.8 Treasury bill rate

The proxy for the treasury bill rate is calculated as the ratio of the public sector borrowing requirement (PSBR) to GDP. As PSBR increases the governments credit-worthiness declines and (in a free-market system) the lending agents are expected to demand higher treasury bill rates. This will determine the amount of credit extended to the government sector and thereby the overall credit in the economy. In the chart this direction of causality is shown by the arrows which run from the PSBR to the treasury bill rate, and thereby to domestic credit to government sector and total domestic credit boxes.

PSBR is determined by the government's decision to spend in excess of its revenue. On this basis we will consider the treasury bill rate as a **policy instrument** in our policy experiments. In the chart this is indicated by the arrows originating from the boxes of government expenditure and government revenues to that of PSBR.

8.1.6.9 Government revenue

In the chart, government revenue is indicated by the boxes of tax, reserves (held in the central bank which are usually available for government spending in a repressed economy) and other revenues. In the chart the link is shown by three arrows feeding the three components into the government revenue box.

8.1.6.10 Government expenditure

Government expenditure is composed of consumption and investment. In the chart this is indicated by arrows linking government expenditure to its two components. The two arrows linking government consumption to private consumption and imports and the arrow linking government expenditure to imports show the direction of causality.

8.1.6.11 Foreign exchange reserves

The net flow of foreign exchange is a function of net exports of goods and services. It is also possible to envisage a short-run relationship with foreign aid and foreign borrowing. In our model, the latter variables were found to be statistically insignificant and, thus, foreign exchange reserve is linked to the ratio of current account to GDP. This is indicated in the flow chart by arrows linking GDP, exports and imports to the foreign exchange reserve box.

8.1.6.12 Informal rate of exchange

A persistent informal market for foreign exchange is a symptom of financial repression. It persists because the authorities maintain an artificial rate of exchange in the official sector and thus create the incentive for the diversion of inflows of foreign exchange to the informal market. The official rate of exchange is unsustainable given the supply of foreign exchange in the official sector. The authorities are therefore forced to introduce quantitative restrictions, thereby forcing some agents to satisfy their demands from the informal sector at a higher rate of exchange.

In our model the rate of exchange in the informal sector is linked to the ratio of external balance to GDP, the level of expected inflation and the expected rate of return on foreign assets. In the chart this direction of causality is reflected by the arrows linking the informal rate of exchange to expected inflation, GDP, exports, imports and the return on foreign assets.

In the policy experiments (sections 9.9.3.1) we will consider the returns on foreign assets (proxied by the American treasury bill rate converted to local currency at the expected informal rate of exchange) as an **exogenous variable**. We will also consider a case where the informal rate of exchange reacts to actual or perceived changes in the economic and political environment.

8.1.6.13 Premium on informal exchange rate

The premium on the informal exchange rate is defined as the ratio of the informal exchange rate to the official exchange rate. In the chart this is indicated by the arrows pointing to the premium on informal exchange rate box from the boxes of its two components. The arrow linking the premium on the informal exchange rate to exports and imports indicates the direction of causality.

Since a fixed exchange rate regime prevailed during the sample period we will consider the official rate of exchange to be a **policy instrument.**

8.1.6.14 Real effective exchange rate

The real effective exchange rate is defined as the weighted average of the real exchange rate of the Ethiopian Birr vis-à-vis the currencies of her major trade partners. As discussed in chapter 6, the real exchange rate is calculated by deflating the official exchange rate by the ratio of the domestic price to foreign prices. To indicate this direction of causality, the chart has arrows originating from the official exchange rate and the foreign price index boxes pointing to that of the real effective exchange rate. The arrow linking the real effective exchange rate to exports and imports indicates the direction of causality.

Given the share of Ethiopia in world trade, we assume that foreign prices are determined independently of the forces in the domestic economy. We will, therefore, treat foreign prices as an **exogenous variable** in our policy experiment section.

8.1.6.15 Other determinants of the export function

In addition to those variables discussed above the export function has price of exports, foreign demand (the weighted average income of Ethiopia's trade partners) and the volatility of the informal exchange rate as its explanatory variables. The arrows in the chart which link these variables to exports indicate the direction of causality.

8.1.6.16 Other determinants of the import function

Similarly, the remaining explanatory variables of the import function are foreign exchange reserves, private consumption, private investment and government investment. These links are indicated in the chart by arrows originating from the box of each variable pointing to imports.

8.1.6.17 Other determinants of private investment function

Finally, it is important to note the bi-causality relationship between imports and private investment. The arrow originating from imports to private investment indicates the second half of this causality.

8.2 Goodness-of-fit of the macro-model

Any model is only as good as the underlying economic (causal) theory, the data and the estimation techniques used in building it. Given the likelihood of deficiencies in data supplied for models involving a developing economy like Ethiopia, we can not expect a "perfect" fit. In the previous chapters we discussed the problems involving the data, the economic and political environment during the sample period and recent criticisms of the estimation techniques. Nevertheless, the diagnostic tests on the single equations were satisfactory. However, this does not guarantee a good fit when all the equations are run simultaneously as a macro-model. The objective of this chapter is, therefore, to evaluate the accuracy level of the model in tracking the dynamics of the actual data used in the estimation of the single equations.[4]

There are several accuracy measures of a simultaneous model. All compare the time-path of actual values (A) with their simulated counterparts (F). Each has advantages and weaknesses and the choice of one or more accuracy criteria depends on the purpose of the investigation at hand and the researcher's judgement. Some of the measures, for example, concentrate on the difference between the actual and fitted values, while the researcher may concentrate on the pattern of the time-path and prefer a model which captures the turning-points of the actual data (see Arestis and Hadjimathou (1982)). Furthermore, the measures are sensitive to the specification of the model. Clements and Hendry (1995), for example, point out that forecasts with the best mean square error for some variable Y may not have the best mean square error for its difference DY.

In this section we will run the model as a system of difference equations with error correction terms calculated from the long-run relationship specified as levels. The result will be evaluated on the basis of the following commonly-used criteria (see Holden, Peel and Thompson ,1990).

Mean error (ME)

$ME = \sum(F_t - A_t) / n$ 8.9

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[4]The simulation is done using Newton's method on TSP. The model is solved for all the endogenous variables. Since it is a dynamic simulation, earlier solved values of lagged endogenous variables are used in place of actual values (see TSP reference manual version 4.2 (1993) p. 259).

where n is the number of observations used in the simulation. The problem with this measure is the possibility that small mean error due to large negative errors may counterbalance large positive errors.

Mean square error (MSE)

$MSE = \Sigma(F_t - A_t)^2 / n$ 8.10

Root mean square error (RMSE)

$RMSE = \sqrt{(MSE)}$

$= [\Sigma (F_t - A_t)^2 / n]^{1/2}$ 8.11

Exaggeration of the effect of larger errors by squaring them can be regarded as the main weakness (or strength) of MSE and RMSE. Also, see below for the decomposition of MSE.

Mean absolute error (MAE)

$MAE = \Sigma|F_t - A_t| / n$ 8.12

Both negative and positive errors increase MAE but, unlike MSE and RMSE, MAE does not penalize larger errors by squaring their effects.

Theil's inequality coefficient (1966)

$TIC = \Sigma(F_t - A_t)^2 / \Sigma A_t^2$

$= MSE / (\Sigma A_t^2 /n)$..8.13

This scales the MSE by the size of the actual values and is more suitable for rates-of-change variables, where forecasts of zero (no change) give TIC =1. If TIC > 1 the forecasts are worse than no-change forecasts. For level variables, forecasts of no change are unlikely and so this is a poor measure of accuracy in this case.

Regression coefficient (B_{AF}) and regression error.

This coefficient is obtained by regressing the actual values on their fitted counterparts as

$A_t = \alpha + \beta_{AF} \ (F_t) + u_t$ 8.14

Good forecasts give a value of β_{AF} equal to or close to 1, and α close to zero, so that A=F.

Decomposition of MSE

Furthermore, Theil (1961) showed that the regression error (u_t) can be sub-divided into three parts: error due to bias (u_B), error due difference of regression coefficient from unity (u_R), and error due to residual variance (u_D). Given the standard errors of actual values (S_A) and fitted values (S_F), and the correlation coefficient (r), the decomposed errors can be defined as:

$u_B = (\ \bar{A} - \ \bar{F}) / MSE$ 8.15

$u_R = (S_F - r\ S_A)^2 / MSE$ 8.16

$u_D = (1 - r^2)\ S_A^2 / MSE$ 8.17

The sum of the three errors is equal to 1 and a good model results in small u_B and u_R and a large u_D.

$u_B + u_R + u_D = 1$ 8.18

The relationship between the regression coefficient and u_R can be derived as follows. From equation 8.14 we deduce that perfect forecasts have $\beta_{AF} = 1$ and $\alpha = 0$. We also have the correlation coefficient defined as

$r = S_{AF} / (S_A S_F)$ 8.19

and

$\beta_{AF} = S_{AF} / S_F^2$ 8.20

By substituting from equation 8.20 in equation 8.19 we have

$r = \beta_{AF} / S_F$ 8.21

Take the numerator of equation 8.16 and substitute for "r" from 8.19.

$S_F - r\,S_A = S_F - [S_{AF} / (S_A S_F)]\,S_A$

$S_F - r\,S_A = S_F - (S_{AF} / S_F)$

$S_F - r\,S_A = S_F\,[1 - (S_{AF} / S_F^2)]$

$S_F - r\,S_A = S_F\,(1 - \beta_{AF})$ 8.22

By substituting 8.22 in to equation 8.16 we get the fraction of error due to difference of regression coefficient from unity (UR) as

$UR = (S_F - r\,S_A)^2 / MSE$

$\quad = [S_F\,(1 - \beta_{AF})]^2 / MSE$ 8.23

Similarly, a perfect fit will have a unit correlation coefficient (r =1) and thereby (u_D) = 0. The fraction of error explained by equation 8.22 can therefore be attributed to the difference of r from unity or to unexplained disturbances.

After running the model as a system, the graphs of the actual and fitted values of the seven behavioural functions (private consumption, private investment, exports, imports, informal exchange rate, foreign exchange reserves and demand for broad money) and of the price equation are presented in figures 8.10 to 8.17. The relevant accuracy measures are reported under each figure. Moreover, the deviation of the simulated from actual values is evident from a visual inspection of the graphs. Care must, however, be exercised in interpreting the accuracy levels related to equations 8.9 to 8.12 because of the criticisms discussed above.

Since the single equations were estimated in chapter 7 as logarithmic functions, the graphs in this section will compare the logarithms of the simulated and actual values. We will report the correlation coefficient, RMSE, MAE, ME, regression coefficient of actual on predicted series, Theil's inequality coefficient (1966), and the decomposition of errors due to bias, due to difference of regression coefficient from unity, and due to residual covariance. These measures are selected on the basis of our discussion above.

The levels of output and external balance will be discussed in the policy experiment section, excluded from this section because they are mere identities whose goodness-of-fit is determined by the goodness-of-fit of their constituent equations. In other words, the income identity is the sum of four behavioural equations (private consumption, private investment, exports and imports) and the exogenously-determined public expenditure, while the external balance is the difference of exports and imports. Since these identities are not directly endogenous to the model, their goodness-of-fit depends whether the errors of their constituent behavioural functions reinforce or cancel each other.

As expected the goodness-of-fit of the functions when the model is run as a system showed some difference from those the single equations (compare figures 8.1 - 8.8 above to figures 8.10 - 8.17 below). In addition to visual inspection, we can also look at the correlation coefficient which is a common accuracy measure for both the single equations and the full model (see table 8.1). It has to some extent declined for all the equations. Nevertheless, the changes are not dramatic and the levels of the correlation coefficients indicate that the model can explain a significant portion of the actual values.

Table 8-1: Correlation coefficient of the functions as single equations and part of system

	Consumption	Investment	Exports	Imports	Informal Ex. rate	For'n ex. reserves	Money demand	Prices
Single equation[5]	0.991	0.925	0.822	0.860	0.999	0.848	0.984	0.993
Part of a Systems	0.987	0.785	0.596	0.684	0.997	0.564	0.955	0.975

The accuracy measures are given under each graph in equations figures 8.10 to 8.17. Judgements on the goodness-of-fit can be made on the basis of visual inspection of each figure

[5]These are calculated as square roots of the R^2 in figures 8.1 to 8.8.

and the interpretation of the accuracy figures is as discussed above. For quick comparison, the levels of correlation coefficients (r), regression coefficient (B) and Theil's (1966) inequality coefficient (TIC) are presented in table 8.2. The TIC is selected for discussion because it is a measure of mean deviation scaled by the actual values and, thus, can give a better approximation of the percentage deviation of fitted from the actual series.

Table 8-2: Summary of some accuracy measures of the model as a system

	Consumption	Investment	Exports	Imports	Informal Ex. rate	For'n ex. reserves	Money demand	Price
Correlation coefficient (r)	0.987	0.785	0.596	0.684	0.997	0.564	0.955	0.975
Regression coefficient (B)	1.007	0.598	0.428	0.497	0.952	0.890	0.787	1.117
Theil 1966 (TIC)	0.007	0.287	0.114	0.050	0.040	0.456	0.039	0.035

The function for private consumption reported in figure 8.10 captures all turning-points and with r and B close to 1, the model gives a good estimation of the actual values. The (TIC) is very small.

Private investment, on the other hand, gives a relatively poor goodness-of-fit, especially in the second half of the 1980s (see figure 8.11). It captures the turning-points and the general trend of the actual series during 1968-86 and 1990-92. Although the correlation coefficient is quite good, the regression coefficient is rather low and the TIC is relatively large at 0.287.

Compared to private investment, the export function reported in figure 8.12 gives a relatively lower TIC of 0.114. The correlation coefficient and regression coefficient are rather low. It is, however, worth noting that the errors are evenly distributed throughout the sample period and the model seems to have captured the general trend of the data and its turning-points.

The function for imports gives a better accuracy level (see figure 8.13). The correlation coefficient is acceptable, while the regression coefficient is rather low. The TIC is relatively low and the error distribution is fairly even throughout the sample period.

The fit of informal exchange rate is very good (see figure 8.14). Both regression and correlation coefficients are almost 1 and the TIC is 0.04.

Foreign exchange reserves, on the other hand, has relatively poor accuracy level. The regression coefficient is good and the correlation coefficient is acceptable, but TIC is large at 0.46. The error is, however, not evenly distributed. It is mainly concentrated in the post-1984 period (see figure 8.15). This is likely to have been caused by the concentration of the shocks such as the major Ethiopian famine of 1985 and the intensification of the war which culminated in the change of government in 1991. These shocks have especial relevance to foreign exchange reserves because a famine requires the importation of a huge quantity of food, and a political crisis usually coincides with capital flight by the defeated political elite and the uncertain business community. Nevertheless, the model gives an acceptable fit especially in the pre-1984 period.

The function for the demand for broad money gives a good fit and captures almost all turning-points of the series with a TIC of 0.039, correlation coefficient close to 1 and quite good (.79) regression coefficient (see figure 8.16).

The actual and fitted values of the price equation are reported in figure 8.17. The level of accuracy is almost identical to that of the demand for broad money, because the coefficient of the monetary sector is far larger than that of the real sector (see equation 8.8). Both correlation and regression coefficients are close to 1 and the TIC is 0.035.[6]

8.3 Conclusion

In deciding on the acceptability of the model as a representation of the Ethiopian economy it is worth noting the following points. First, the purpose of this study is basically to analyze the structure of the Ethiopian economy rather than to predict future values of economic variables. It suffices if the model helps us to evaluate the ability of the Ethiopian economy to accept the disciplines of a common economic policy, in order that we may comment on its ability to lead the process of economic integration in the Horn of Africa. Secondly, given the changes in

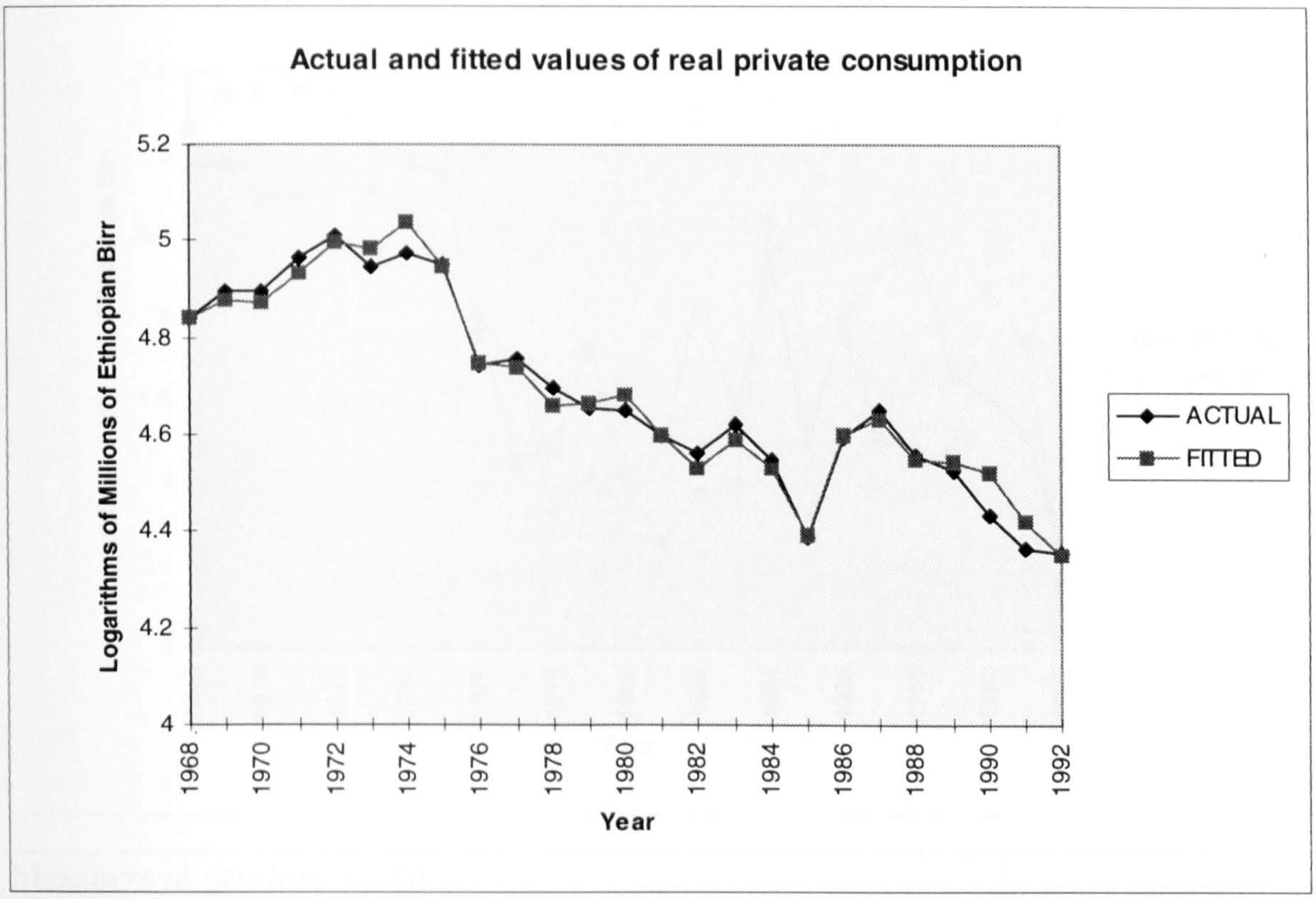
[6] Note that the simulated demand for money underestimates the actual values up to 1978 and overestimates them for the rest of the sample period. The exact reverse takes place in the price function because the demand for real broad money has a negative coefficient in the price equation (see section 8.1.4)

government and some economic policies since 1991, one would like to extend the sample period to recent times. Towards this end we checked the published data until January 1997 but have decided not extend the sample period beyond 1993 because the data published are incomplete.[7] On balance, therefore, we accept the model as a satisfactory representation of the Ethiopian economy during the sample period.

The next chapter will continue the analysis by conducting historical simulations. The model will be subjected to various exogenous and policy-induced shocks in order to answer 'what if' questions and test the congruence of the model. Post-shock dynamics of the relevant variables will be tested vis-à-vis the **a priori** theory and the model is expected to be stable and eventually return to its equilibrium positions.

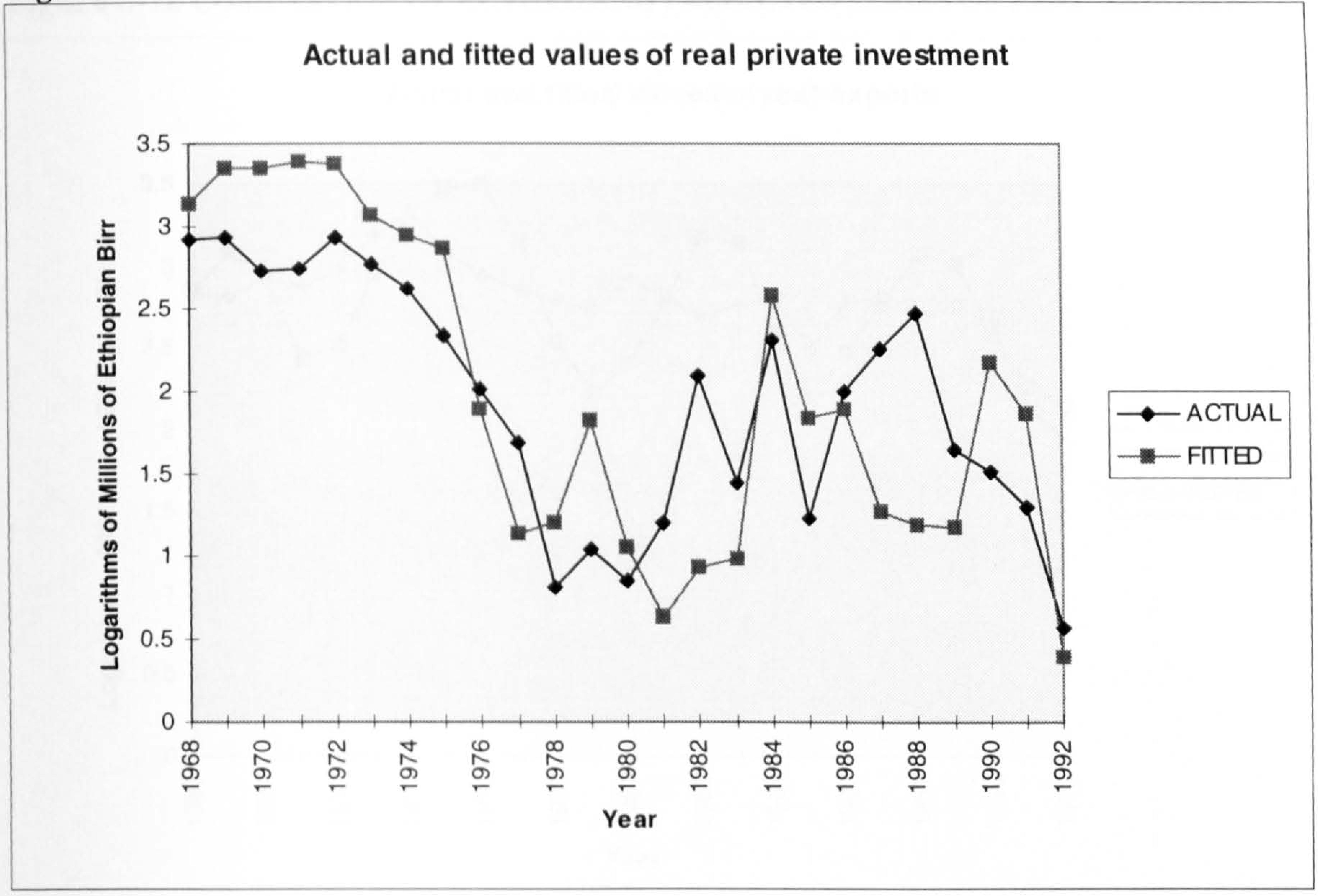
[7]This is particularly true for data on fiscal variables such as tax revenues and expenditure, and the informal exchange rate.

Figure 8-10 COMPARISON OF ACTUAL AND PREDICTED SERIES OF PRIVATE CONSUMPTION



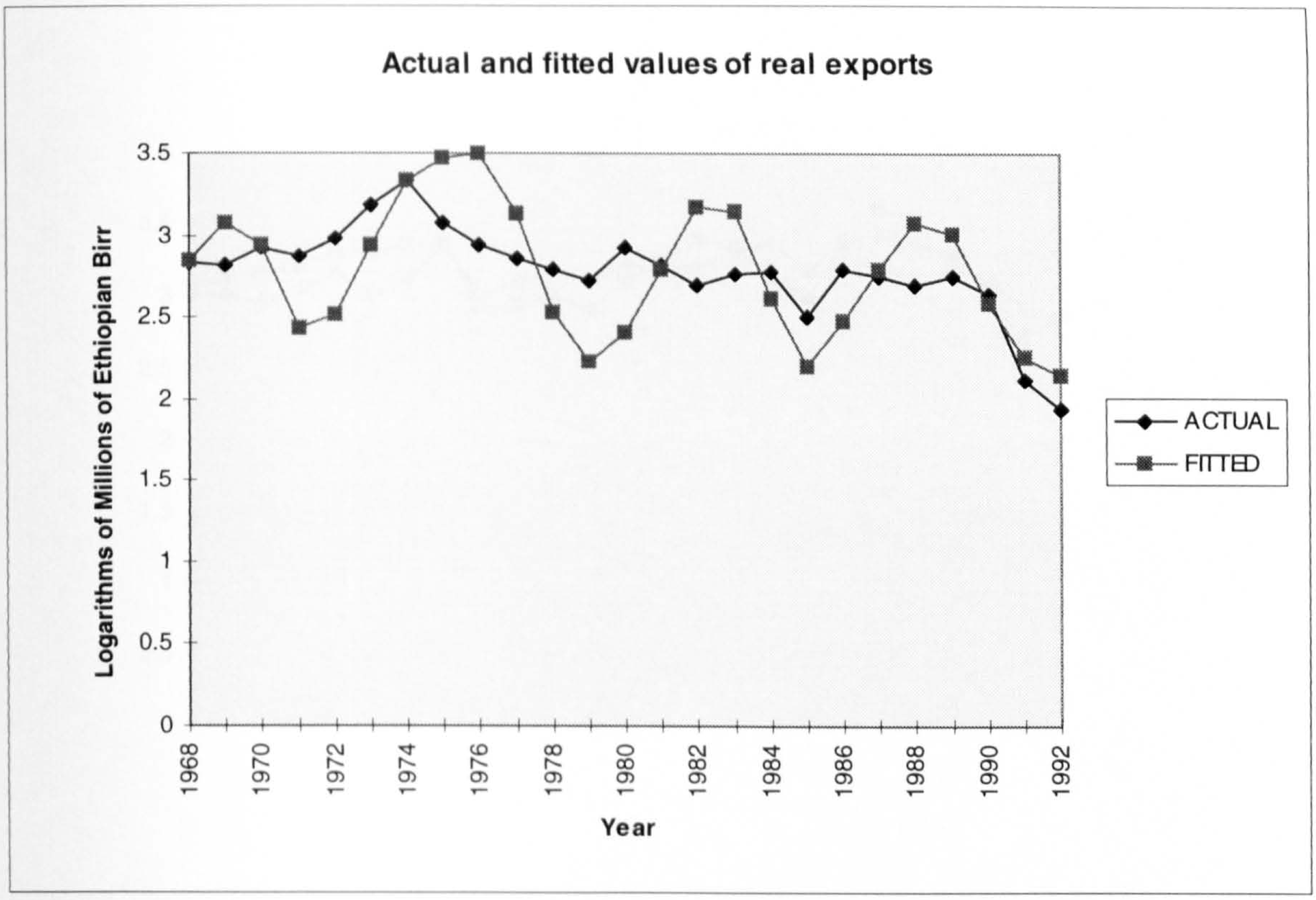
Measures of goodness-of-fit	
CORRELATION COEFFICIENT	0.98730
ROOT-MEAN-SQUARED ERROR	0.031687
MEAN ABSOLUTE ERROR	0.023404
MEAN ERROR	-0.0024641
REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED	1.00654
THEIL'S INEQUALITY COEFFICIENT (1966)	0.0067535
FRACTION OF ERROR DUE TO BIAS	0.0060471
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY	0.0016160
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE	0.99234

Figure 8-11 COMPARISON OF ACTUAL AND PREDICTED SERIES OF PRIVATE INVESTMENT



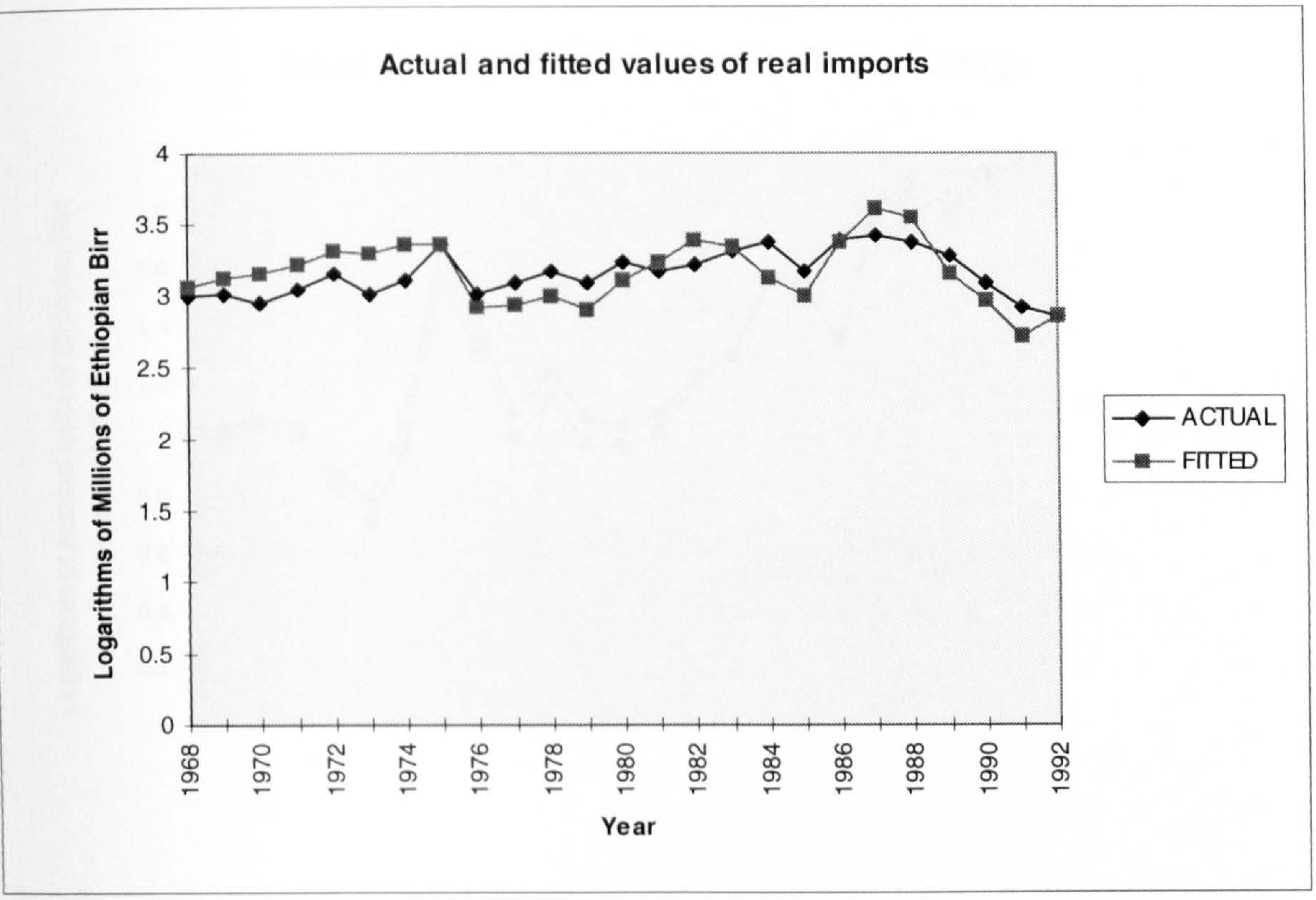
Measures of goodness-of-fit	
CORRELATION COEFFICIENT	0.78509
ROOT-MEAN-SQUARED ERROR	0.59372
MEAN ABSOLUTE ERROR	0.51555
MEAN ERROR	-0.045230
REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED	0.59827
THEIL'S INEQUALITY COEFFICIENT (1966)	0.28695
FRACTION OF ERROR DUE TO BIAS	0.0058035
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY	0.41768
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE	0.57652

Figure 8-12 COMPARISON OF ACTUAL AND PREDICTED SERIES OF REAL EXPORTS



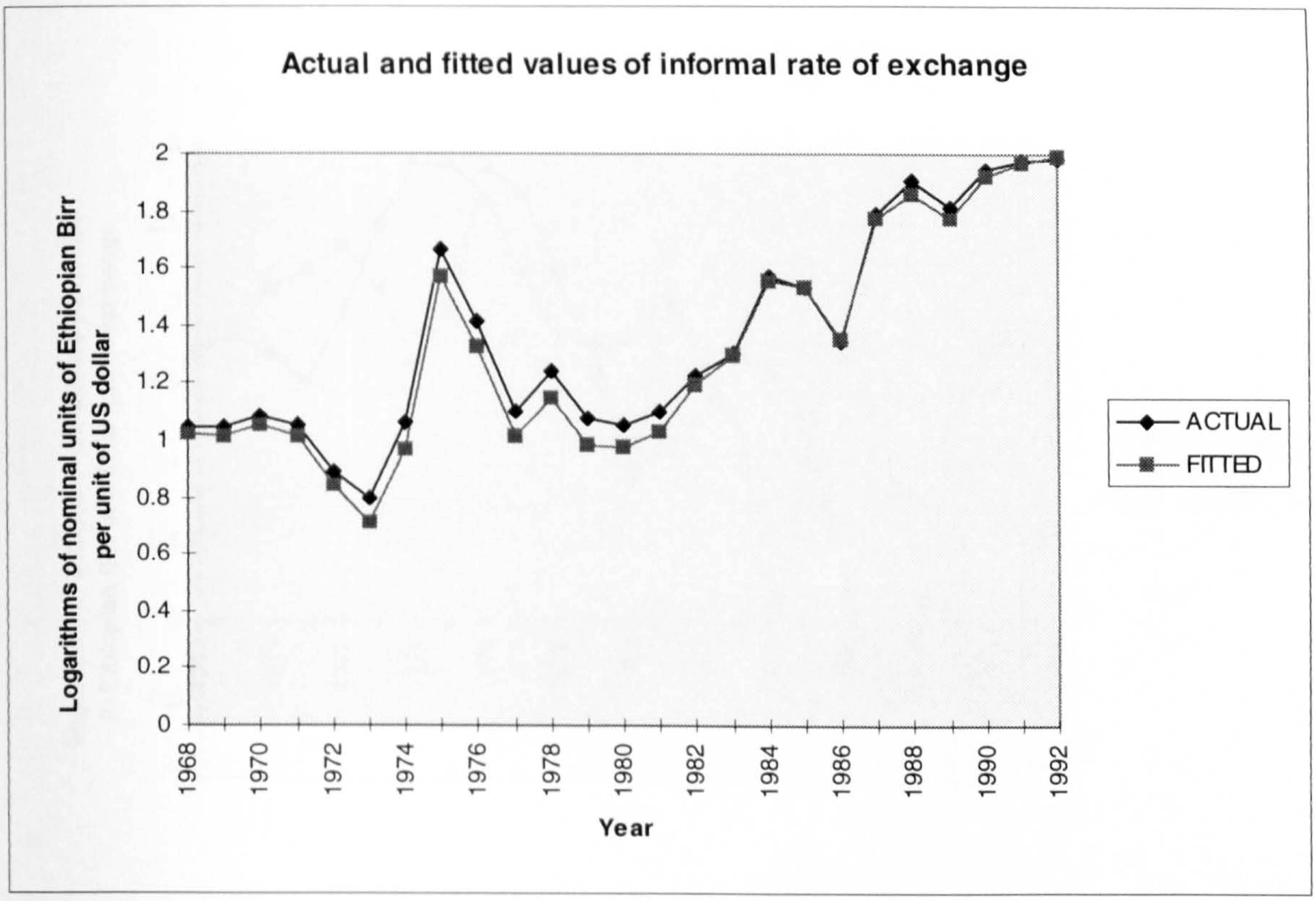
Measures of goodness-of-fit	
CORRELATION COEFFICIENT	0.59589
ROOT-MEAN-SQUARED ERROR	0.31879
MEAN ABSOLUTE ERROR	0.26784
MEAN ERROR	-0.0044879
REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED	0.42759
THEIL'S INEQUALITY COEFFICIENT (1966)	0.11413
FRACTION OF ERROR DUE TO BIAS	0.00019819
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY	0.49656
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE	0.50324

Figure 8-13 COMPARISON OF ACTUAL AND PREDICTED SERIES OF REAL IMPORTS



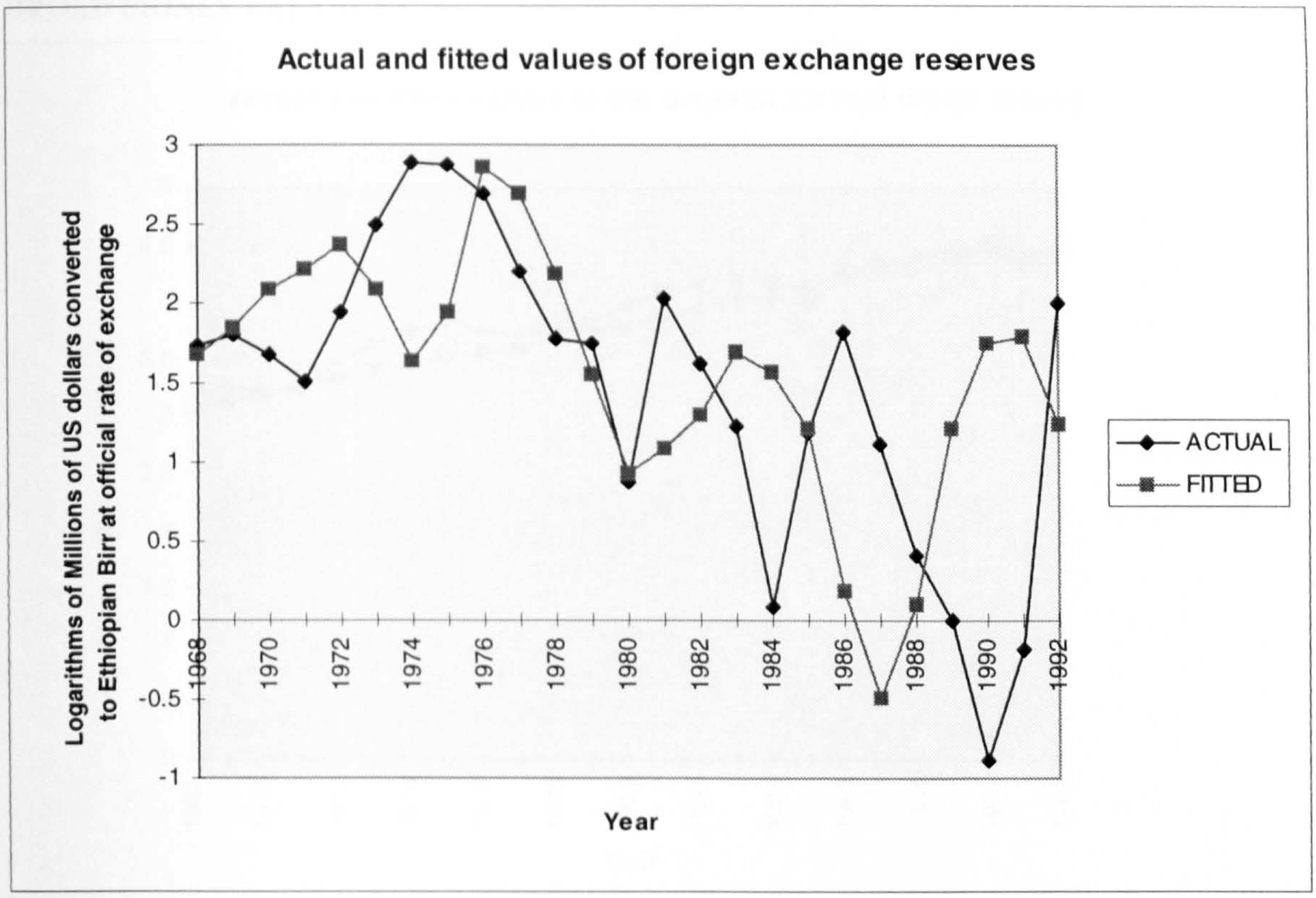
Measures of goodness-of-fit	
CORRELATION COEFFICIENT	0.68406
ROOT-MEAN-SQUARED ERROR	0.15819
MEAN ABSOLUTE ERROR	0.13912
MEAN ERROR	-0.010634
REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED	0.49703
THEIL'S INEQUALITY COEFFICIENT (1966)	0.050086
FRACTION OF ERROR DUE TO BIAS	0.0045195
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY	0.47171
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE	0.52377

Figure 8-14 COMPARISON OF ACTUAL AND PREDICTED SERIES OF informal rate of exchange



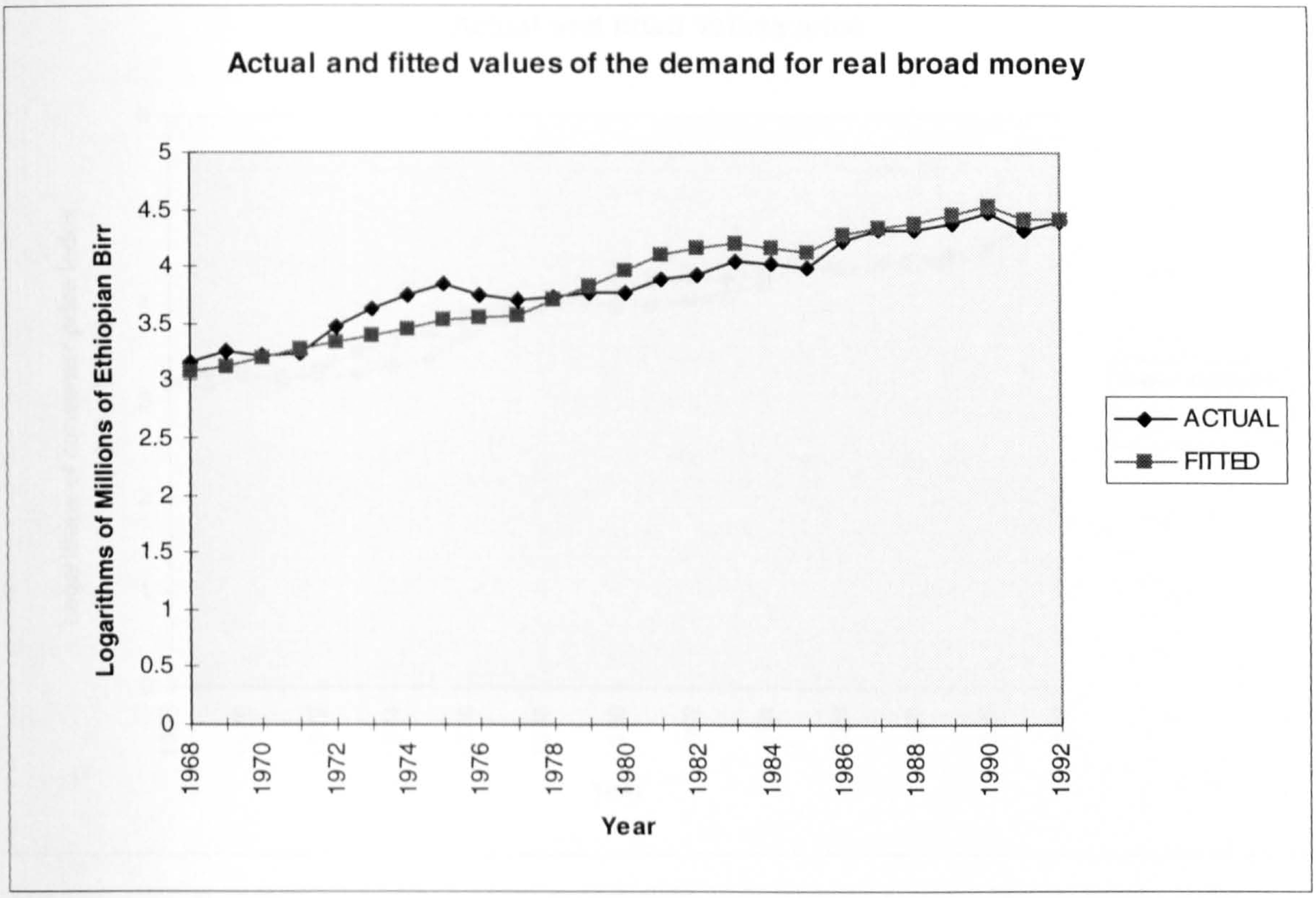
Measures of goodness-of-fit	
CORRELATION COEFFICIENT	0.99688
ROOT-MEAN-SQUARED ERROR	0.055853
MEAN ABSOLUTE ERROR	0.045638
MEAN ERROR	0.044372
REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED	0.95249
THEIL'S INEQUALITY COEFFICIENT (1966)	0.039646
FRACTION OF ERROR DUE TO BIAS	0.63114
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY	0.10470
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE	0.26417

Figure 8-15 COMPARISON OF ACTUAL AND PREDICTED SERIES OF **foreign exchange reserves**



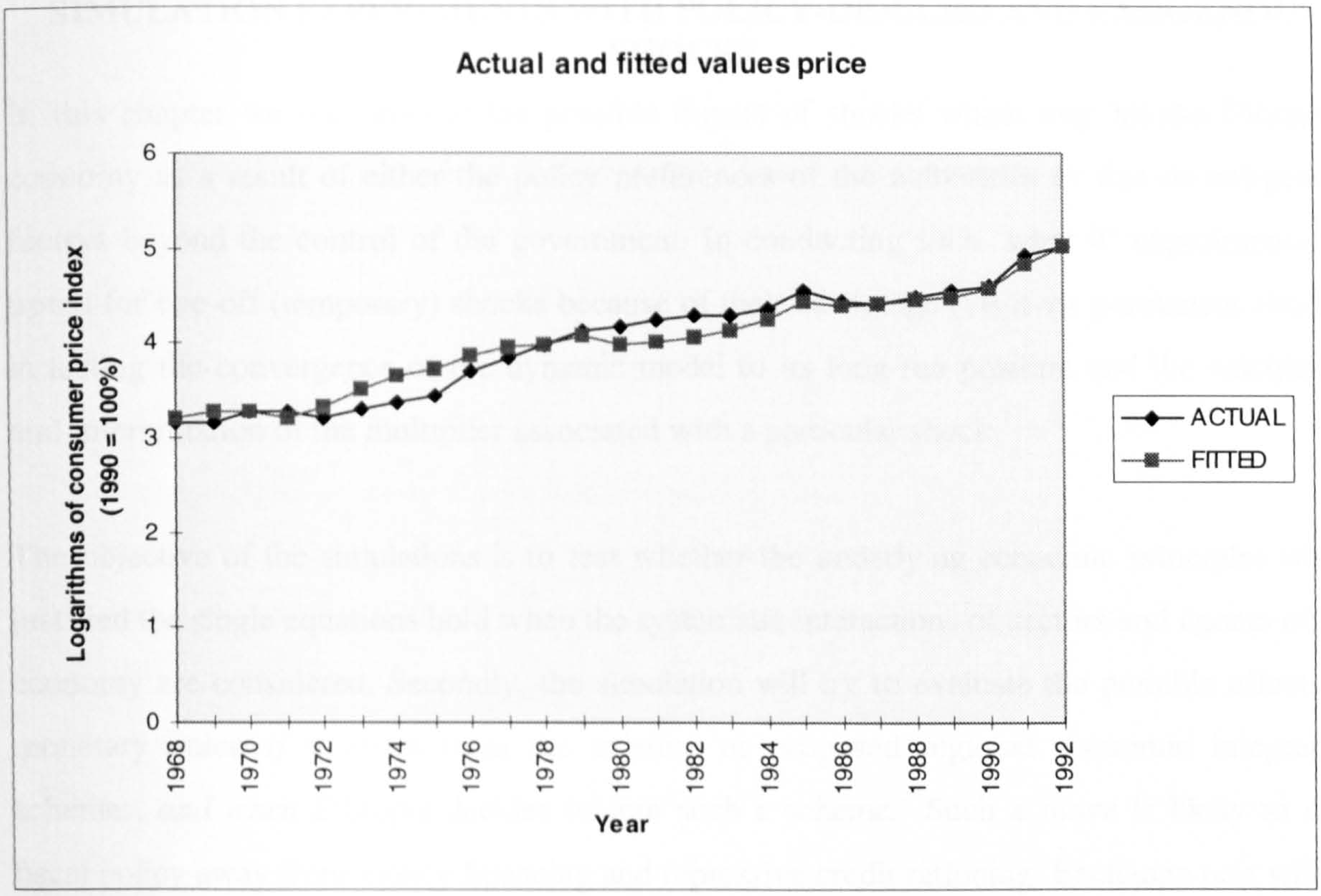
Measures of goodness-of-fit	
CORRELATION COEFFICIENT	0.56395
ROOT-MEAN-SQUARED ERROR	0.79625
MEAN ABSOLUTE ERROR	0.59977
MEAN ERROR	-0.11709
REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED	0.89021
THEIL'S INEQUALITY COEFFICIENT (1966)	0.45586
FRACTION OF ERROR DUE TO BIAS	0.021624
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY	0.0068909
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE	0.97149

Figure 8-16 COMPARISON OF ACTUAL AND PREDICTED SERIES OF DEMAND FOR REAL BROAD MONEY BALANCES



Measures of goodness-of-fit	
CORRELATION COEFFICIENT	0.95456
ROOT-MEAN-SQUARED ERROR	0.15110
MEAN ABSOLUTE ERROR	0.12532
MEAN ERROR	-0.00013189
REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED	0.78656
THEIL'S INEQUALITY COEFFICIENT (1966)	0.038923
FRACTION OF ERROR DUE TO BIAS	7.61934D-07
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY	0.43034
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE	0.56966

Figure 8- 17: COMPARISON OF ACTUAL AND PREDICTED SERIES OF PRICES



Measures of goodness-of-fit	
CORRELATION COEFFICIENT	0.97490
ROOT-MEAN-SQUARED ERROR	0.14012
MEAN ABSOLUTE ERROR	0.11102
MEAN ERROR	0.00045516
REGRESSION COEFFICIENT OF ACTUAL ON PREDICTED	1.11655
THEIL'S INEQUALITY COEFFICIENT (1966)	0.034626
FRACTION OF ERROR DUE TO BIAS	0.000010552
FRACTION OF ERROR DUE TO DIFFERENCE OF REGRESSION COEFFICIENT FROM UNITY	0.17281
FRACTION OF ERROR DUE TO RESIDUAL VARIANCE	0.82718

CHAPTER NINE

SIMULATION EXPERIMENTS WITH POLICY-INDUCED AND EXOGENOUS SHOCKS

In this chapter we will analyze the possible impact of shocks which may hit the Ethiopian economy as a result of either the policy preferences of the authorities or due to exogenous factors beyond the control of the government. In conducting such 'what if' experiments we opted for one-off (temporary) shocks because of their advantage (vis-à-vis permanent shocks) in testing the convergence of the dynamic model to its long-run position and the calculation and interpretation of the multiplier associated with a particular shock.[1]

The objective of the simulations is to test whether the underlying economic principles which justified the single equations hold when the systematic interactions of sectors and agents of the economy are considered. Secondly, the simulation will try to evaluate the possible effects of monetary union *if* it arises from the existing or proposed regional economic integration schemes, *and when* Ethiopia decides to join such a scheme.[2] Such a move is likely to shift fiscal policy away from money financing and repressive credit rationing. Exchange rate will no longer be in the list of trade policy instruments and the informal foreign exchange market is likely to shrink. The simulations will, therefore, try to analyze the instruments of the new policy regime and suggest possible ways of measuring the magnitude of its effects on key economic variables.

On the basis of our discussion on the flow-chart we have selected government expenditure and the official exchange rate as policy instruments, while the foreign interest rate and foreign prices are used in the exogenous-shock experiments. We will also examine a case where the informal rate of exchange behaves as a semi-exogenous variable due to its sensitivity to variables outside the model, such as unexpected political and economic changes at home and abroad. The nominal values of these variables are increased by 10% in 1975 so that the dynamics of their effect can be followed in the subsequent 12 years of the sample period. The

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[1]The literature on international trade and co-operation also disputes the notion of permanent external shocks (see for example De Grauwe 1992, p. 31) and one can also expect that in reality periodic changes of policies prevent the permanence any policy induced-shocks.

[2] For a detailed discussion on African Economic and Monetary Unions and the prospect for such a scheme in the Horn of Africa see Mehari (1999).

shock-point coincides with the emergence of an interventionist government which ruled the country until 1991, while the size of the shock is arbitrary.

We have considered four modes of financing the increase in government expenditure, i.e. an increase in taxation, an increase in seigniorage revenue, increasing the share of bank credit extended to the government by restraining the share of the private sector, and selling government bonds at the market rate of interest.

A total of seven simulation experiments are discussed in the next sections of this chapter. The results are reported in tables 9.1 to 9.9 and figures 9.1 to 9.44 which show that the shocks move each equation in a direction consistent with the **a priori** theory. The dynamics of each series differs mainly due to the differences in their lag structure and the size and sign of each of the coefficients of their explanatory variables which are related to the shocked variable.

In some cases the functions do not respond to the shock up to the second or third period, due to the lag structure of the particular variable. As discussed in chapter seven, the ECM methodology of economic modelling requires the deletion of variables whose coefficients fail the statistical tests. This led to the deletion of some contemporaneous variables of the policy instruments in some equations of the model. Since the model is based on annual data, such deletions implied that the policy instrument required more than a year to affect some sectors of the economy. In general one may find such long delays in shock responses as less than convincing. The remedy would have been to build a model based on quarterly data so that a lag of 4 periods would imply a year rather than 4 years. However, the data for this are not available.

This can be seen as a weakness of the model although the following points need some emphasis. Firstly, for a developing country such as Ethiopia, adjustment via the market forces can take a long time because the economy is fragmented by both sector and geography. The information system is very underdeveloped and the majority of the economy is at subsistence level, where farmers satisfy their needs from their village resources with very little interdependence on the rest of the economy. Secondly, to the best of my knowledge, the model is unique for its methodology and for its comprehensive treatment of both the formal and informal sectors of the Ethiopian economy. It apparently gives a good understanding on the structure of the economy and thus suffices the objective of this thesis. Finally, in all the equations, the effect of the temporary shock dies out over time and the model returns to its equilibrium position. This is an indication of the dynamic stability of the model and the convergence of its individual equations as part of the system.

9.1 Increase in public expenditure.

In this section we will consider the effect of an increase in government expenditure under four modes of financing, namely: tax, seigniorage, credit restraint, and bond financing. It is a temporary shock (i.e., in 1975 only) where the nominal value of government expenditure is increased by 10% and is proportionally distributed between government consumption and government investment.

In 1975 the value of government consumption and investment were respectively 730 million and 255.4 million Birr. The scenario which is considered in this policy experiment is, therefore, an increase in government consumption and investment by 73 million and 25.54 million Birr respectively and is financed by an equivalent adjustment in either of the four financing instruments. The total increase in government expenditure is 1.78% of the GDP in 1975.

The model as presented in the flow-chart (figure 8.9) is quite complex and a change in government expenditure feeds through to almost all the equations of the model albeit at different speeds, depending on the lag structure of each equation. It becomes necessary, therefore, to introduce the discussion by singling out the part of each equation which directly responds to changes in government consumption and investment, assuming all other things remain the same.

The initial effect of an increase in public expenditure is reflected in the equations where government consumption (Cg) and/or government investment (Ig) appear as explanatory variables. Furthermore, all equations which have income (y), disposable income (yd) or expected growth of real income (rexdy2) as an explanatory variable, are expected to respond to changes in public expenditure via the aggregate income identity.[3] Consequently, with the exception of the functions for exports, the informal rate of exchange and foreign exchange reserves, all equations of the model are expected to respond to the change in government expenditure.[4]

The mode of financing the change in government expenditure will be discussed in sections 9.1.1 to 9.1.4. To simplify the discussion, however, it is worth singling out the relevant parts of the equations of the model (see section 8.1.1) that will determine the pattern of the dynamics of change in government expenditure. These are listed in equations 9.1 to 9.7 and are taken from their respective functions in section 8.1.1 because they respond to changes of government expenditure directly or via the aggregate income identity.

Consumption

$$dlrcp = +.99687\ dlryd + .44025\ dlryd(-1) + 0.25499\ lryd(-2) - .10755\ dlrcg \quad \ldots\ldots 9.1$$

Investment

$$dlrip = +0.04082\ lryd(-2) + 7.1 dlrexdy2 + 6.9 dlrexdy2(-1) + 7.7 dlrexdy2(-2) \quad \ldots\ldots 9.2$$

Imports

$$dlrim = +.43573\ dlrcg - .52740\ dlrcg(-1) + 0.03512\ lrcg(-2) - .18076\ dlrig(-1) + 0.06154\ lrig(-2) \quad \ldots\ldots 9.3$$

Money demand

$$dlm2 = +0.20433\ lry(-3) \quad \ldots\ldots 9.4$$

External balance

$$ca = -\exp(lrim) \quad \ldots\ldots 9.5$$

[3] Note that public expenditure is part of the aggregate demand. Y = Cp + Ip + (Cg + Ig) + (X - IM) and expected growth of real income is a function of changes in income and prices in the recent past.

[4] It is worth stressing here that we are considering only those functions which are directly linked to government expenditure. Otherwise, almost all other functions and variables are going to respond to the shock in subsequent rounds. The effect on prices for example, will be reflected in the real values of all variables and the effect on imports is going to affect the external balance and thereby the functions for the informal rate of exchange and foreign exchange reserves.

Real GDP

ry = exp (lrcp) + exp(lrip) + exp (lrcg) + exp (lrig) + exp (lrx) - exp(lrim) 9.6

Price equation

lp = .983(log(nm2) - log(rm2)) + .836E-05(log(ngdp)-log(rgdp)) 9.7

Export function: At this stage one might ask whether the increase in government expenditure should not affect exports. Surely government expenditure affects prices and prices should affect exports. Such an argument is justified on the basis of general economic principles and the export function in our model accommodates it. In this study, exports respond to changes in domestic prices via the real effective exchange rate (REER) defined as

REER = ERO (Pf/Pd) 9.8

where ERO is exchange rate (official), Pf is an index of foreign prices, and Pd is an index of domestic prices. Moreover the premium on the informal exchange rate (which is an explanatory variable in the export function) responds to prices via expected inflation. Nonetheless, the size of change in price caused by the 10% increase in government expenditure in 1975 is not large enough to result in a significant change in international competitiveness (REER) and thereby to exports.

In spite of the increase in the share of the public sector, prices and exchange rates were relatively stable for most of the sample period. The average rate of inflation for 1968-92 was 8.5% while the share of GDP spent by the government increased from 13% in 1968 to 35% in 1990. Exchange rate was fixed at 2.07 Birr/ US$ and price control was introduced.

Price stability is therefore evidence of the effectiveness of the government's price and exchange control measures, at least as far as the official sector is concerned. Our model provides evidence of the relatively small impact on prices, especially when the increase in government expenditure is financed by non-money instruments.

The economic rationale for such insensitivity of exports to changes in government expenditure is basically the stability of domestic prices and Ethiopia's junior position in the world market. The price stability is achieved as a result of the government's near-monopoly position in the supply of many domestic products and the strong regulatory power of international trade. Secondly, Ethiopia, like most developing countries, is a price-taker in the international market and, thus, her domestic price will have very little impact on the international price of her exports. The objective of the government is usually to meet a certain target of export earnings and will normally do everything in its power to achieve its objective at the existing international market price.

Before proceeding to the next section, it is worth noting some points on the dynamics of equations 9.1 to 9.7. Only the equations with contemporaneous variables can be expected to respond to the shock at the initial period. Private consumption can be expected to increase because the impact of the the shock on disposable income (+ .99687 dlryd) is larger than that on public consumption (-.10755 dlrcg); while imports are expected to increase because part of the government expenditure is used to finance imports (+ .43573 dlrcg). This change will also be reflected in the external balance and in income via the aggregate income identity. Private investment and the demand for broad money do not respond to the shock up to the end of the second and third periods respectively.

Of course the story is incomplete without a discussion on the different methods of financing the additional spending and the dynamics of the shock over time. Four financing policy options are considered below.

9.1.1 Policy one: Tax financing

In this section we consider the case where the 10% increase in government expenditure is financed by an equivalent rise in the tax revenue collected from the economy in 1975. As discussed above the increase in government expenditure is 98.54 million Birr and requires a rise of 1.78% on income tax. The policy operates via its negative impact on disposable income and thereby on private consumption and investment functions.

Yd = Y - T 9.9

Disposable income is an explanatory variable in the functions for private consumption and investment.

dlrcp = .99687 dlryd +.44025 dlryd(-1) + 0.25499 lryd(-2) 9.10
dlrip = 0.04082 lryd(-2) 9.11

The initial impact of the tax rise is, therefore, to reduce private consumption on almost a unit-per-unit basis, while the effect on private investment will not be felt before the second period.

As indicated in the flow-chart (section 8.1.6) the model is composed of interrelated equations. Fluctuations will occur in variables which do not have a direct relationship with the variable to which the shock is applied. In other words, although government expenditure and tax return to their original level, their net impact on private consumption, imports, income and prices will affect other variables in the model with lags. To clarify this point we will follow the dynamics of each of the equations as follows.

The shocks (i.e., changes in government expenditure and its mode of financing) affect the informal rate of exchange and foreign exchange reserves indirectly in the second and third round (see the flow-chart in chapter 8). This effect is accommodated in the dynamics of the import and export functions. Thus, we will confine the discussion to the dynamics of the five behavioural equations (private consumption, private investment, exports, imports, and money demand), the price equation and the identities for external balance and GDP. The result of each policy option is presented in separate graphs (except for those with marginal changes) and will be summarized in a table at the end of each section.

Consumption function

The dynamic impact of the policy experiment on private consumption is presented in table 9.1 and figure 9.1. In the period of the shock the change in private consumption is explained by the contemporaneous values of disposable income and government consumption. Since the increase in aggregate income is offset by the equivalent rise in taxation, private consumption decreases due to the crowding-out effect of government expenditure. The part of the consumption function (equation 8.1) which is relevant for this period is

dlrcp = + .99687 dlryd -.10755 dlrcg + ...8.1a

One period after the shock (1976), the relevant portion of the consumption function includes the variables of private consumption, government consumption, and disposable income which have a lag period of one.

dlrcp = ... -.59333 dlrcp(-1) + .44025 dlryd(-1) + ...8.1b

Since consumption declined in the previous period the first term will have a positive impact. The second term will have a positive effect because the overall impact of the shock increased income in 1975 (see figure 9.5). The net effect is an increase in private consumption vis-à-vis that of 1975, although still below its pre-shock level.

In the second period (1977) the relevant portion of the private consumption function includes the variables of private consumption, government consumption, and disposable income which have lags of one or two periods.

dlrcp = ... -.59333 dlrcp(-1) -.48345 lrcp(-2) + .44025 dlryd(-1) + 0.25499 lryd(-2) + ... 8.1c

The first term will reduce private consumption because the change in private consumption was positive in 1976. The second term will have a negative impact because the level of private consumption declined in 1975. The third term will have a negative effect because the change in income is negative in 1976. The fourth term will have a positive impact because the level of disposable income increased in 1975. The remaining terms will have no impact because financial wealth, deposit rate and credit restraint are assumed not to respond to this particular shock. The net effect is an increase in private consumption in 1977. From 1977 onwards private consumption will fluctuate in accordance with equation 8.1c.

Investment function

The dynamic impact of the policy experiment on private investment is presented in table 9.1 and figure 9.2. None of the variables directly affected by the shock (i.e., government consumption, government expenditure, tax and disposable income) appear as contemporaneous variables in our investment function. The function will therefore remain unchanged in 1975.

In the first post-shock period the only relevant variable which appears in the investment function is its own lagged value. However, this will have no effect because the change in private investment in the previous period is zero. Private investment will therefore, remain unchanged until 1977. From 1977 onwards, the series will fluctuate in accordance with the following portion of the private investment function (see equation 8.2).

dlrip = ... - 1.0121 dlrip(-1) -.75452 lrip(-2) + 0.8019642 lrim(-2) + 0.04082 lryd(-2) + ...
....8.2a

The first and second terms are zero in 1977 because private investment did not respond to the shock in 1975-76. The third and fourth terms will increase private investment because both imports and income increased in 1975 (see table 9.1). The net effect is to increase private consumption in 1977.

In 1978 the first term will reduce private investment because it increased in 1977. The second will have no effect because private investment remained unchanged in 1976. The third term will reduce private investment because imports declined in 1976. The fourth term will have a positive impact because income is still above its pre-shock level. The net effect is, however, to reduce the level of private investment in 1978.

From 1979 onwards all four components of equation 8.2a will have impact on private investment. In 1979 the first term will have a positive impact due to the decline of private investment in 1978. The second term will reduce private investment because its level in 1977 was above its pre-shock level. The third and fourth terms will have a positive impact because in 1977 both imports and income are slightly above their pre-shock level. The net impact on private investment is, however, still negative.

In 1980 the first and second terms have a positive impact because private investment declined in 1979 and its level in 1978 was below the pre-shock level. The third term will increase private investment because imports stayed above their pre-shock level in 1978. Income on the other hand, declined below its pre-shock level in 1978 and its impact will therefore, be negative. The net effect on the level of private investment in 1980 is to increase it above its pre-shock level. The dynamics continue in similar fashion in subsequent periods. The adjustment of private investment is very sluggish mainly because of the long lag structure and large coefficients associated with the lagged dependent variable and imports in equation 8.2. The adjustment oscillates because the coefficients of the lagged dependent variables are negative. The curve crosses the base-line in an interval of about three periods and the size of the fluctuation dies down slowly.[5]

Import function

The effect of the shock on imports is presented in table 9.1 and figure 9.3. Increase in imports in 1975 is explained by the following portion of equation 8.4 where government consumption appears as a contemporaneous variable.

dlrim = ... + .43573 dlrcg + ...8.4a

In the next period imports decline sharply because the increases in government consumption and government investment in 1975 are negatively related to the level of imports in 1976. The portion of equation 8.4 which explains this relationship is

dlrim = ... -.52740 dlrcg(-1) -.18076 dlrig(-1) + ...8.4b.

Equation 8.4c is the portion of equation 8.4 which determines the dynamics of imports in 1977 onwards. The first term has a negative impact because imports in 1975 were above their pre-

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[5]Such convergence towards the base-line becomes clearer when the shock is administered in earlier periods such as 1968. This is evidence of the sluggishness of the investment function and our relatively shorter post-shock period (1975-92) would not make any difference to the basic argument pursued here.

shock level. The second and third terms have a positive impact on imports because they are policy variables which increased in 1975. The fourth variable will have no effect as private imports remained unchanged in 1975, while the fifth will have a positive impact because private consumption decreased in 1975. The sixth term is foreign exchange reserves which have a positive impact on imports.

dlrim = ... - .20226 lrim(-2) + 0.03512 lrcg(-2) + 0.06154 lrig(-2) + 0.08931 lrip(-2) - 0.23804 lrcp(-2) + 0.035 lrfer(-2)... ....8.4c

From 1978 onwards the dynamics of imports is determined by the following portion of equation 8.4, although the impact of the private investment will not be felt until 1979.

dlrim = ... - .20226 lrim(-2) + 0.08931 lrip(-2) - 0.23804 lrcp(-2) 8.4d

External balance

The external balance is an identity based on the difference of exports and imports.

CA = X - IM ....8.4e.

Its dynamics are, therefore, determined by those of its constituent equations. In this case the shock has no effect on the export function and thus, the dynamics of the external balance are dominated by the behaviour of the imports function (see table 9.1 and figure 9.4).

Income identity

Aggregate income is defined as the sum of private consumption, private investment, government consumption, government investment, and exports net of imports.

Y = Cp + Ip + Cg + Ig + X - IM 8.4f

The dynamics of aggregate income presented in figure 9.5 are, therefore, determined by the behaviour of its four functions and exogenous government expenditure which constitute the income identity.

Money-demand function

The effect of the policy experiment on the demand for broad money is presented in table 9.1 and figure 9.7. The demand for broad money starts to respond to the shock after three years, in 1978.[6] Government expenditure is part of aggregate income and the latter is an explanatory variable in the demand function for broad money. Consequently an increase in government expenditure in 1975 leads to an increase in the demand for broad money in 1978. The portion of equation 8.5 which explains this is

dlm2 = ... + 0.20433 lry(-3) + ...8.5a

This equation determines the dynamics of the function until 1981 because the other relevant variable (lm2 (-3)) requires another three years to have an impact on the dynamics. This leads to a persistent increase in the function until 1981. From 1981 onwards the portion of equation 8.5 which determines the dynamics of the demand for broad money is

dlm2 = ... - .17188 lm2(-3) + 0.20433 lry(-3) + ...8.5b

In 1981 the first term has a negative impact because the demand for money was above its pre-shock level in 1978. This is reinforced by the decline of income in 1978 below its pre-shock level. The net impact is to reduce broad money in 1981. This decline continues throughout subsequent years because the first term will be negative as long as broad money remains above its pre-shock level, while the impact of the second term dies down with the decline of simulated income below its pre-shock level.

Price equation

The dynamics of prices are determined by the price equation which links prices to the output and monetary sectors.

[6]As discussed in the introductory part of this chapter such a delay can be seen as a short-coming of the model given that one would expect the monetary sector to adjust more quickly than the real sector of the economy. It is, however, worth noting that the monetary balance considered here is M2 which includes both savings and demand deposits. One would therefore expect a relatively slower adjustment in the demand for M2 (vis-à-vis the transactions demand for money) especially when the shock is introduced via the income identity rather than through monetary instruments such as the interest rate.

$lp = .982598\ [\log(nm2) - lm2] + .836360E{-}05\ [NGDP - \log(RGDP)]$ 8.5c

The shock is administered as an increase in the nominal values of government expenditure and taxes. This will, therefore, affect the nominal value of aggregate income (NGDP) while the real value of aggregate demand (RGDP) is determined by the behaviour of the four behavioural equations and the real value of the aggregate expenditure.

In the monetary sector, on the other hand, the shock does not affect nominal broad money (nm2), while the demand for real broad money responds to changes in real aggregate income.

The dynamics of the effect of the shock on prices are presented in table 9.1 and figure 9.6. The increase in prices in 1975 is due to inflationary pressures through the increase in the nominal values of government expenditure. Post-1978 dynamics of the price level are, however, explained by changes in the demand for real money balances in a situation of zero changes in nominal money balances.

Table 9- 1: Tax financing of 10% increase in government expenditure in 1975

Post-shock deviations from base-line (millions of Ethiopian Birr) F-S

	Consumption	Investment	Imports	External balance	GDP	Prices	Money demand
1975	-0.984	0.000	0.833	-0.833	5.950	0.034	0.000
1976	-0.202	0.000	-1.193	1.193	0.991	0.000	0.000
1977	0.088	0.072	0.172	-0.172	-0.013	0.000	0.000
1978	0.171	-0.099	0.465	-0.465	-0.394	-0.100	0.077
1979	0.132	-0.243	0.431	-0.431	-0.542	-0.108	0.086
1980	0.050	0.003	0.357	-0.357	-0.305	-0.100	0.098
1981	-0.014	0.097	0.185	-0.185	-0.102	-0.084	0.095
1982	-0.034	0.163	0.113	-0.113	0.017	-0.070	0.078
1983	-0.029	0.081	0.187	-0.187	-0.135	-0.056	0.061
1984	-0.011	-0.180	0.262	-0.262	-0.453	-0.044	0.041
1985	0.002	-0.193	0.260	-0.260	-0.451	-0.035	0.026
1986	0.008	-0.076	0.286	-0.286	-0.354	-0.022	0.020
1987	0.007	0.080	0.160	-0.160	-0.073	-0.013	0.012
1988	0.003	0.129	0.043	-0.043	0.089	-0.008	0.007
1989	0.000	0.084	0.051	-0.051	0.033	-0.004	0.004
1990	-0.002	-0.025	0.104	-0.104	-0.130	-0.001	0.001
1991	-0.001	-0.130	0.110	-0.110	-0.241	0.000	0.000
1992	-0.001	-0.020	0.104	-0.104	-0.125	0.001	-0.001
Average	**-0.045**	**-0.014**	**0.163**	**-0.163**	**0.209**	**-0.034**	**0.034**

Figure 9- 1: Effect on private consumption of a 10% increase in government expenditure financed by tax in 1975

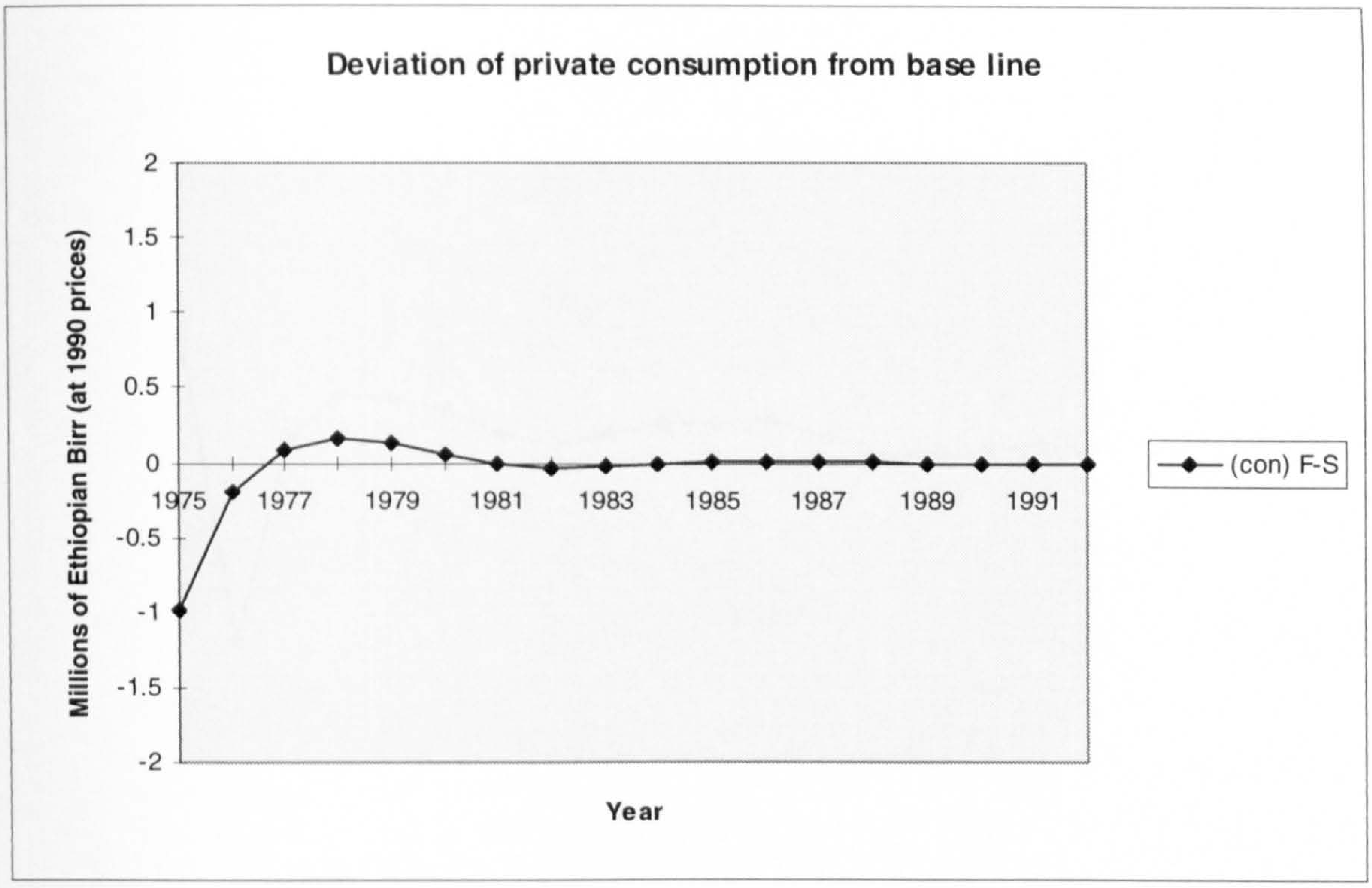


Figure 9- 2: Effect on private investment of a 10% increase in government expenditure financed by tax in 1975

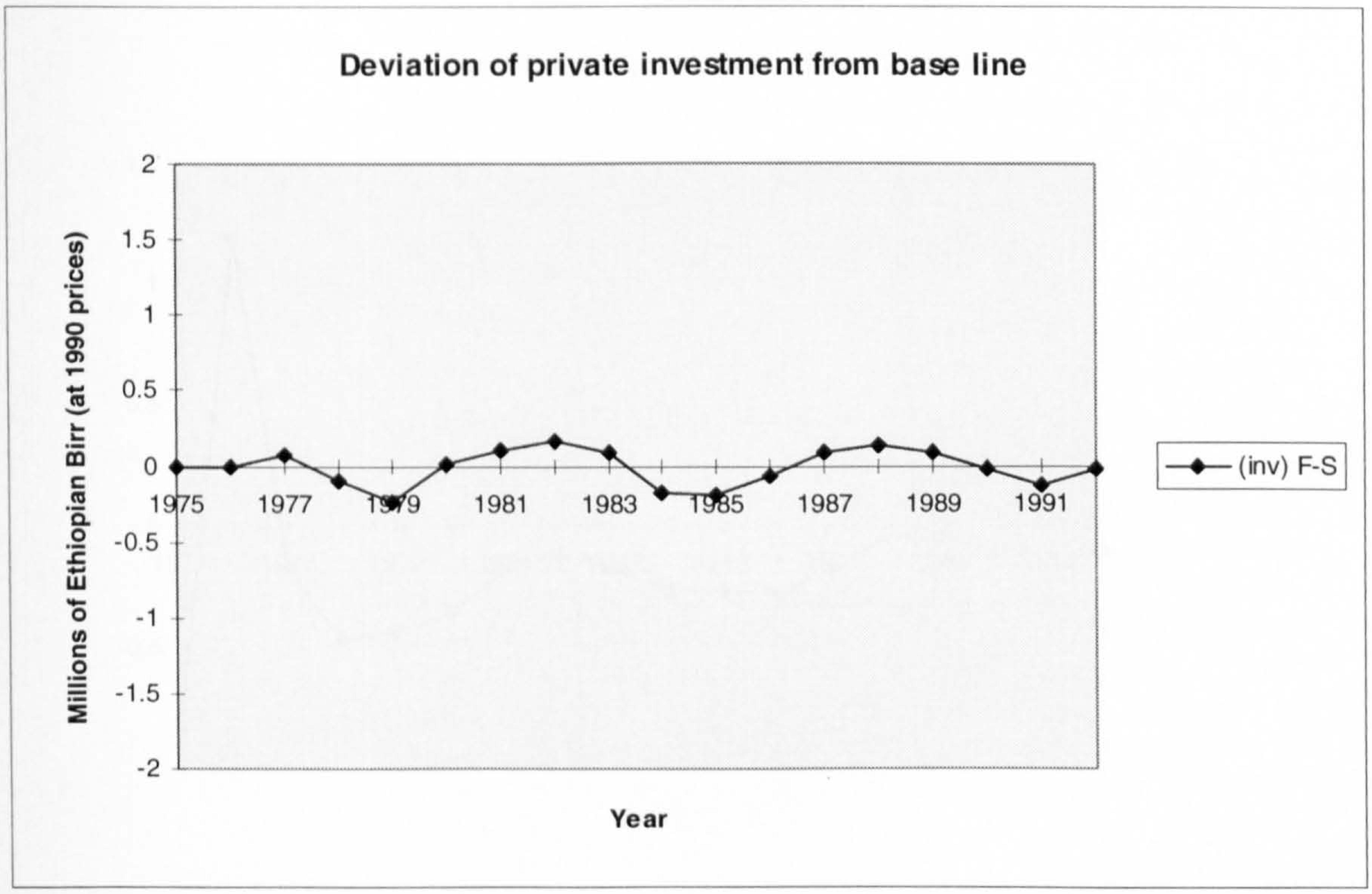


Figure 9- 3: Effect on imports of a 10% increase in government expenditure financed by tax in 1975

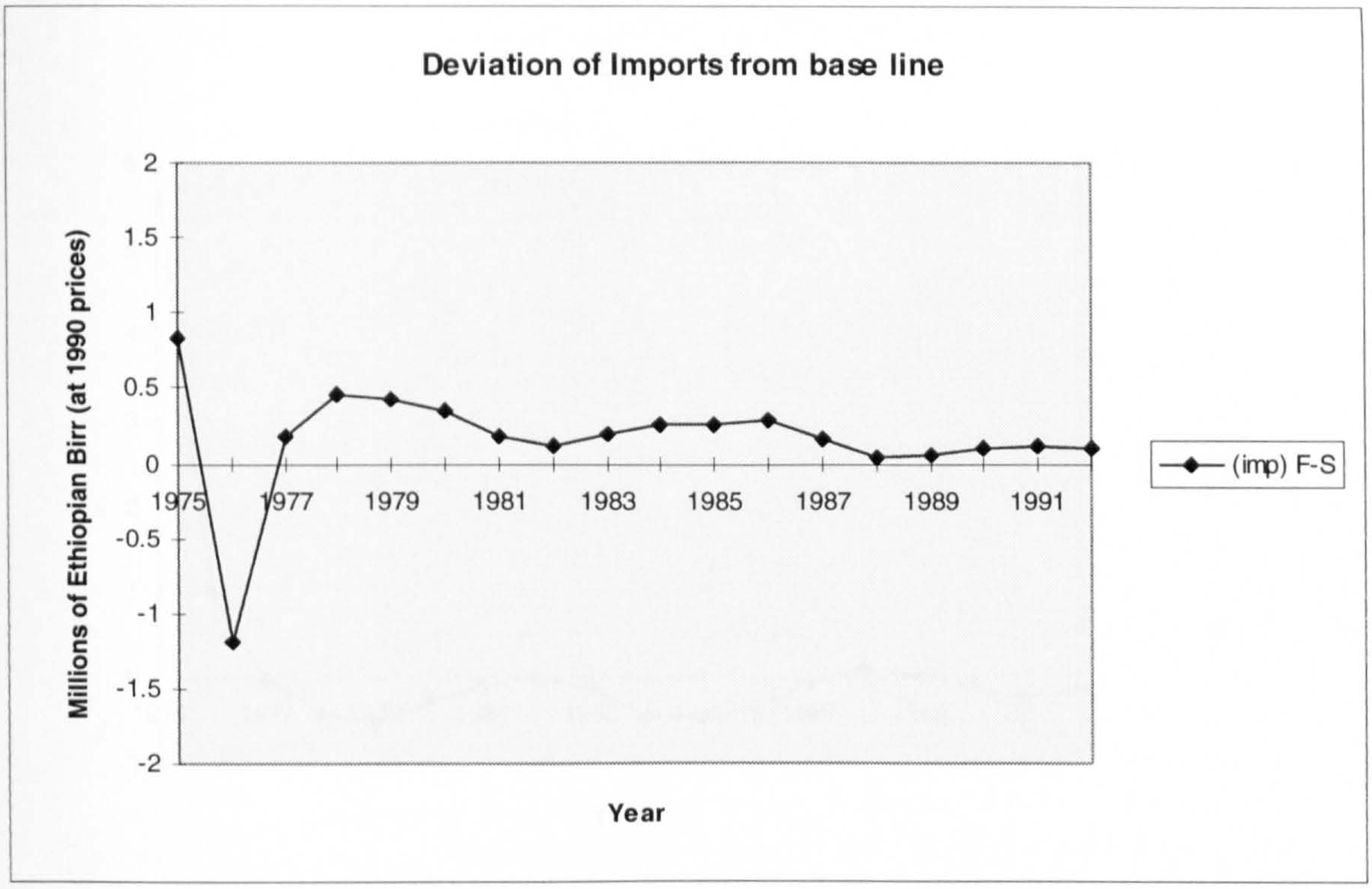


Figure 9- 4: Effect on external balance of a 10% increase in government expenditure financed by tax in 1975

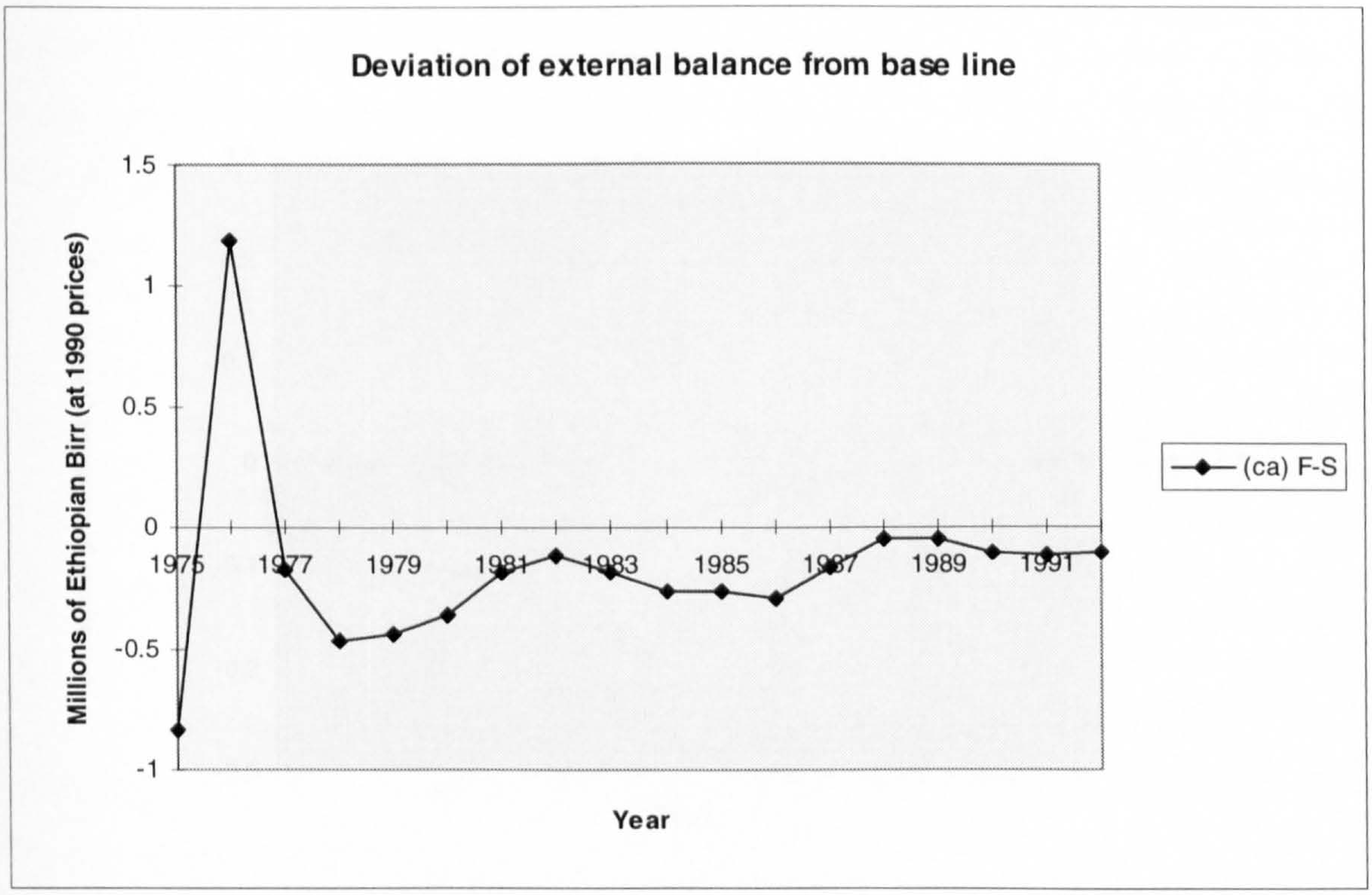


Figure 9- 5: Effect on GDP of a 10% increase in government expenditure financed by tax in 1975

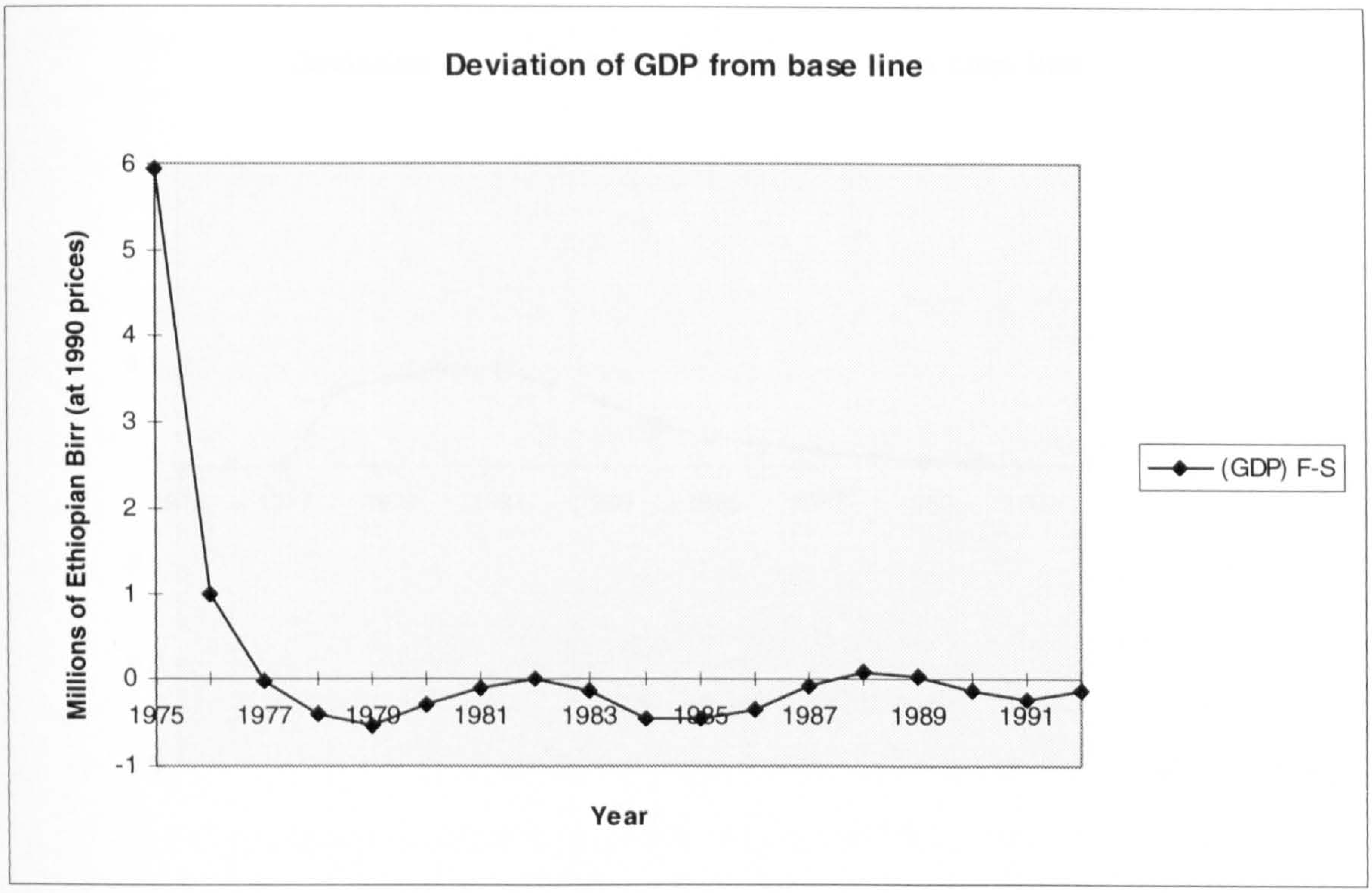


Figure 9- 6: Effect on prices of a 10% increase in government expenditure financed by tax in 1975

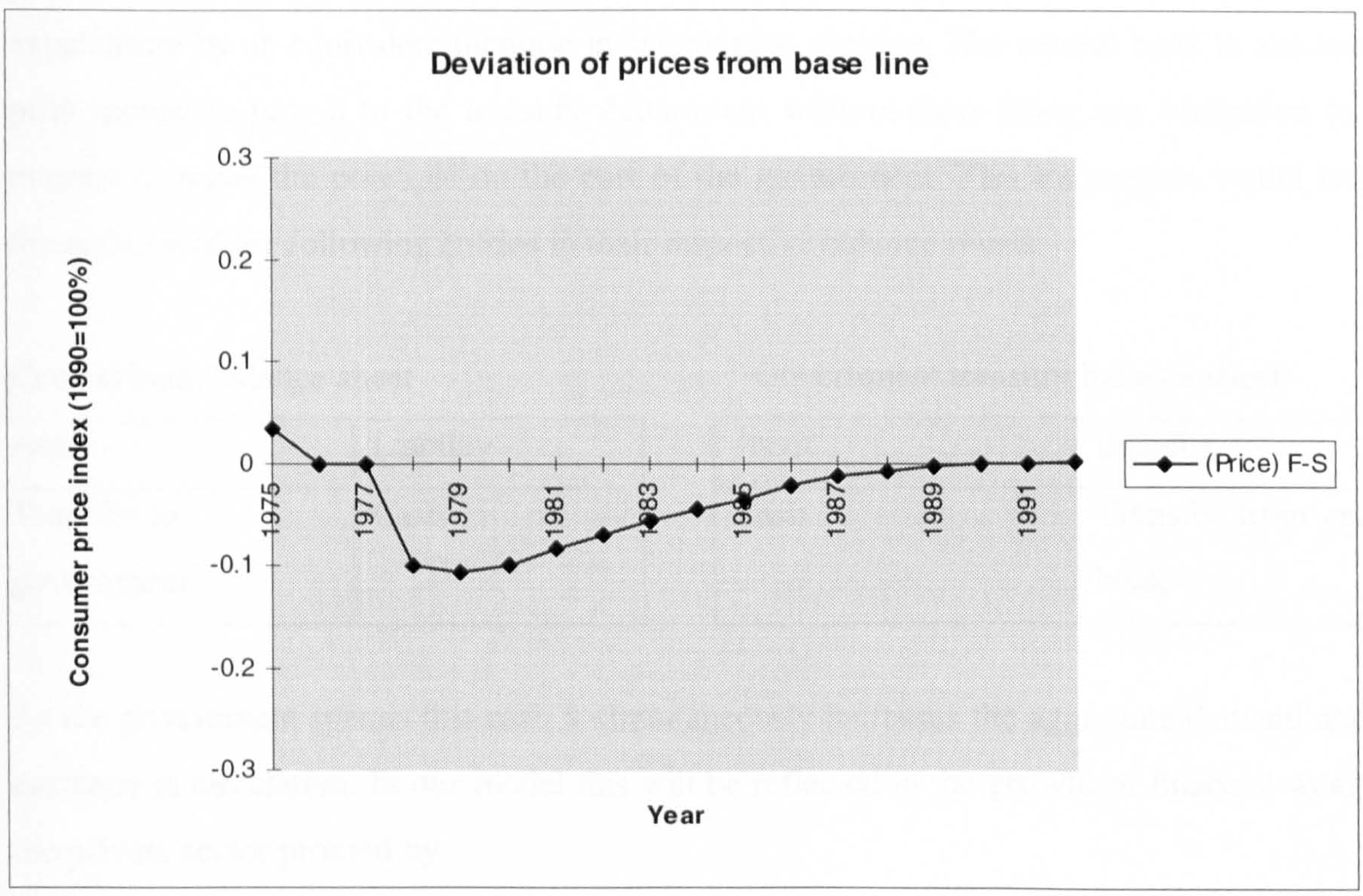
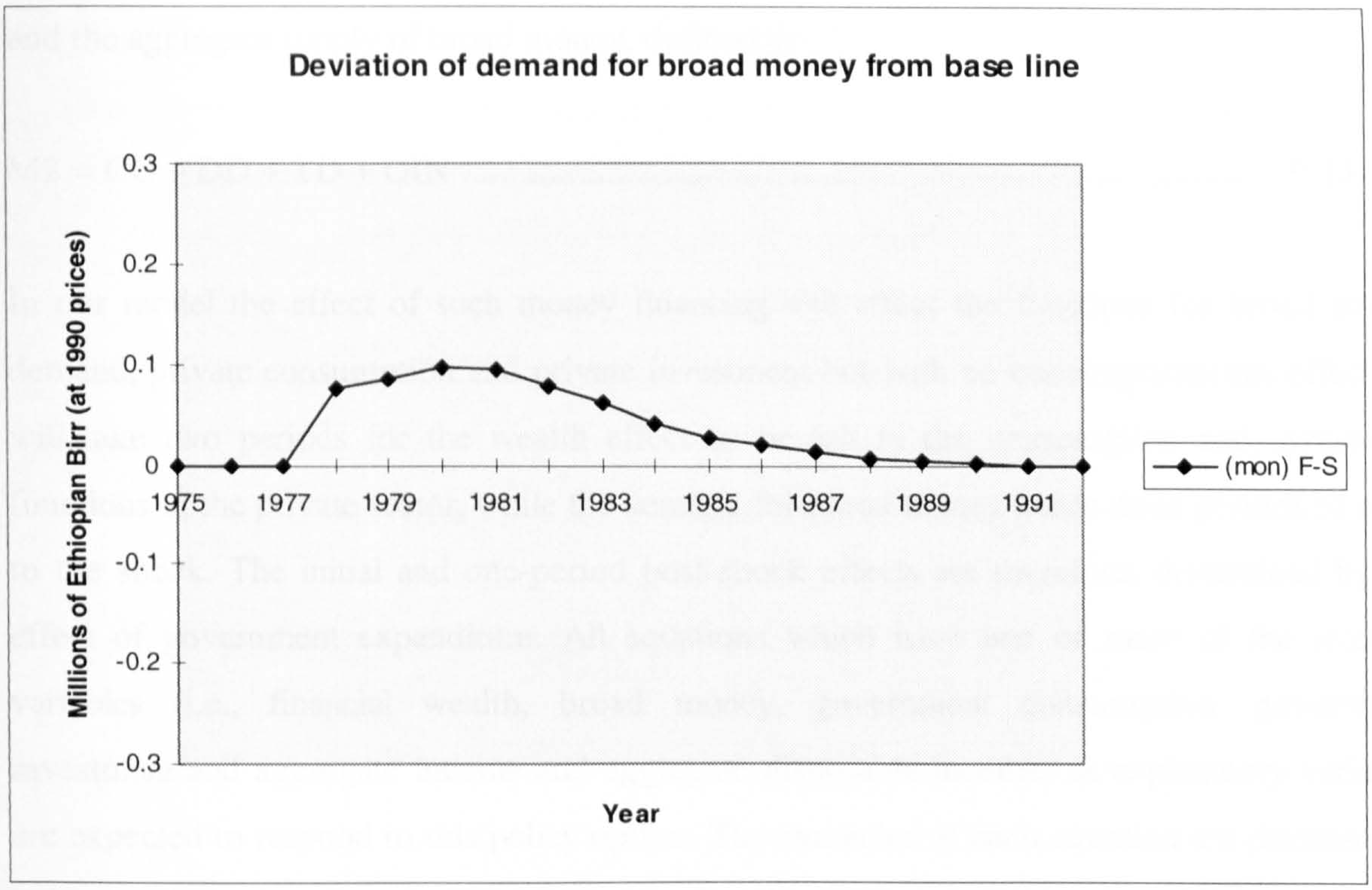


Figure 9- 7: Effect on money demand of a 10% increase in government expenditure financed by tax in 1975



9.1.2 Policy two: Money financing

In this case we consider the financing of a 98.54 million Birr increase in government expenditure by an equivalent increase in seigniorage revenue. The central bank is assumed to print money to pass it to the treasury department without there being any obligation to pay interest or repay the principal on the part of the government. This transaction would lead to the creation of the following entries in their respective balance sheets

Central bank balance sheet

Asset	Liability
Transfer to government	Cash

Government treasury balance sheet

Asset	Liability
Cash	Transfer from central bank

As the government spends this cash it simultaneously increases the aggregate demand and the currency in circulation. In our model this will be reflected in the growth of financial wealth of the private sector proxied by

W = Currency in circulation + Private deposits - Bank loans to the private sector 9.12

and the aggregate supply of broad money, defined as

M2 = CC + DD + TD + OIN 9.13

In our model the effect of such money financing will affect the functions for broad money demand, private consumption and private investment but with no contemporaneous effect.[7] It will take two periods for the wealth effect to be felt in the consumption and investment functions of the private sector, while the demand for broad money needs three periods to react to the shock. The initial and one-period post-shock effects are therefore, determined by the effect of government expenditure. All equations which have one or more of the relevant variables (i.e., financial wealth, broad money, government consumption, government investment and aggregate income and aggregate disposable income) as explanatory variables are expected to respond to this policy option. The dynamics of each equation are discussed as below and the results of all equations under this policy option are consistent with the underlying economic theory. The magnitude of the effects of the shock in each equation is summarized in table 9.2.

Consumption function

For this policy option the dynamics of private consumption are explained by the following portion of equation 8.1.

dlrcp = + -.59333 dlrcp(-1) -.48345 lrcp(-2) + .99687 dlryd + .44025 dlryd(-1) + 0.25499 lryd(-2) + 0.00231 lrw(-2) -.10755 dlrcg 8.1d

Note that the difference between equations 8.1c and 8.1d is the inclusion of private financial wealth in the latter.

dlrcp = + 0.00231 lrw(-2) 9.14

[7]Note that we have argued in chapter 7 that private financial wealth held in the banking system negatively affects private investment in a financially-repressed economy if bank credit is biased against private enterprise.

The dynamics of the consumption function under money financing are similar to those discussed under the tax financing option. The only differences in this case are the absence of the negative effect of taxation on disposable income, the presence of the positive effect of the increase in financial wealth from period two onwards, and the upward pressure on prices (due to the expansion of nominal money balances) from period three onwards.

The effect of the policy-experiment on private consumption is presented in Table 9.2 and figure 9.8. In the period of the shock, the change in private consumption is explained by the contemporaneous values of disposable income and government consumption.

dlrcp = + .99687 dlryd -.10755 dlrcg + ...8.1e

The policy will increase disposable income because public expenditure is part of aggregate demand (and aggregate income) which, in the absence of additional taxation will increase disposable income. The crowding-out effect of government expenditure will therefore, be more than offset by the growth in disposable income. This explains the increase in private consumption in 1975.

For the dynamics in the one period after the shock (1976) the relevant portion of the consumption function becomes:

dlrcp = ... -.59333 dlrcp(-1) + .44025 dlryd(-1) + ...8.1f

Since consumption increased in the previous period the first term will have a negative impact. This will, however, be more than offsets by the positive impact of the growth in the previous period's income (see figure 8.23). The net effect is to keep private consumption above its pre-shock level.

From 1977 onwards the dynamics of private consumption are explained by dlrcp = ... -.59333 dlrcp(-1) -.48345 lrcp(-2) + .44025 dlryd(-1) + 0.25499 lryd(-2) + 0.00231 lrw(-2)... ....8.1g

The first term will increase private consumption because change in private consumption was negative in 1976. The second term will have a positive impact because the level of private consumption increased in 1975. The third term will have a negative effect because the change in income was negative in 1976. The fourth term will have a positive impact because the level of disposable income increased in 1975. The fifth term will increase private consumption because, by definition, the expansion of broad money balances implies an increase in the financial assets of private agents. The net effect in 1977 is a decline in private consumption below its pre-shock level until 1981 when it becomes positive, though small.

Investment function

The dynamics of private investment under this policy option are presented in table 9.2 and figure 9.9. They are explained by the following portion of equation 8.2.

dlrip = ... - 1.0121 dlrip(-1) -.75452 lrip(-2) + 0.8019642 lrim(-2) + 0.04082 lryd(-2) - 0.605374 lrw(-2) 8.2b

Note that the difference between equations 8.2a and 8.2b is the inclusion of private financial wealth in the latter.

dlrip = - 0.605374 lrw(-2) 9.15

The dynamics of the private investment function under money financing are similar to those under the tax financing option. The only differences in this case are the absence of the negative effect of taxation and the presence of the wealth effect. There is no contemporaneous variable in equation 8.2b and, thus, private investment remains unchanged in 1975. This renders the first term of the equation (i.e., -1.0121 dlrip(-1)) and the second term (i.e., -.75452 lrip(-2)) ineffective during 1975-77 and 1975-78 respectively. In 1977 the change in private investment is explained by dlrip = 0.8019642 lrim(-2) + 0.04082 lryd(-2) - 0.605374 lrw(-2) 8.2c

The first two terms have a positive impact on private investment because both imports and disposable income increased in 1975. The third term represents growth in private financial wealth and has a negative impact on private investment because private financial wealth increased in 1975. The net effect in 1975 is a decline in private investment.

In 1978 the first term of equation 8.2b becomes effective. It will have a negative impact because of the increase in the level of private investment in the previous year. The dynamics of the function in 1978 will, therefore, be determined by

dlrip = ... - 1.0121 dlrip(-1) + 0.8019642 lrim(-2) + 0.04082 lryd(-2) 8.2d

The second and third terms will have a negative impact because both imports and disposable income declined in 1976. Private financial wealth will have no impact from 1978 onwards because the shock (the change in broad money balances) is temporary (i.e., in 1975 only). The net impact will therefore be a further decline in private investment.

From 1979 onwards the second term of equation 8.2b becomes effective due to the fluctuations in the level of private investment from 1977 onwards. The dynamics of the function will therefore, be determined by

dlrip = ... - 1.0121 dlrip(-1) -.75452 lrip(-2) + 0.8019642 lrim(-2) + 0.04082 lryd(-2) 8.2e

Since the error correction term has a negative coefficient of -0.76 the dynamics oscillate up and down the base-line.[8] Such a large coefficient and the lag structure of the model makes the adjustment slow. As in the tax financing case, however, the deviation dies down eventually because $0 < |-0.76| < 1$.

[8]Note that the error term in equation 8.2 is represented by the terms whose lag period is two. The coefficients of these terms are products of long-run function and the coefficient of the error term.

Import function

The relevant portion of equation 8.4 for this policy option is

dlrim = ... - .20226 lrim(-2) + .43573 dlrcg -.52740 dlrcg(-1) + 0.03512 lrcg(-2) -.18076 dlrig(-1) + 0.06154 lrig(-2) + 0.08931 lrip(-2) - 0.23804 lrcp(-2) 8.4g

The discussion on the dynamics of the import function is the same as that presented in equations 8.4a and 8.4b because the function does not respond directly to taxes or to monetary variables. Any indirect effect of these variables is likely to affect the magnitude (rather than the general pattern) of the fluctuation of the imports function (see figure 9.10).

External balance and income identities

Since external balance and aggregate income are identities, they will fluctuate in response to the changes in their constituent behavioural functions. The discussion is basically the same as that presented in equations 8.4e and 8.4f (see also table 9.2 and figures 9.11-9.12)

Money demand

The dynamics of the demand for money function is similar to that discussed in equations 8.5a and 8.5b. This is mainly because the function considers the impact on real (not nominal) money balances while the policy shift from tax to money financing affects the nominal money balances and thereby the price level (see also figure 9.14).

Price equation

Prices are determined mainly by events in the monetary sector. The shift from tax to money financing has therefore increased the price index (see figure 9.13). The discussion on the pattern of price movements is basically the same as in equation 8.5c.

Table 9- 2: Effect of 10% increase in government expenditure financed by money in 1975

Post-shock deviations from base-line (millions of Ethiopian Birr) F-S

	Consumption	Investment	Imports	External balance	GDP	Prices	Money demand
1975	1.801	0.000	0.833	-0.833	8.736	2.822	0.000
1976	0.809	0.000	-1.193	1.193	2.002	0.000	0.000
1977	-0.394	-0.146	0.083	-0.083	-0.623	0.000	0.000
1978	-0.720	-0.321	0.326	-0.326	-1.367	-0.100	0.077
1979	-0.547	-0.368	0.222	-0.222	-1.137	-0.108	0.086
1980	-0.200	0.082	0.037	-0.037	-0.155	-0.100	0.098
1981	0.063	0.166	-0.128	0.128	0.357	-0.084	0.095
1982	0.142	0.170	-0.078	0.078	0.390	-0.070	0.078
1983	0.121	-0.009	0.156	-0.156	-0.043	-0.056	0.061
1984	0.045	-0.694	0.261	-0.261	-0.911	-0.044	0.041
1985	-0.009	-0.290	0.197	-0.197	-0.495	-0.035	0.026
1986	-0.034	0.018	0.082	-0.082	-0.098	-0.022	0.020
1987	-0.030	0.167	-0.121	0.121	0.259	-0.013	0.012
1988	-0.012	0.155	-0.125	0.125	0.268	-0.008	0.007
1989	0.002	0.029	0.025	-0.025	0.006	-0.004	0.004
1990	0.007	-0.253	0.115	-0.115	-0.361	-0.001	0.001
1991	0.006	-0.222	0.099	-0.099	-0.316	0.000	0.000
1992	0.002	-0.012	0.049	-0.049	-0.059	0.001	-0.001
Average	**0.058**	**-0.085**	**0.047**	**-0.047**	**0.359**	**0.121**	**0.034**

Figure 9- 8: Effect on private consumption of a 10% increase in government expenditure financed by money in 1975

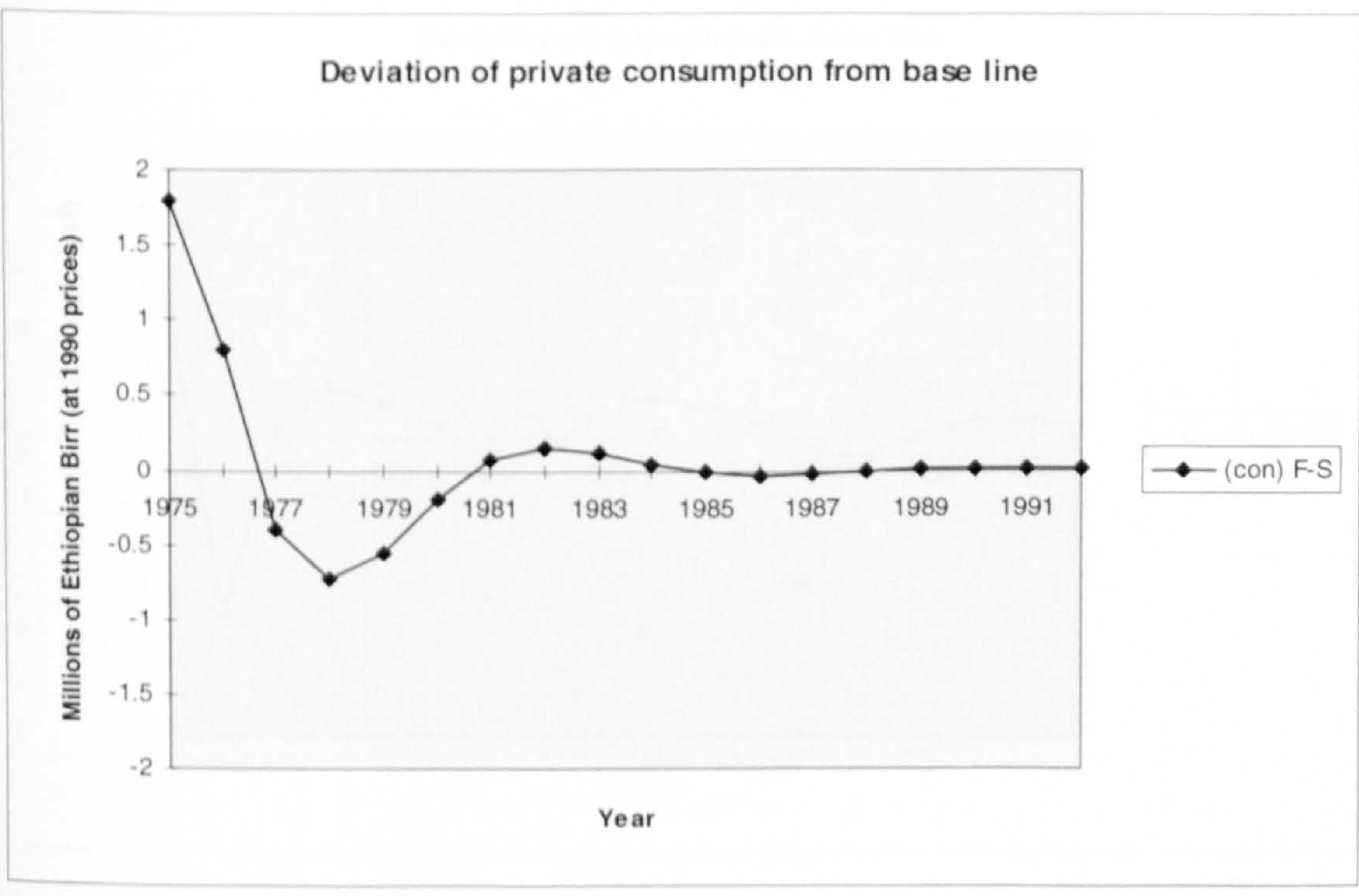


Figure 9- 9: Effect on private investment of a 10% increase in government expenditure financed by money in 1975

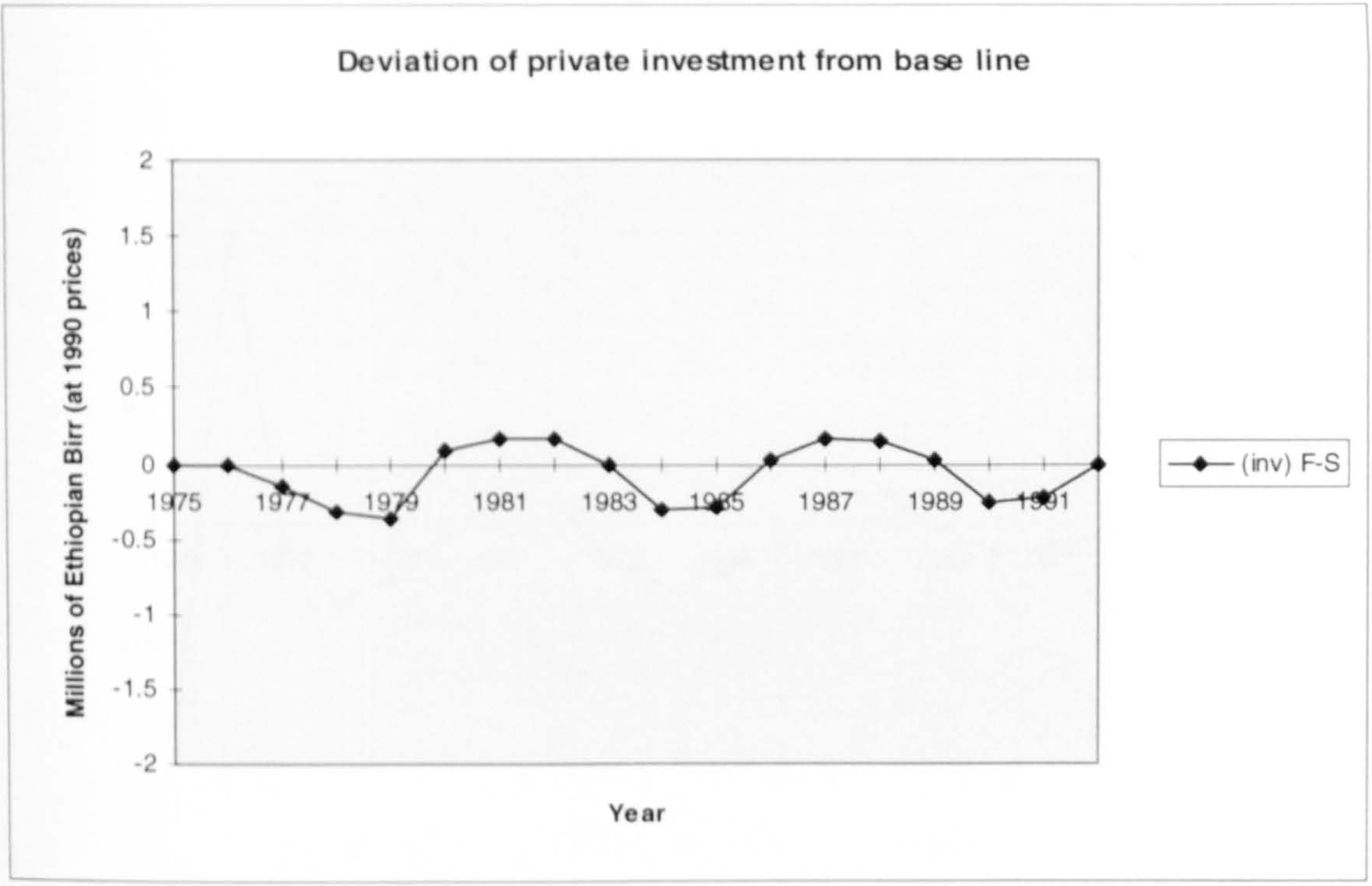


Figure 9- 10: Effect on imports of a 10% increase in government expenditure financed by money in 1975

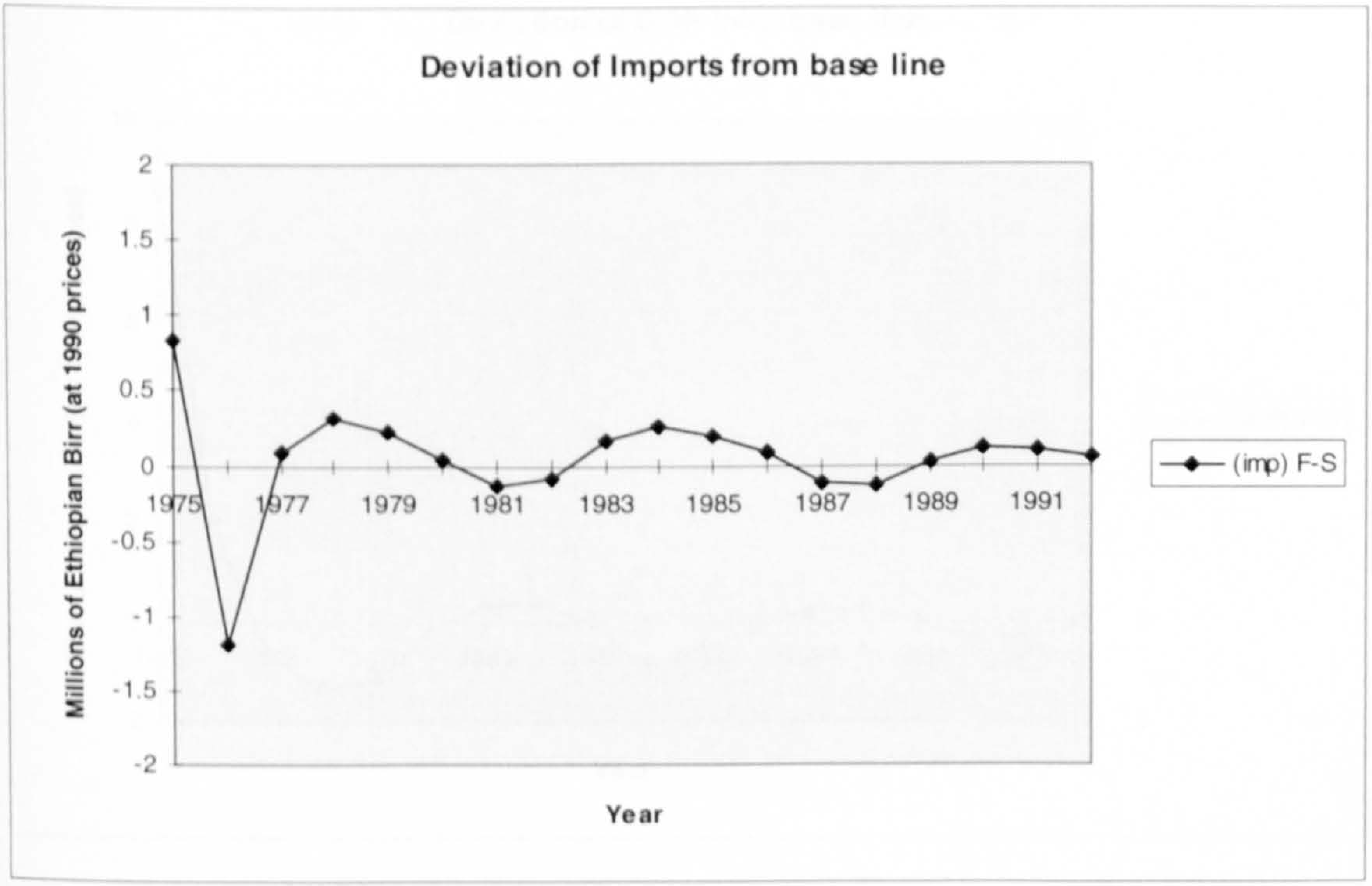


Figure 9- 11: Effect on external balance of a 10% increase in government expenditure financed by money in 1975

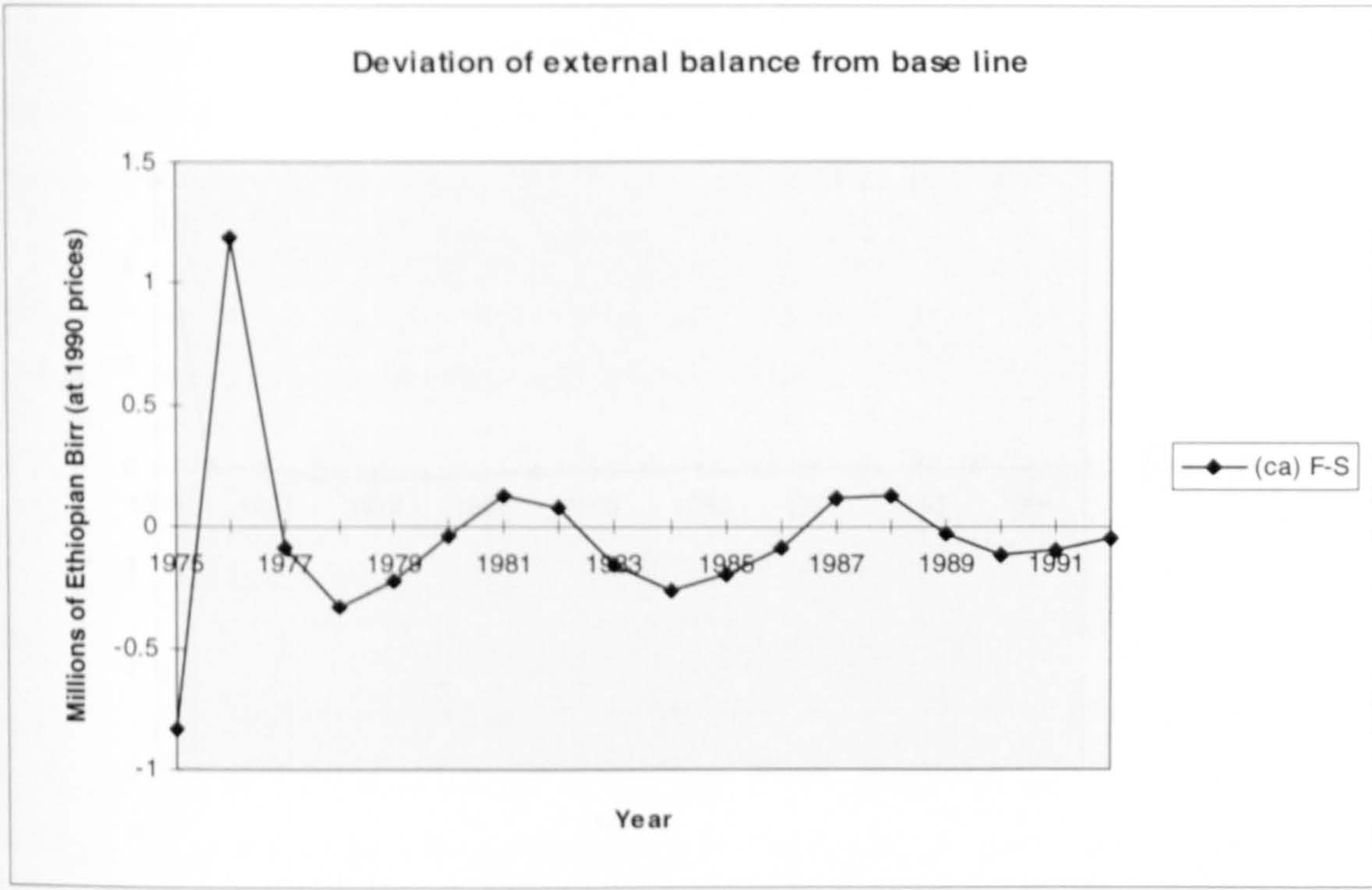


Figure 9- 12: Effect on GDP of a 10% increase in government expenditure financed by money in 1975

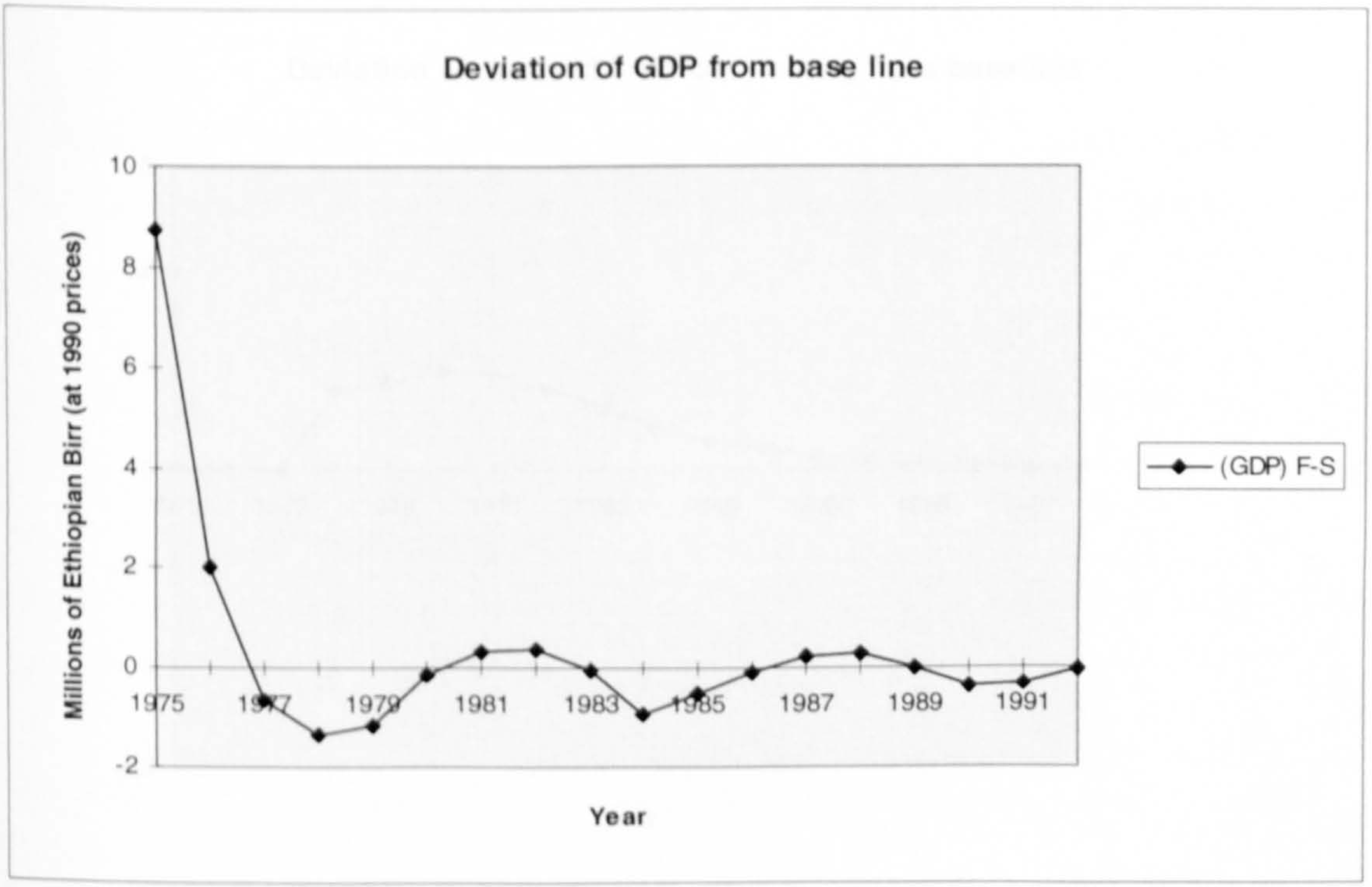


Figure 9- 13: Effect on prices of a 10% increase in government expenditure financed by money in 1975

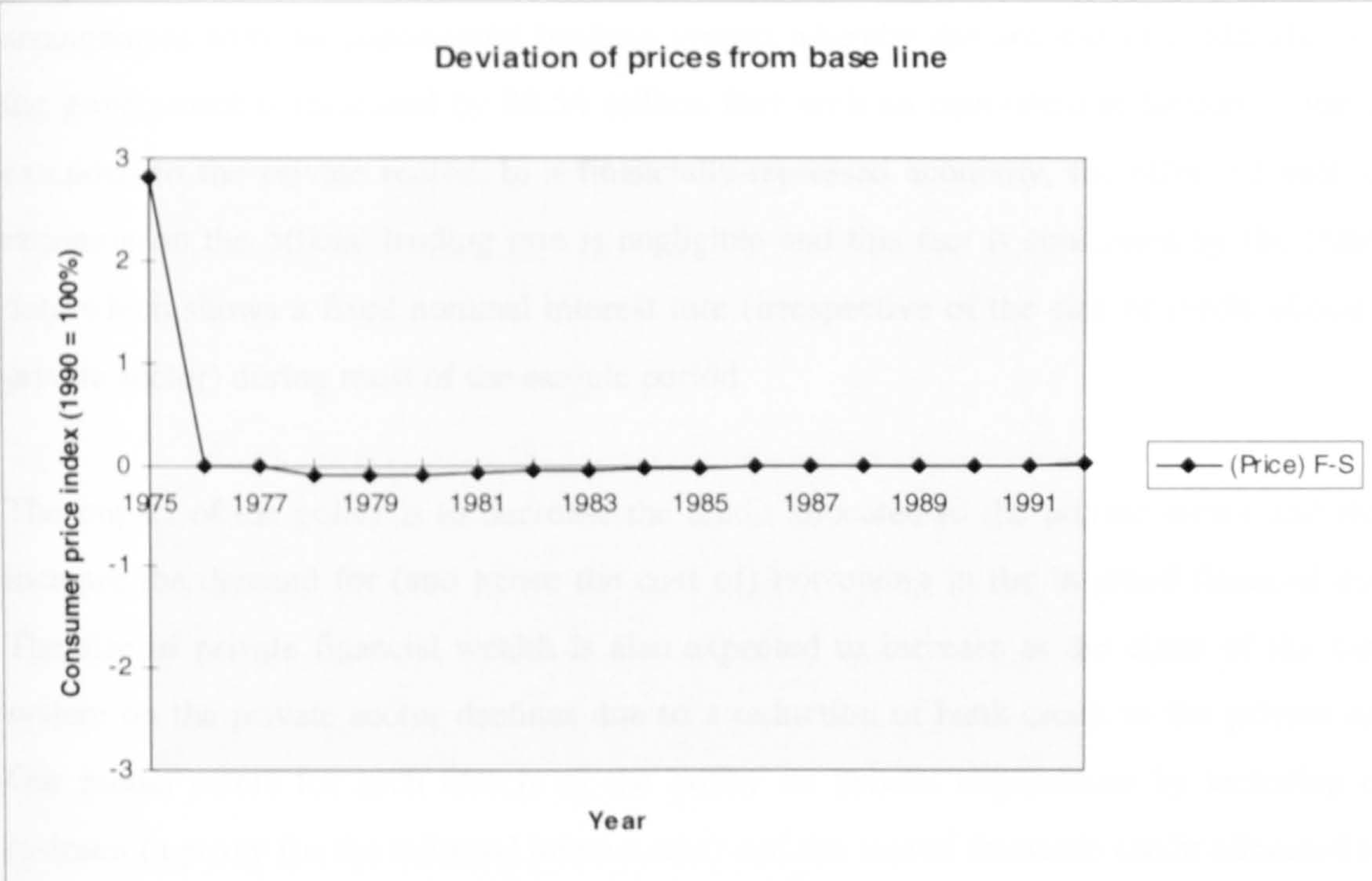
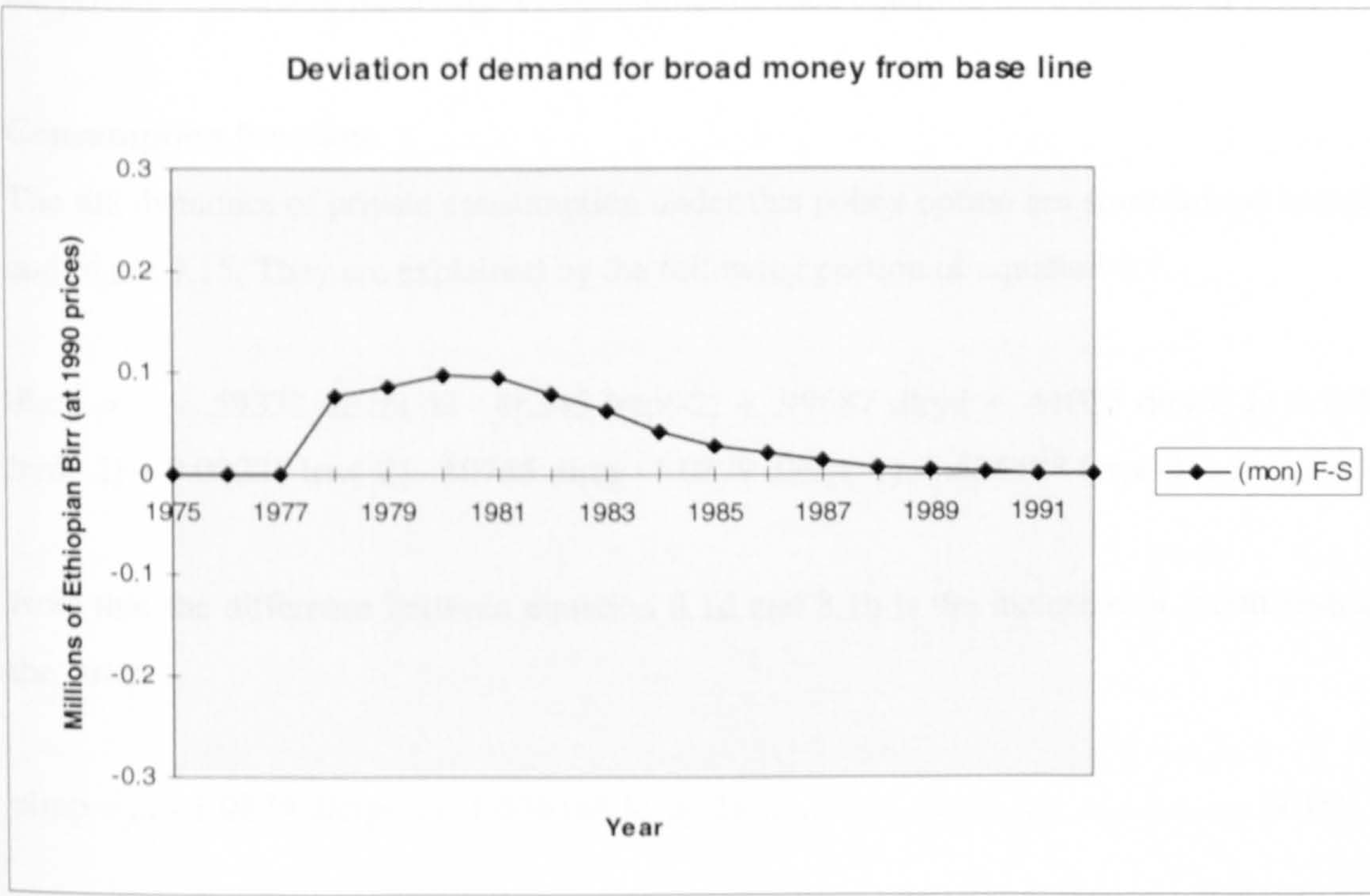


Figure 9- 14: Effect on money demand of a 10% increase in government expenditure financed by money in 1975



9.1.3 Policy three: Financing by restraining credit to private sector

This option assumes that the government (through its central bank) can impose an arrangement with the commercial banking system whereby the amount of credit allocated to the government is increased by 98.54 million Birr with an equivalent reduction in the credit extended to the private sector. In a financially-repressed economy, the effect of such credit rationing on the official lending rate is negligible and this fact is confirmed by the Ethiopian data which shows a fixed nominal interest rate (irrespective of the size of credit allocated to private sector) during most of the sample period.

The impact of the policy is to decrease the credit allocated to the private sector and thereby increase the demand for (and hence the cost of) borrowing in the informal financial market. The size of private financial wealth is also expected to increase as the claim of the banking system on the private sector declines due to a reduction of bank credit to the private sector. Our model caters for such effects of the policy on private expenditure by including credit restraint (a proxy for the informal interest rate) and the size of domestic credit allocated to the private sector in the functions for private consumption and private investment respectively. Furthermore, financial wealth is an explanatory variable in both the private consumption and the private investment functions. The dynamics of each equation are discussed as follows.

Consumption function

The full dynamics of private consumption under this policy option are summarized in table 9.3 and figure 9.15. They are explained by the following portion of equation 8.1.

dlrcp = ... - .59333 dlrcp(-1) -.48345 lrcp(-2) + .99687 dlryd + .44025 dlryd(-1) + 0.25499 lryd(-2) + 0.00231 lrw(-2) -.10755 dlrcg -1.0879 dlcrp(-1) -1.636188 lcrp(-2) 8.1h

Note that the difference between equation 8.1d and 8.1h is the inclusion of credit restraint in the latter

dlrcp = ... - 1.0879 dlcrp(-1) -1.636188 lcrp(-2) 9.16

With the exception of the effects of credit restraint, the dynamics of the consumption function under this policy option are similar to those under the money financing option. In the period of the shock, the change in private consumption is explained by equation 8.1e leading to an increase in private consumption by exactly the same amount as in money financing.

For the dynamics in the period after the shock (1976) the relevant portion of the consumption function becomes:

dlrcp = ... -.59333 dlrcp(-1) + .44025 dlryd(-1) - 1.0879 dlcrp(-1) 8.1i

As in the money financing option, private consumption declines one period after the shock. The negative effect of the third term (i.e., credit restraint) has, however, increased the magnitude of the change and thus, private investment declines below its pre-shock level.

In 1977 the dynamics of private consumption are explained by

dlrcp = ... - .59333 dlrcp(-1) -.48345 lrcp(-2) + .44025 dlryd(-1) + 0.25499 lryd(-2) + 0.00231 lrw(-2) -1.636188 lcrp(-2) 8.1j

The first to fifth terms of equation 8.1j have the same effects as in the money financing option. The sixth term has a negative effect, thereby leading to a further decline in private consumption. Since the shock which affected private wealth and credit restraint is assumed to be temporary, the last two terms of equation 8.1j cease to be effective after 1977. Thus, from 1978 onwards the dynamics of the function are explained by

dlrcp = ... - .59333 dlrcp(-1) -.48345 lrcp(-2) + .44025 dlryd(-1) + 0.25499 lryd(-2) + ...8.1k

Thus the overall pattern is a positive effect in 1975, negative effects for 1976-79 and other small oscillations thereafter.

Investment function

The dynamics of private investment under this policy option are explained by the following portion of equation 8.2.

dlrip = ... - 1.0121 dlrip(-1) -.75452 lrip(-2) + 0.8019642 lrim(-2) + 0.04082 lryd(-2) - 0.605374 lrw(-2) + .58585 dlrdcp + 1.0114 dlrdcp(-1) + 0.00749 lrdcp(-2) 8.2f

Note that the difference between equations 8.2b and 8.2f is the inclusion of domestic credit extended by the banking system to the private sector in the latter.

dlrip = ... + .58585 dlrdcp + 1.0114 dlrdcp(-1) + 0.00749 lrdcp(-2) 9.17

The effect of the policy on private investment is summarized in table 9.2 and figure 9.16. With the exception of the effects of the last three terms in equation 8.2f, the dynamics of the private investment function under credit restraint to the private sector are similar to those discussed under the money financing option. The difference in the pattern of fluctuation of private investment presented in figures 9.9 and 9.16 is, therefore, explained by the addition of these three terms in the latter.

In 1975 the decline in private investment is explained by the crowding-out effect of government expenditure on the amount of credit extended to private sector. The portion of equation 8.2f which explains this change is

dlrip = ... + .58585 dlrdcp 8.2g

One period after the shock (1976) private investment increases but still remains below its pre-shock level. This rise is explained by

dlrip = ... - 1.0121 dlrip(-1) + 1.0114 dlrdcp(-1) 8.2h

The first term has a positive impact because in the previous year we had an increase in private investment, while the second term has a negative impact because domestic credit declined in 1975. The net effect is an increase in private investment but still below its base-line.

In 1977 the dynamics of private investment are determined by

dlrip = ... - 1.0121 dlrip(-1) -.75452 lrip(-2) + 0.8019642 lrim(-2) + 0.04082 lryd(-2) - 0.605374 lrw(-2) + 0.00749 lrdcp(-2) 8.2i

Note that the last two terms become zero after 1977 because the change in domestic credit to private sector (dcp) is zero after 1975. From 1978 onwards, therefore, the dynamics of the model develop according to the following equation.

dlrip = ... - 1.0121 dlrip(-1) -.75452 lrip(-2) + 0.8019642 lrim(-2) + 0.04082 lryd(-2) 8.2i-a

Following changes in its own past values and the fluctuations in imports and income, private investment remains above its base-line in 1978-79. This is followed by negative effects in 1980-82, positive effects in 1983-86, and small oscillations thereafter. The deviation eventually dies down and converges to the base-line.

Import function

The relevant portion of equation 8.4 for this policy option is the same as in the money financing option

dlrim = ... - .20226 lrim(-2) + .43573 dlrcg -.52740 dlrcg(-1) + 0.03512 lrcg(-2) -.18076 dlrig(-1) + 0.06154 lrig(-2) + 0.08931 lrip(-2) - 0.23804 lrcp(-2) 8.4g

For 1975-76 the effect of the shock is the same for both the money financing and credit restraint options of financing (see figure 9.17). In 1977-78 however, the latter leads to a lower level of imports because private investment declines below its pre-shock level in 1975-76. Any difference in the magnitude of fluctuation of imports under the two options is therefore caused by the difference in the changes in private investment in 1975-76. Otherwise the discussion on the dynamics of the import function is the same as that presented in the money financing option.

External balance and income identities

The discussion for these identities is the same as in the previous policy options. The result is summarized in table 9.3 and figures 9.18-9.19. Any difference in the magnitude of the fluctuations is attributable to changes in their constituent behavioural functions under the different policy options.

Money demand

This policy option does not affect aggregate balances of broad money because we assumed a reallocation of the existing supply of credit in favour of the public sector without affecting its total. The dynamics of the demand for money function are therefore, similar to those discussed in equations 8.5a and 8.5b (see figure 9.21).

Price equation

Under this policy option the pattern of movement in prices is closer to the tax financing than the money financing option (see figure 9.20). The discussion on the pattern of price movements is basically the same as in equation 8.5c.

The results of all five equations under this policy option are consistent with the underlying economic theory. The magnitude of the effects of the shock in each equation is summarized in table 9.3.

Table 9- 3: Effect of 10% increase in government expenditure by credit restraint in 1975

Post-shock deviations from base-line (millions of Ethiopian Birr) F-S

	Consumption	Investment	Imports	External balance	GDP	Prices	Money demand
1975	1.801	-2.285	0.833	-0.833	6.451	0.034	0.000
1976	-1.562	-1.431	-1.193	1.193	-1.800	0.000	0.000
1977	-3.868	0.176	-0.153	0.153	-3.539	0.000	0.000
1978	-2.906	0.672	-0.260	0.260	-1.973	-0.100	0.077
1979	-1.183	0.898	0.038	-0.038	-0.323	-0.108	0.086
1980	0.244	-0.039	0.639	-0.639	-0.433	-0.100	0.098
1981	0.767	-0.204	1.106	-1.106	-0.543	-0.084	0.095
1982	0.612	-0.201	1.049	-1.049	-0.637	-0.070	0.078
1983	0.284	0.105	0.398	-0.398	-0.010	-0.056	0.061
1984	-0.029	1.816	-0.046	0.046	1.833	-0.044	0.041
1985	-0.137	0.738	-0.038	0.038	0.639	-0.035	0.026
1986	-0.154	0.079	0.303	-0.303	-0.377	-0.022	0.020
1987	-0.075	-0.250	0.780	-0.780	-1.105	-0.013	0.012
1988	0.002	-0.233	0.707	-0.707	-0.938	-0.007	0.007
1989	0.035	-0.006	0.222	-0.222	-0.193	-0.004	0.004
1990	0.033	0.642	-0.025	0.025	0.701	-0.001	0.001
1991	0.015	0.534	-0.052	0.052	0.601	0.000	0.000
1992	0.001	0.038	0.055	-0.055	-0.016	0.001	-0.001
Average	**-0.340**	**0.058**	**0.242**	**-0.242**	**-0.092**	**-0.034**	**0.034**

Figure 9- 15: Effect on private consumption of a 10% increase in government expenditure financed by restraining credit extended to the private sector in 1975

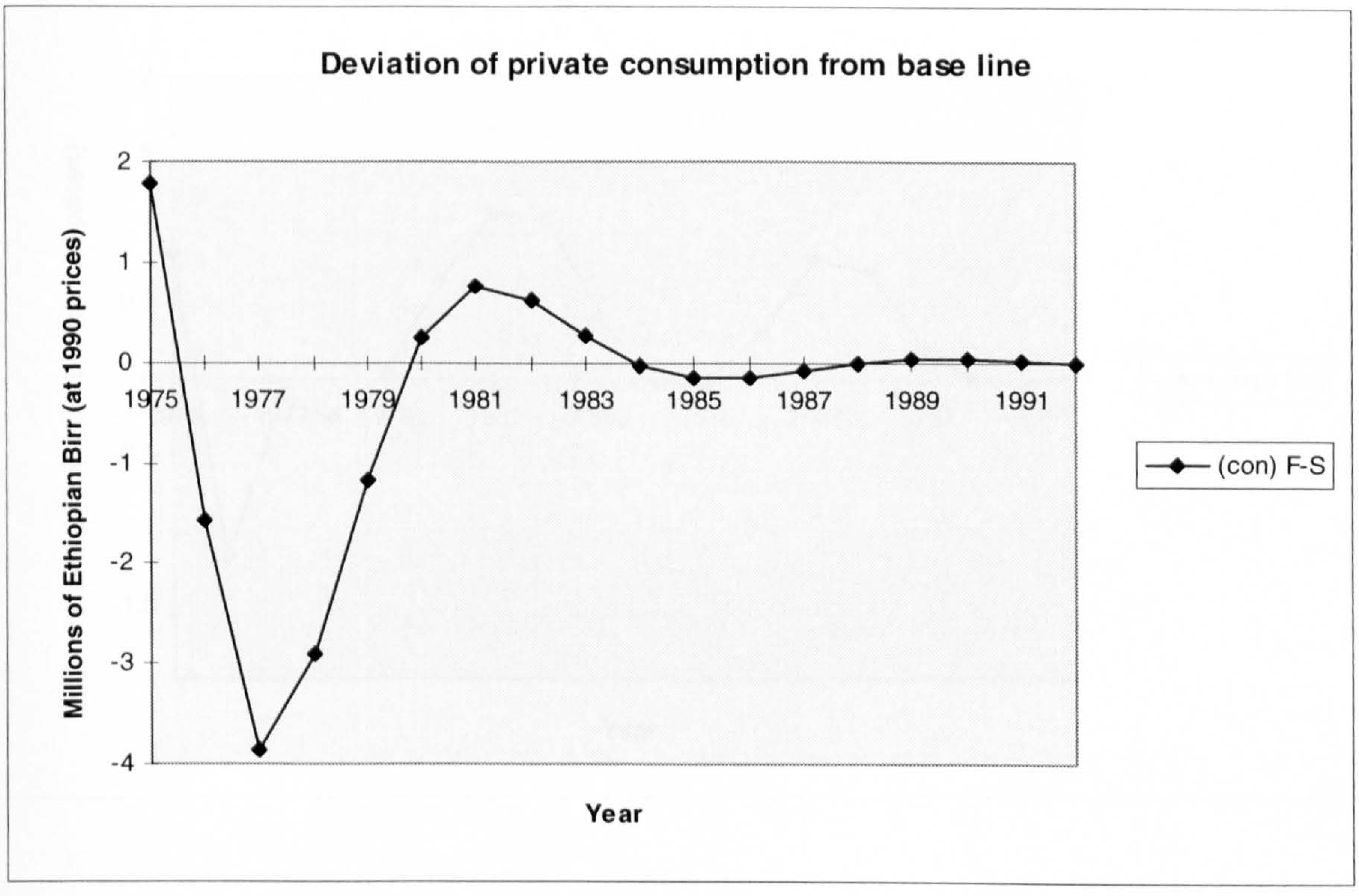


Figure 9- 16: Effect on private investment of a 10% increase in government expenditure financed by restraining credit extended to the private sector in 1975

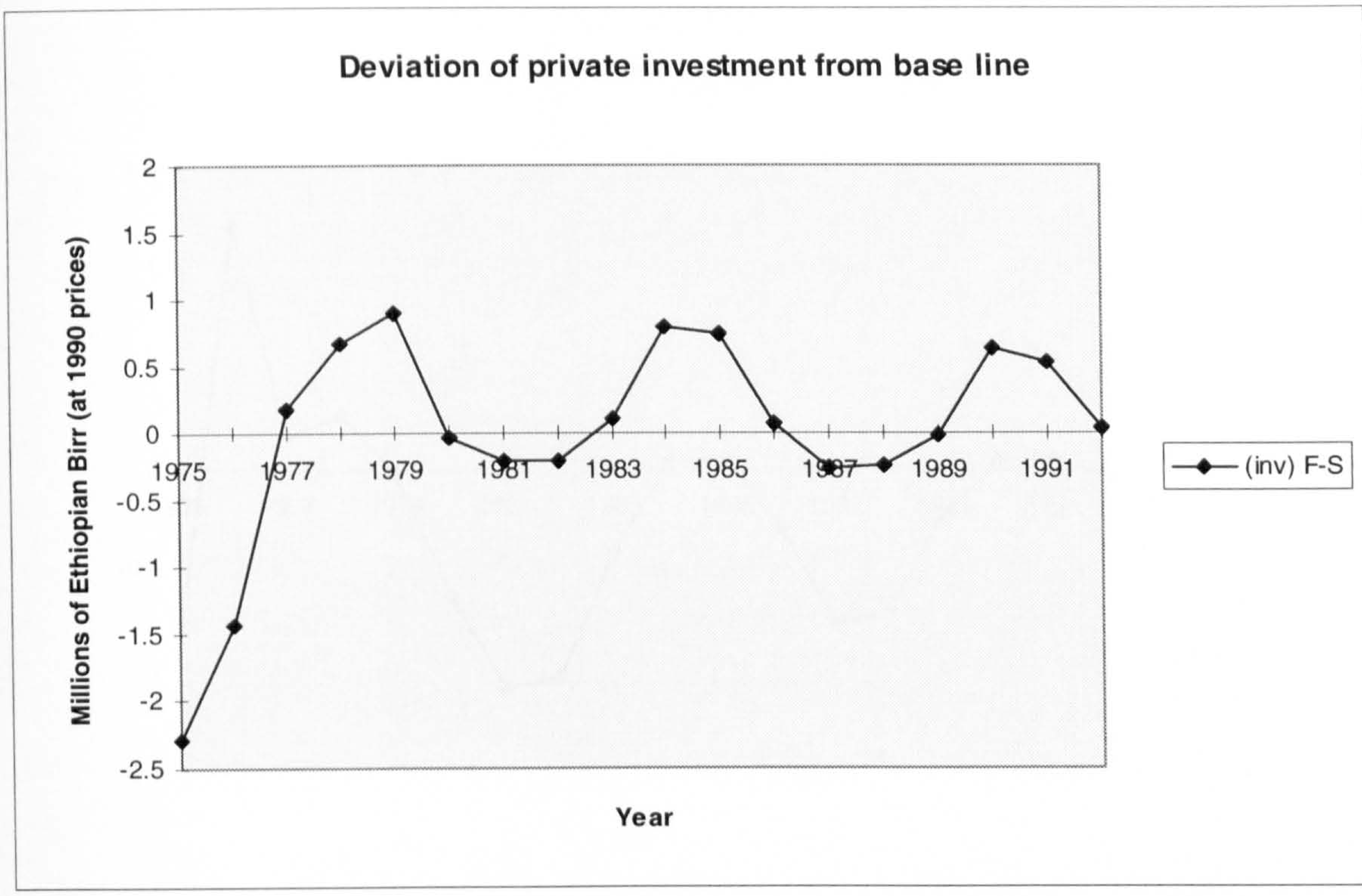


Figure 9- 17: Effect on imports of a 10% increase in government expenditure financed by restraining credit extended to the private sector in 1975

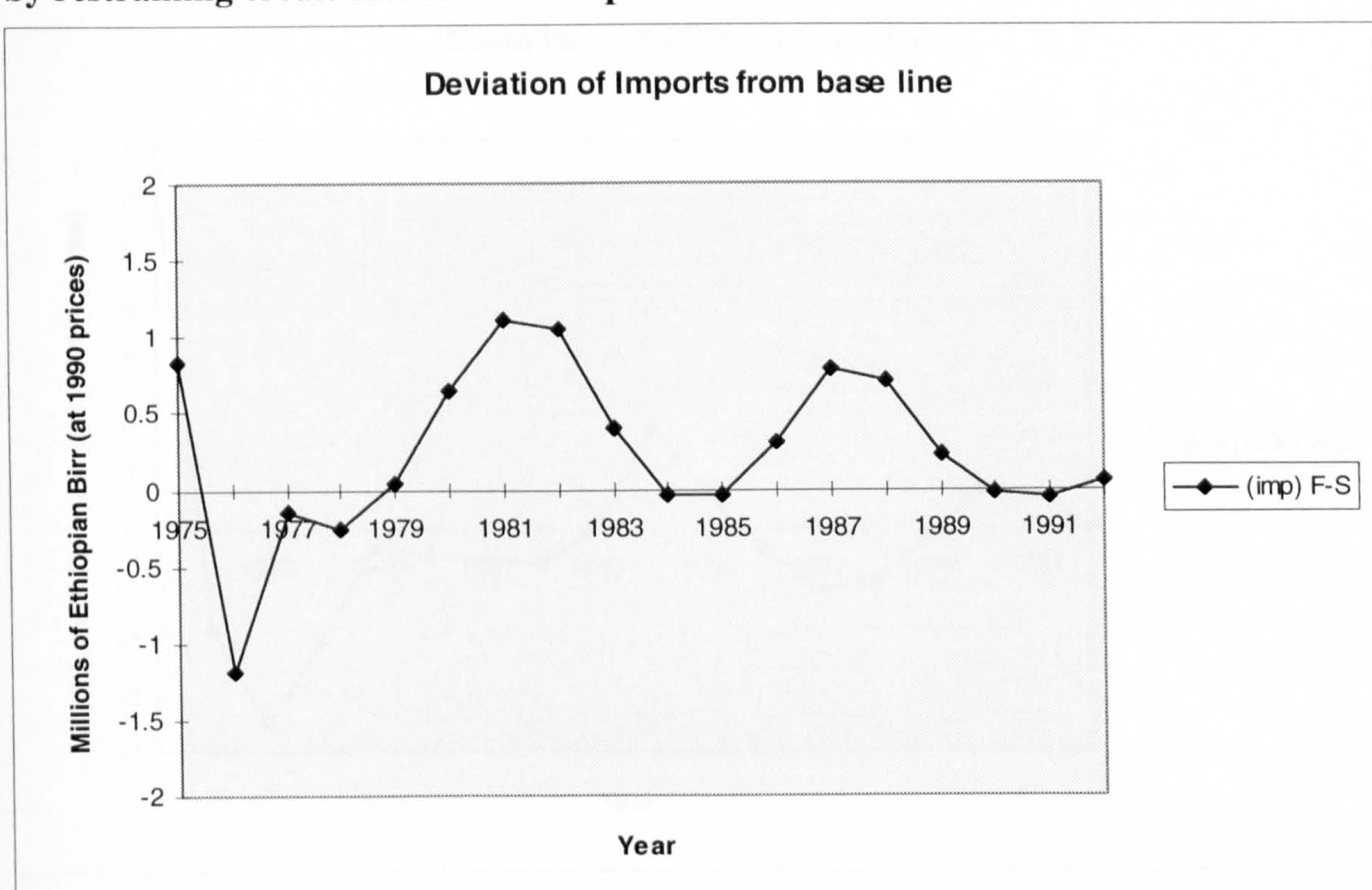


Figure 9- 18: Effect on external balance of a 10% increase in government expenditure financed by restraining credit extended to the private sector in 1975

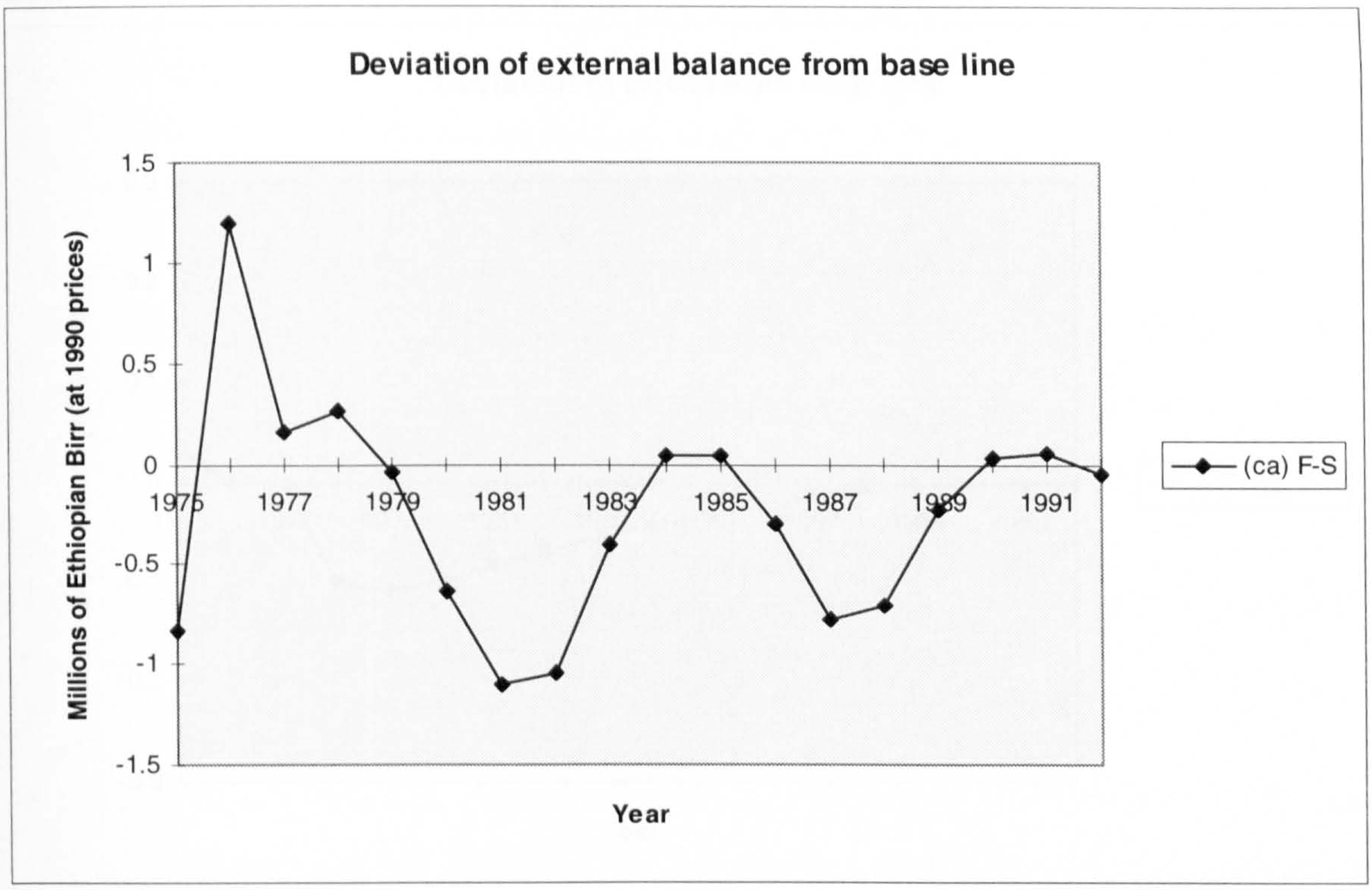


Figure 9- 19: Effect on GDP of a 10% increase in government expenditure financed by restraining credit extended to the private sector in 1975

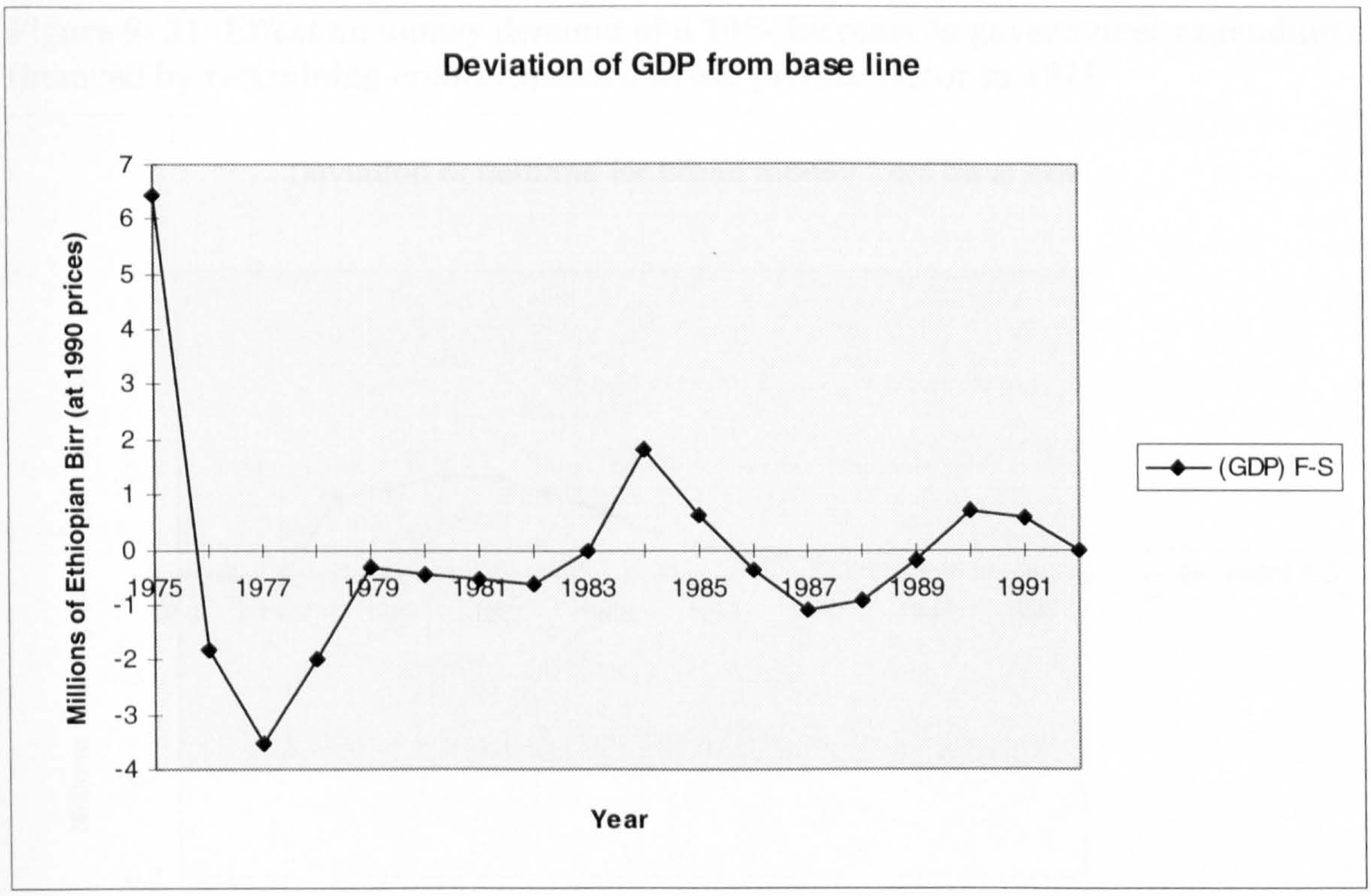


Figure 9- 20: Effect on prices of a 10% increase in government expenditure financed by restraining credit extended to the private sector in 1975

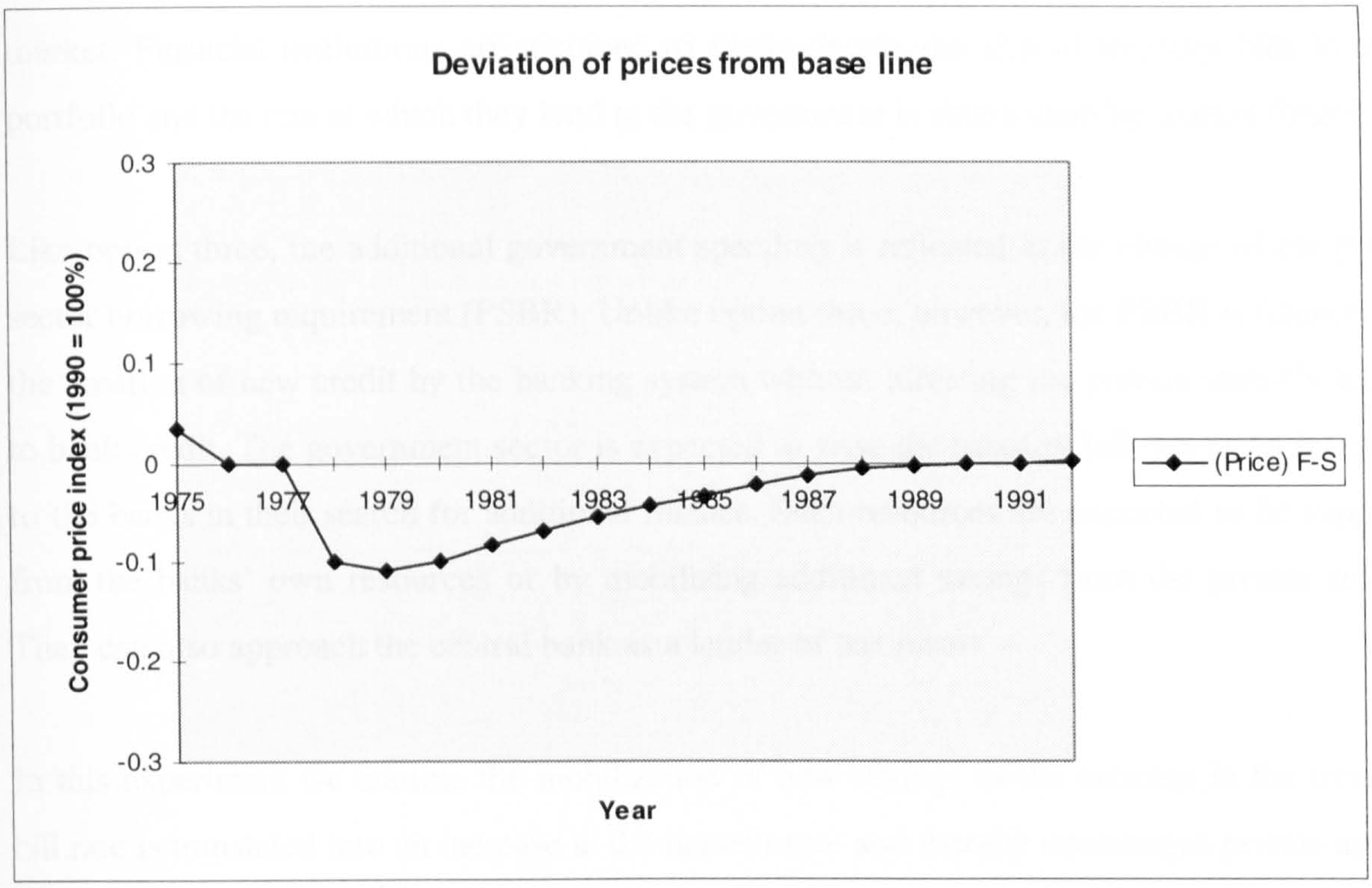
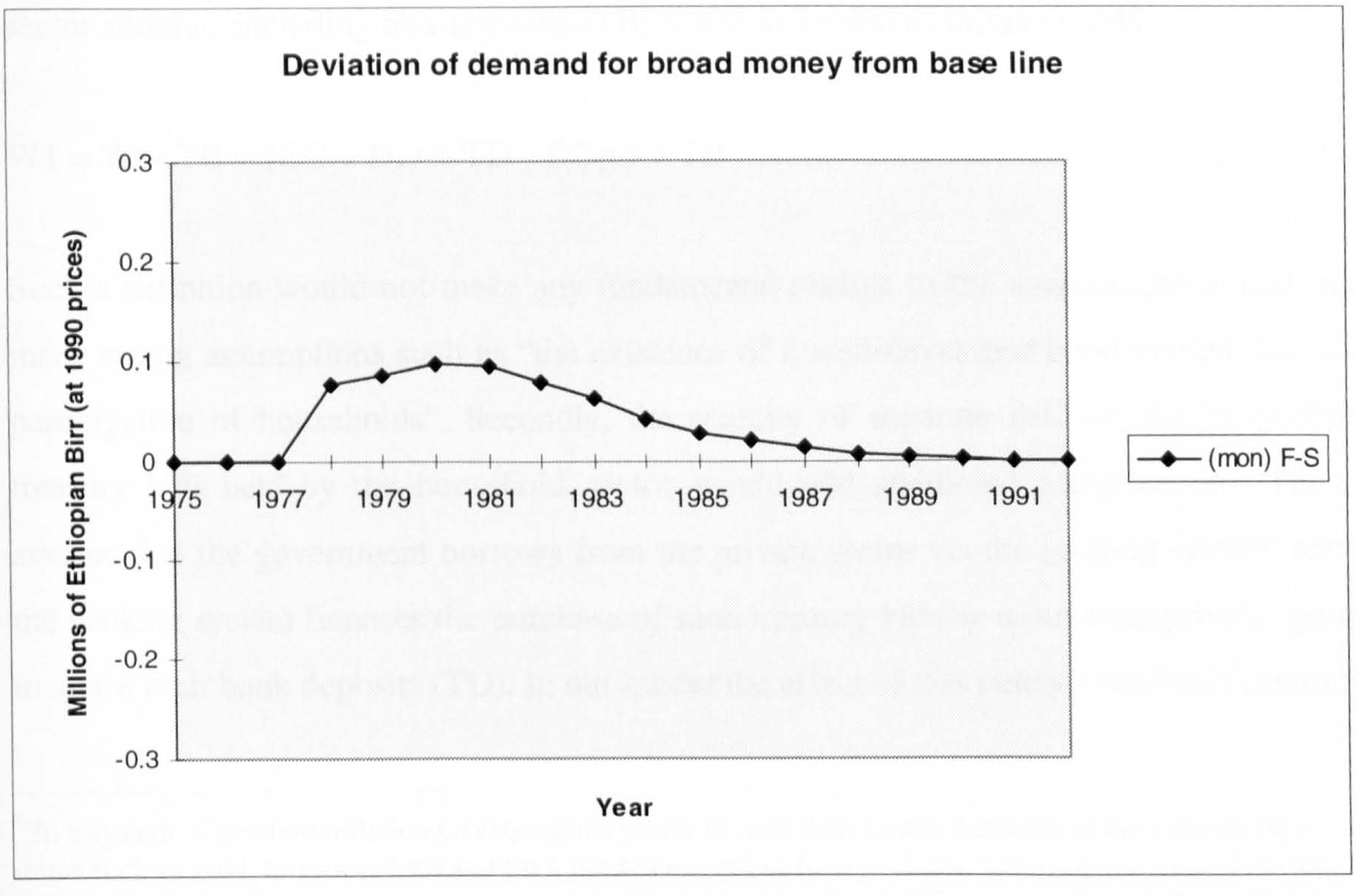


Figure 9- 21: Effect on money demand of a 10% increase in government expenditure financed by restraining credit extended to the private sector in 1975



9.1.4 Policy four: Bond financing at market rate of interest

This policy is equivalent to using fiscal policy (deficit financing) in a deregulated financial market. Financial institutions are assumed to freely decide the size of treasury bills in their portfolio and the rate at which they lend to the government is determined by market forces.

Like option three, the additional government spending is reflected in the change of the public sector borrowing requirement (PSBR). Unlike option three, however, the PSBR is financed by the creation of new credit by the banking system without affecting the private sector's access to bank credit. The government sector is expected to raise the treasury bill rate as an incentive to the banks in their search for additional finance. Such resources are expected to be supplied from the banks' own resources or by mobilizing additional savings from the private sector. They can also approach the central bank as a lender of last resort.

In this experiment we assume the mobilization of new savings as the increase in the treasury bill rate is translated into an increase in the deposit rate and thereby encourages private agents to swap their idle balances (inflation hedges) for bank deposits.[9] This will increase the financial wealth of the private sector as defined in equation 9.12. An alternative approach would be to assume the possibility of the government borrowing directly from the private sector and thus including treasury bills (TB) in the definition of private wealth.

$$W1 = W + TB = (CC + DD + TD - DCp) + TB \qquad 9.18$$

Such a definition would not make any fundamental change to the analysis and would lead to many strong assumptions such as "the existence of a well-developed bond market that allows participation of households". Secondly, the scarcity of separate data on the proportion of treasury bills held by the household sector would add additional complications. Thus, we assume that the government borrows from the private sector via the banking system; and that the banking system finances the purchase of such treasury bills by motivating private agents to increase their bank deposits (TD). In our model the effect of this policy exercise is captured by

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[9] In a system of positive inflation private agents prefer to hold their excess balances in the form of physical items such as gold, furniture, land and (to a limited extent) in foreign assets. Thus, cash is excluded from our notion of idle balances because we assume private agents limit their holdings of cash to the bare minimum required for their daily transactions of goods and services.

the rise in private wealth and the treasury bill rate[10]. The level of total domestic credit and thereby the supply of broad money is also increased in accordance with the identity for m2 in equation 9.13 and the consolidated balance sheet of the banking system presented below.

Consolidated balance sheet of the banking system

Assets	Liabilities
Foreign assets	Currency in circulation
Domestic credit	Demand deposits
	Time deposits
	Other items (net)

The change in private wealth will affect the private consumption and investment functions while the additional money supply and public borrowing are captured in the function for the demand for broad money.

Under this policy option the magnitude and pattern of the effects of the shock on private consumption, private investment, exports, imports, external balance and real income are the same as those discussed under money the financing option (see table 9-4 and figures 9.22-9.26). This is because money financing increases currency in circulation, while public borrowing (via the banking system) increases private deposits held in the banking system and, thus, both methods of financing have the same effect in our definition of private financial wealth. There is, however, a marked difference on the dynamics of money demand and thereby the price level, with money financing being more inflationary than bond financing.

Money demand function

The relevant portion of equation 8.5 for this policy option is

$$dlm2 = \ldots - .17188\ lm2(-3) + 0.20433\ lry(-3) + 2.51204\ ltbr(-3) \ldots\ldots\ldots 8.5d$$

[10]Note that the treasury bill rate is proxied by the ratio of PSBR to GDP due to the lack of a market-determined treasury bill rate for Ethiopia during the sample period.

Consequently, the demand for broad money starts to respond to the shock after three years in 1978 (see figure 9.28) The effect of the first and second terms is as discussed in equations 8.5a and 8.5c under the tax financing policy option. The first term remains ineffective until 1981, while the second term increases the demand for broad money in 1978 because the increase in public expenditure is by definition an increase in aggregate demand for output in 1975. This is reinforced by the demand for savings induced by an increase in the rate of return on treasury bills. The initial impact of bond financing is therefore to increase the demand for real broad money above that under money financing. The dynamics of the function follow a similar pattern to that of money financing although the magnitude of the deviation from the base line is larger under bond financing (compare figures 9.21 and 9.28).

Price equation

The dynamics of prices are presented in figure 9.27 and are determined by equation 8.5. The overall impact of the shock on price level is smaller than that under money financing mainly because the demand for broad money is larger and the composition of broad money is shifted in favour of savings under bond financing.

The results of all five equations under this policy option are consistent with the underlying economic theory. The magnitude of the effects of the shock in each equation is summarized in table 9.4.

Table 9- 4: Effect of 10% increase in government expenditure financed by borrowing from the domestic banking system at a market-determined interest rate in 1975

Post-shock deviations from base-line (millions of Ethiopian Birr) F-S

	Consumption	Investment	Imports	External balance	GDP	Prices	Money demand
1975	1.801	0.000	0.833	-0.833	8.736	2.822	0.000
1976	0.809	0.000	-1.193	1.193	2.002	0.000	0.000
1977	-0.394	-0.146	0.083	-0.083	-0.623	0.000	0.000
1978	-0.720	-0.321	0.326	-0.326	-1.367	-2.292	1.827
1979	-0.547	-0.368	0.222	-0.222	-1.137	-2.477	2.055
1980	-0.200	0.082	0.037	-0.037	-0.155	-2.291	2.342
1981	0.063	0.166	-0.128	0.128	0.357	-1.934	2.247
1982	0.142	0.170	-0.078	0.078	0.390	-1.618	1.855
1983	0.121	-0.009	0.156	-0.156	-0.043	-1.292	1.430
1984	0.045	-0.694	0.261	-0.261	-0.911	-1.024	0.966
1985	-0.009	-0.290	0.197	-0.197	-0.495	-0.817	0.621
1986	-0.034	0.018	0.082	-0.082	-0.098	-0.507	0.465
1987	-0.030	0.167	-0.121	0.121	0.259	-0.307	0.291
1988	-0.012	0.155	-0.125	0.125	0.268	-0.176	0.167
1989	0.002	0.029	0.025	-0.025	0.006	-0.087	0.086
1990	0.007	-0.253	0.115	-0.115	-0.361	-0.032	0.032
1991	0.006	-0.222	0.099	-0.099	-0.316	0.003	-0.002
1992	0.002	-0.012	0.049	-0.049	-0.059	0.028	-0.016
Average	**0.058**	**-0.085**	**0.047**	**-0.047**	**0.359**	**-0.667**	**0.798**

Figure 9- 22: Effect on private consumption of 10% increase in government expenditure financed by borrowing at market rate of interest in 1975

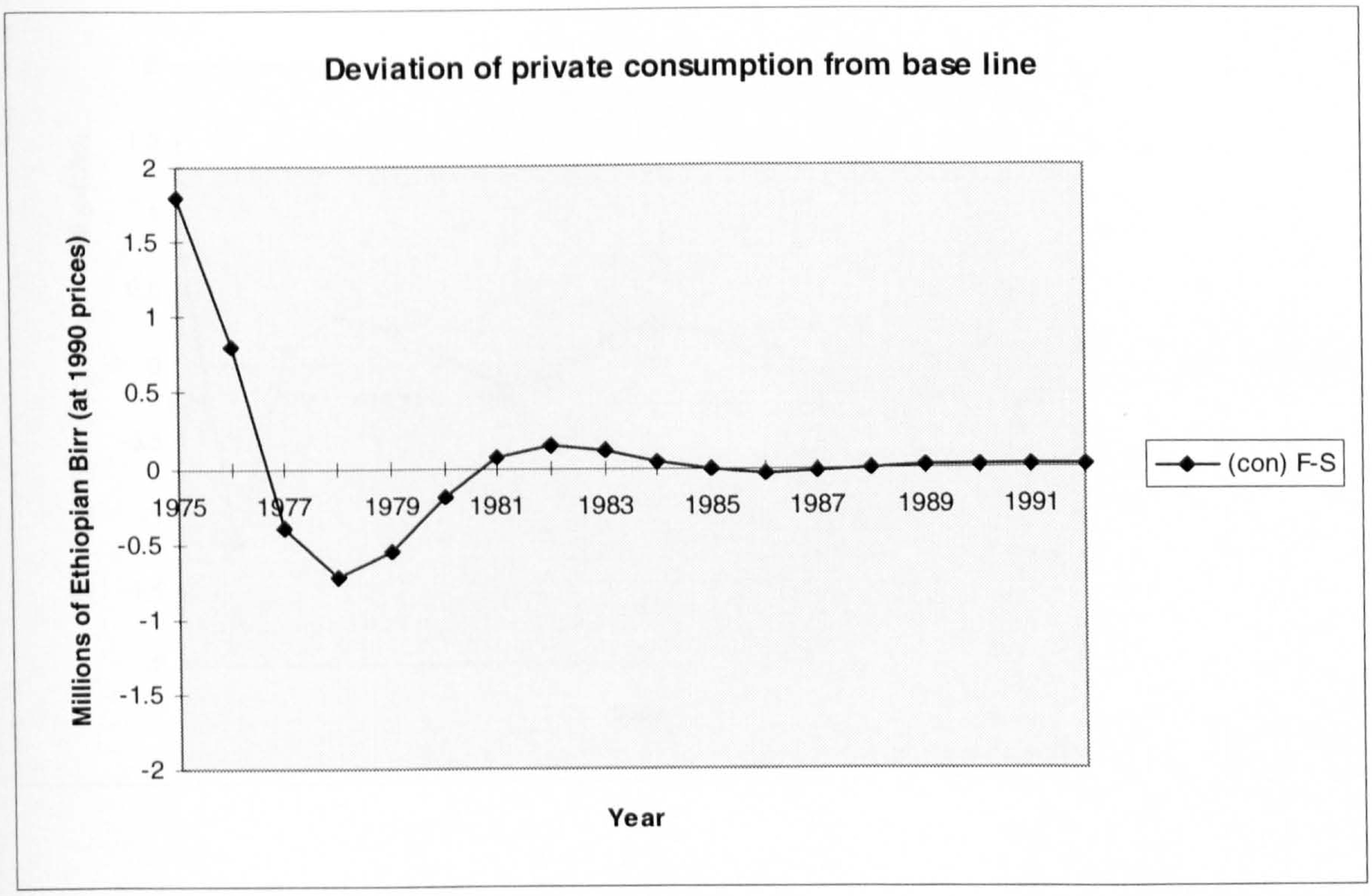


Figure 9- 23: Effect on private investment of 10% increase in government expenditure financed by borrowing at market rate of interest in 1975

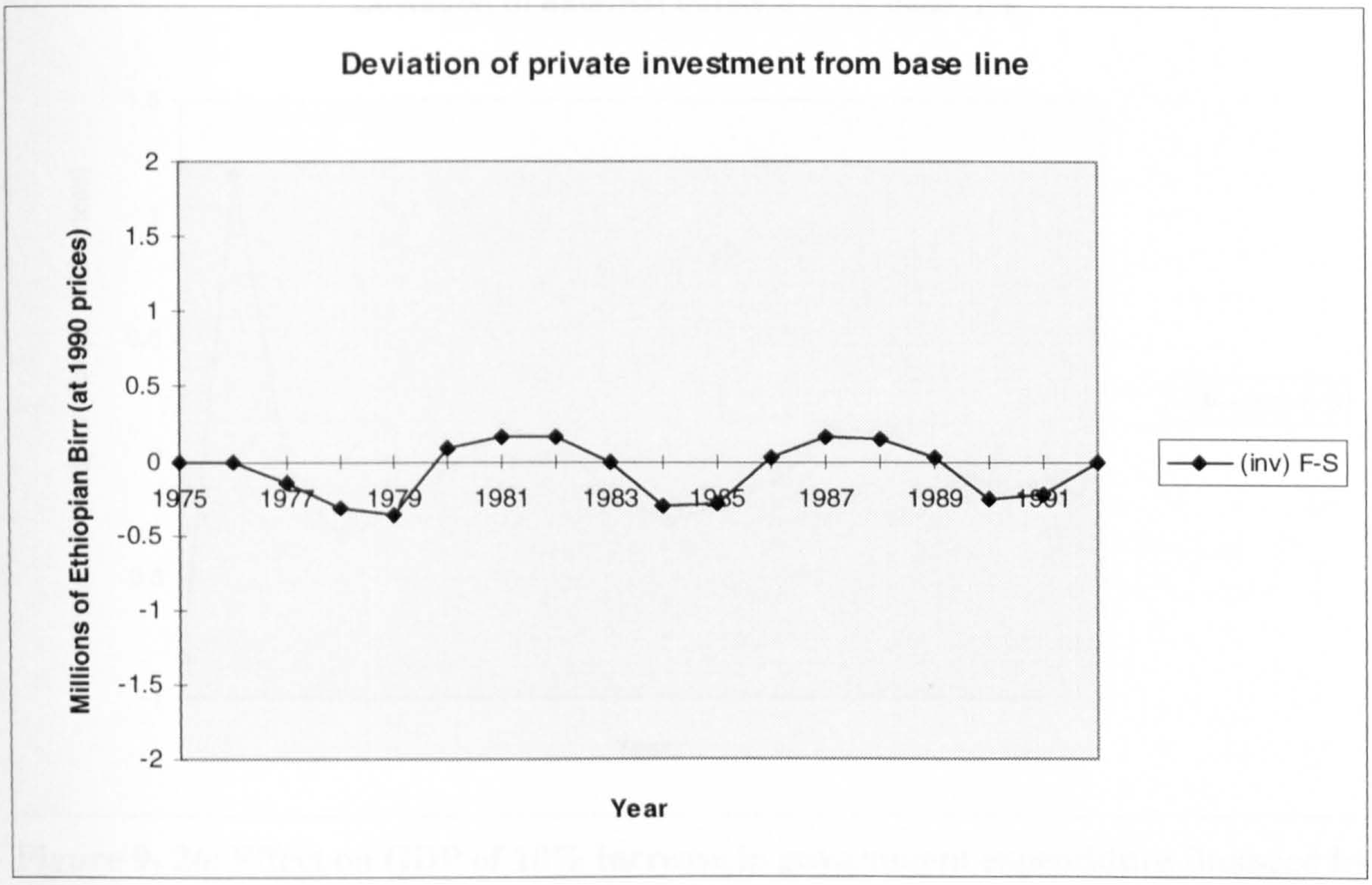


Figure 9- 24: Effect on imports of 10% increase in government expenditure financed by borrowing at market rate of interest in 1975

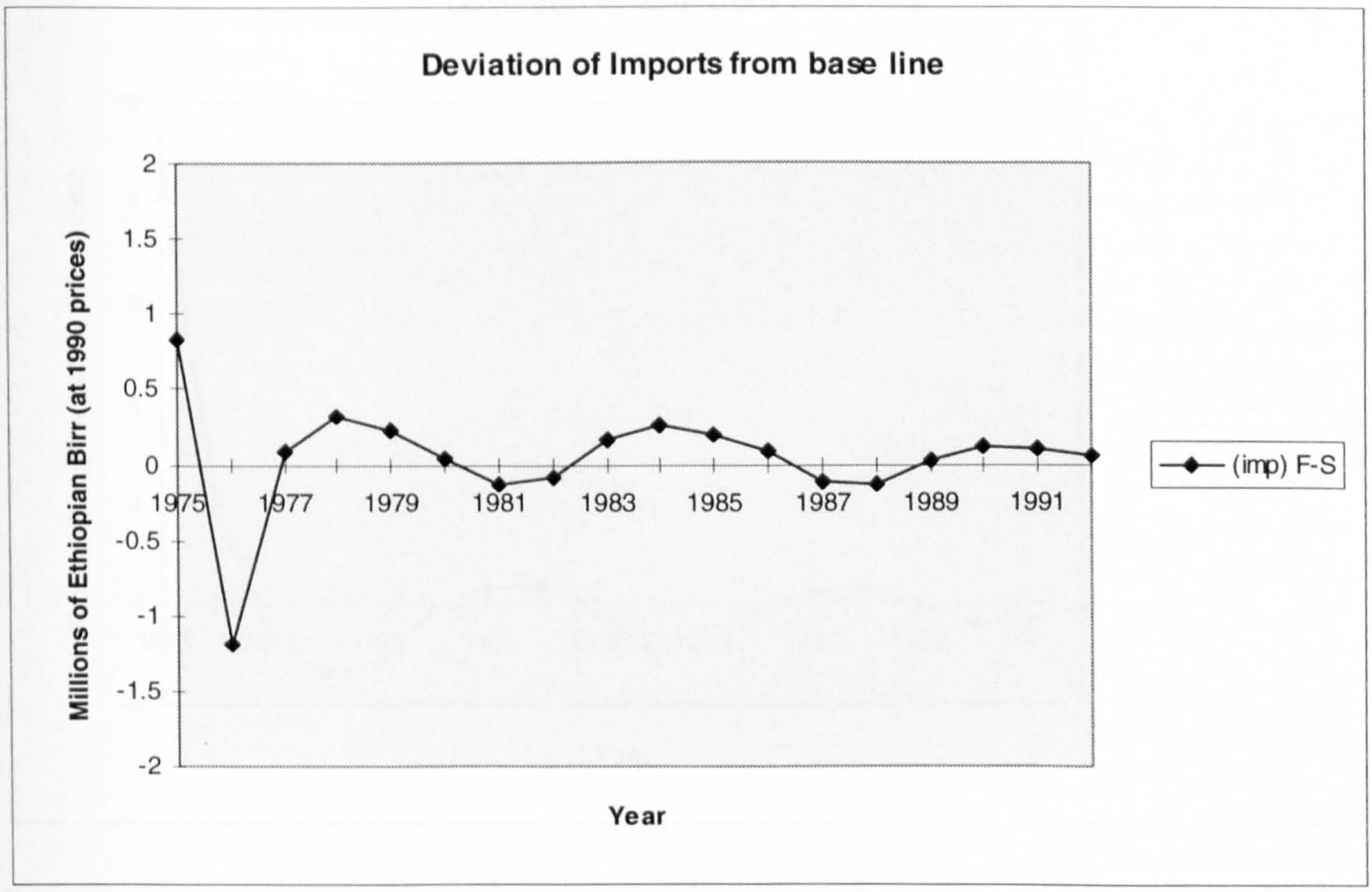


Figure 9- 25: Effect on external balance of 10% increase in government expenditure financed by borrowing at market rate of interest in 1975

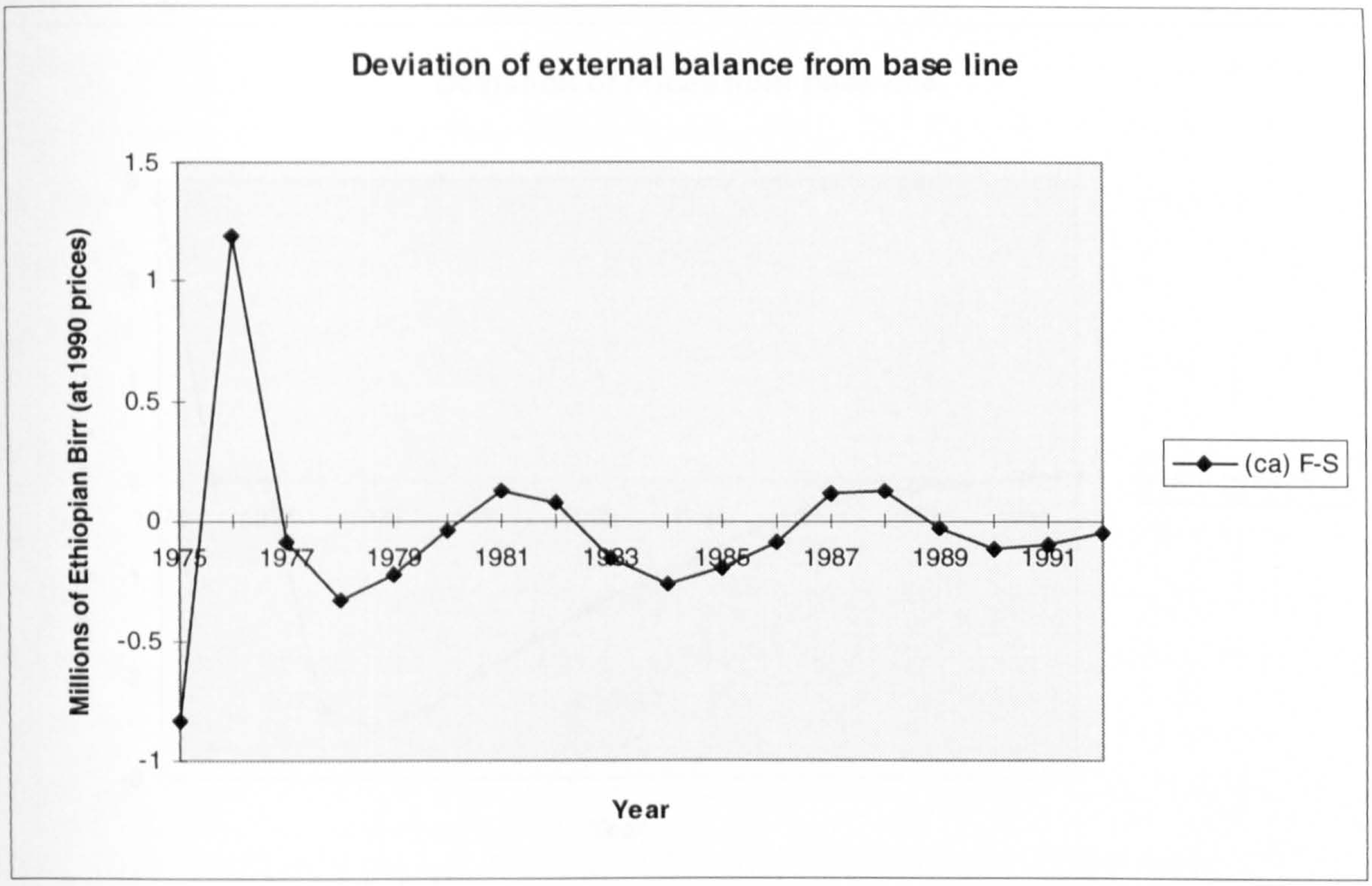


Figure 9- 26: Effect on GDP of 10% increase in government expenditure financed by borrowing at market rate of interest in 1975

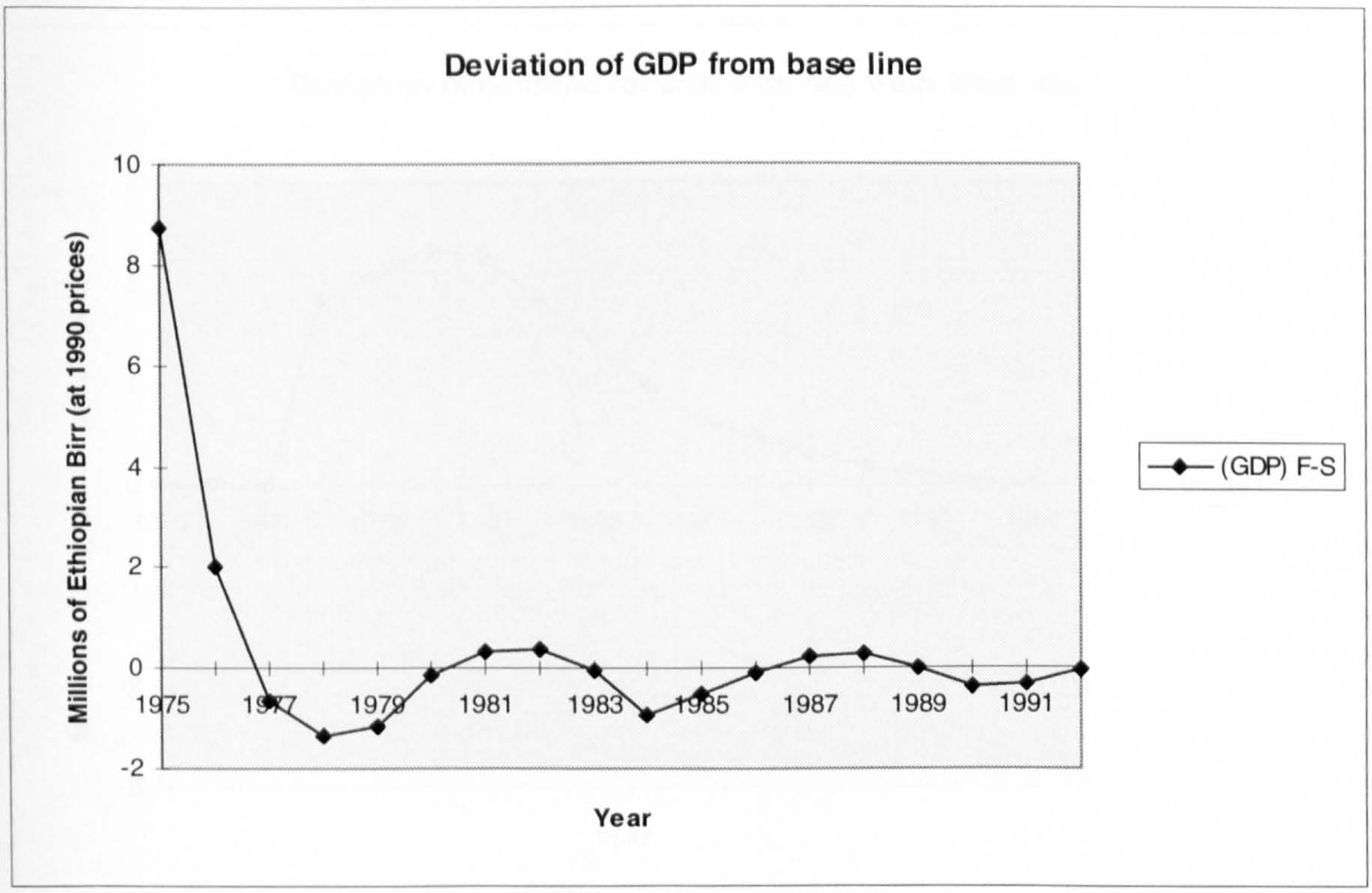


Figure 9- 27: **Effect on prices of 10% increase in government expenditure financed by borrowing at market rate of interest in 1975**

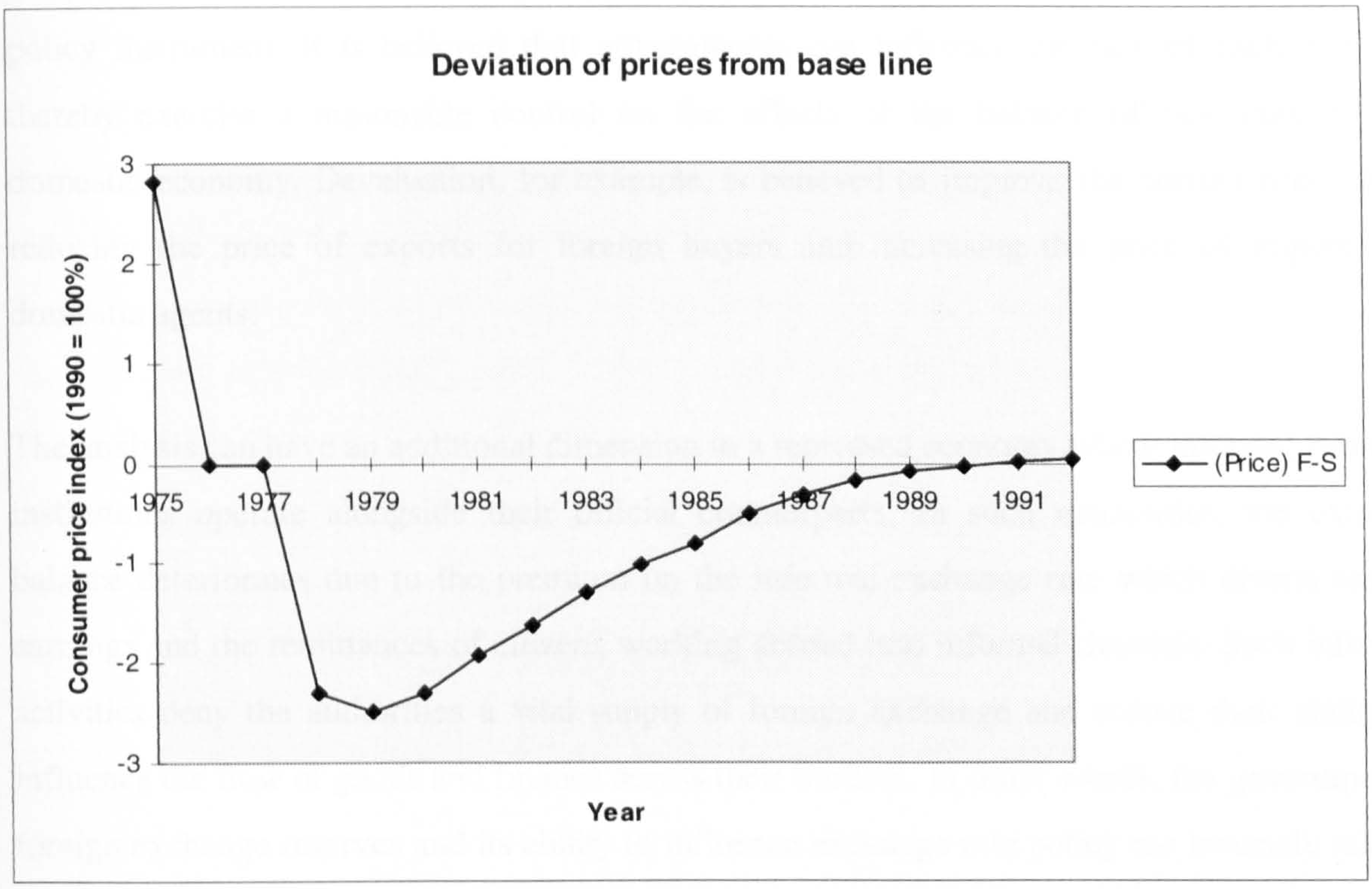
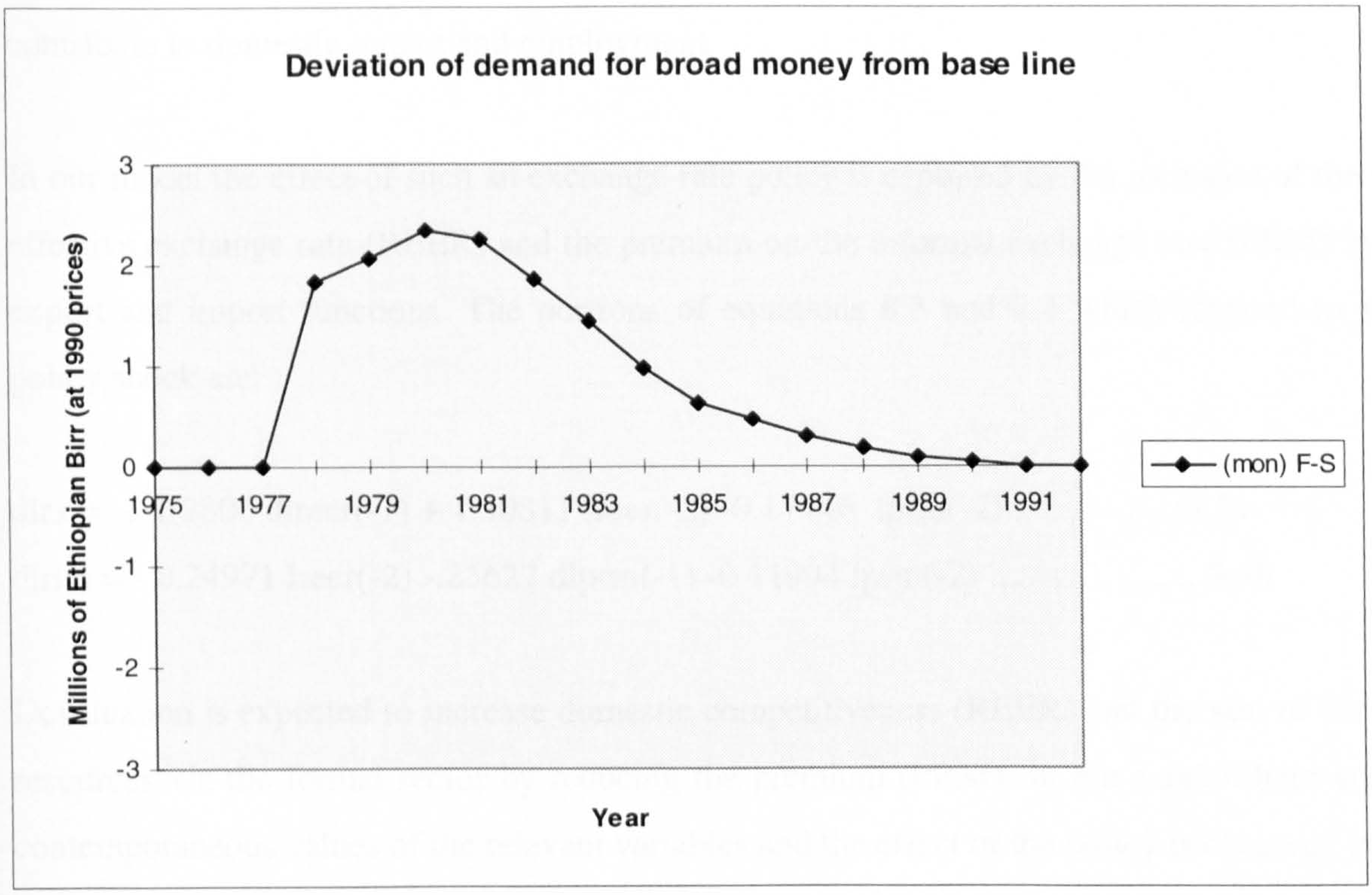


Figure 9- 28: **Effect on money demand of 10% increase in government expenditure financed by borrowing at market rate of interest in 1975**



9.2 Exchange rate policy

One of the objections to monetary union revolves around the loss of the exchange rate as a policy instrument. It is believed that governments can influence the rate of exchange and thereby exercise a reasonable control on the effects of the balance of payments on the domestic economy. Devaluation, for example, is believed to improve the current account by reducing the price of exports for foreign buyers and increasing the price of imports for domestic agents.

The analysis can have an additional dimension in a repressed economy where informal financial institutions operate alongside their official counterparts. In such economies, the external balance deteriorates due to the premium on the informal exchange rate which diverts export earnings and the remittances of citizens working abroad into informal channels. Such informal activities deny the authorities a vital supply of foreign exchange and reduce their ability to influence the flow of goods and finance across their borders. In other words, the government's foreign exchange reserves and its ability to influence exchange rate policy are inversely related to the size of the informal foreign exchange market. By reducing the premium on the informal exchange rate, a devaluation is expected to improve the balance of payments and thereby contribute to domestic output and employment.

In our model the effect of such an exchange rate policy is captured by the inclusion of the real effective exchange rate (REER) and the premium on the informal exchange rate (PRM) in the export and import functions. The portions of equations 8.3 and 8.4 which respond to such policy shock are:

dlrx = + 1.2806 dlreer(-1) + 1.50811 lreer(-2) -0.17146 lprm(-2) 8.3a
dlrim = - 0.24971 lreer(-2) -.25627 dlprm(-1) -0.11994 lprm(-2) 8.4h

Devaluation is expected to increase domestic competitiveness (REER) and the size of flow of resources via the formal sector by reducing the premium (PRM). In our model there are no contemporaneous values of the relevant variables and the effect of the policy is observed in the next period following the shock.[11] In that period exports and imports are expected to increase respectively due to the increase in REER and decline in PRM as the official exchange rate is devalued. In subsequent periods the simultaneous effect of both REER and PRM start to influence imports and exports. Private consumption is almost unaffected throughout the post-shock period while private investment responds to the fluctuations in imports. For the full post-shock period the model suggests that devaluation improves the external balance and thereby increases the level of output. The effect on the price level however, is negligible. Consequently table 9.5 and graphs 9.29-9.33 show only the target variables which show a significant change in the post-devaluation period.

Table 9- 5 Effect of 10% devaluation of the official exchange rate in 1975

Post-shock deviations from base-line (millions of Ethiopian Birr) (F-S)

	Investment	Exports	Imports	External balance	GDP
1975	0.000	0.000	0.000	0.000	0.000
1976	0.000	4.295	0.460	3.835	3.835
1977	0.000	3.959	-0.232	4.191	4.191
1978	0.066	0.723	-0.345	1.068	1.134
1979	0.060	-0.727	-0.270	-0.457	-0.397
1980	-0.054	-1.331	-0.213	-1.118	-1.172
1981	-0.071	-0.933	-0.145	-0.788	-0.859
1982	-0.079	1.240	-0.161	1.401	1.321
1983	-0.019	2.465	-0.217	2.683	2.664
1984	0.064	0.817	-0.215	1.032	1.194
1985	0.072	-0.252	-0.169	-0.083	-0.011
1986	-0.035	-0.886	-0.162	-0.723	-0.758
1987	-0.073	-0.856	-0.102	-0.753	-0.826
1988	-0.069	0.281	-0.074	0.355	0.287
1989	-0.025	1.218	-0.080	1.298	1.273
1990	0.058	0.653	-0.095	0.749	0.806
1991	0.063	-0.023	-0.074	0.051	0.114
1992	0.001	-0.361	-0.058	-0.303	-0.302
Average	**-0.002**	**0.571**	**-0.120**	**0.691**	**0.694**

[11]The theoretical argument for such lags on the responses to devaluation is the J-curve effect. According to such arguments devaluation does not necessarily lead to an instantaneous adjustment in the quantity of imports and exports and thus, the trade balance may deteriorate in the early post-devaluation period because of the decline in the price of exports and increase in the price of imports. See for example, Hillier (1991) and Krugman and Obstfeld (1994).

Figure 9- 29: Effect on private investment of 10% devaluation of the official exchange rate in 1975

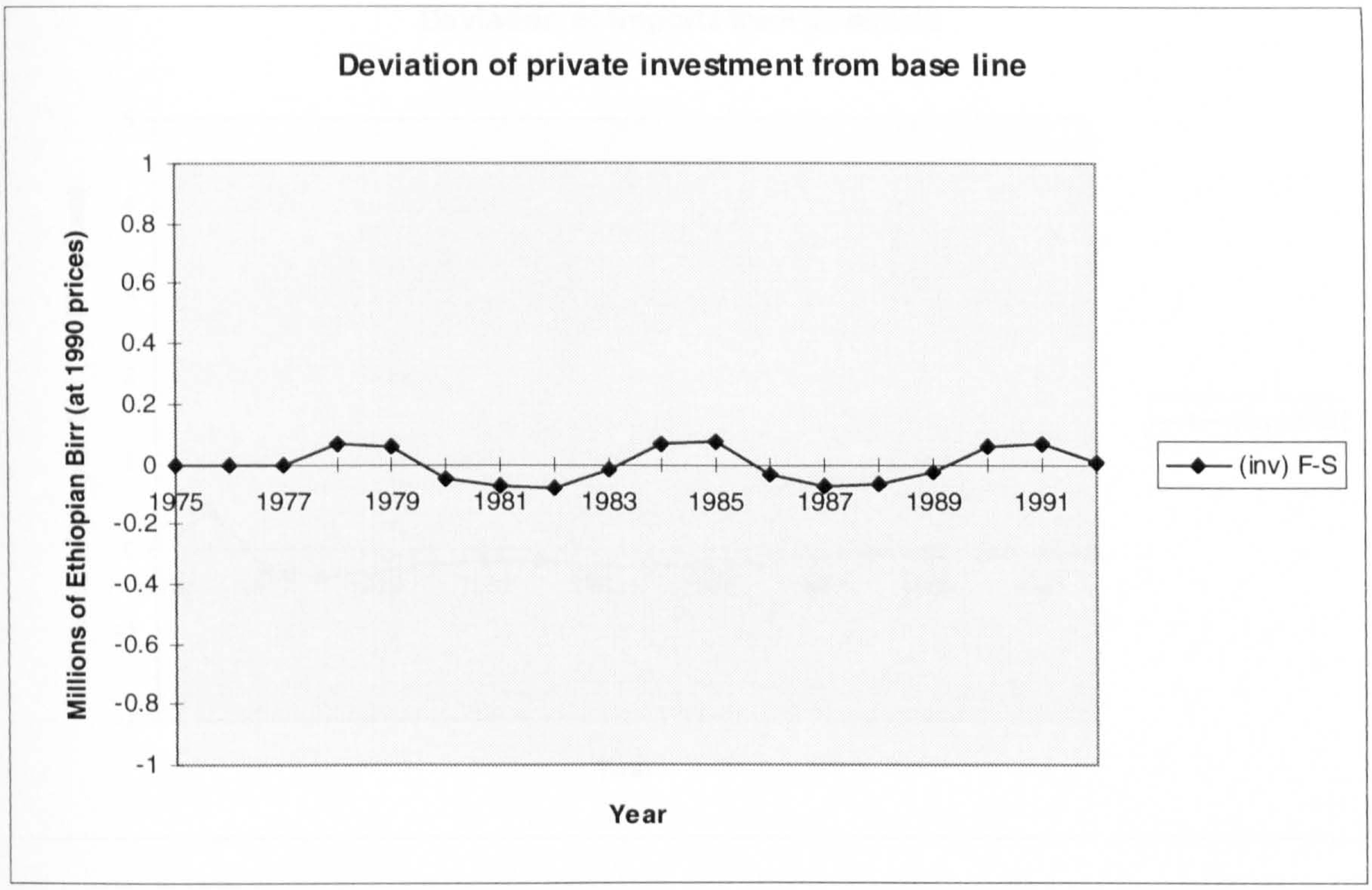


Figure 9- 30: Effect on exports of 10% devaluation of the official exchange rate in 1975

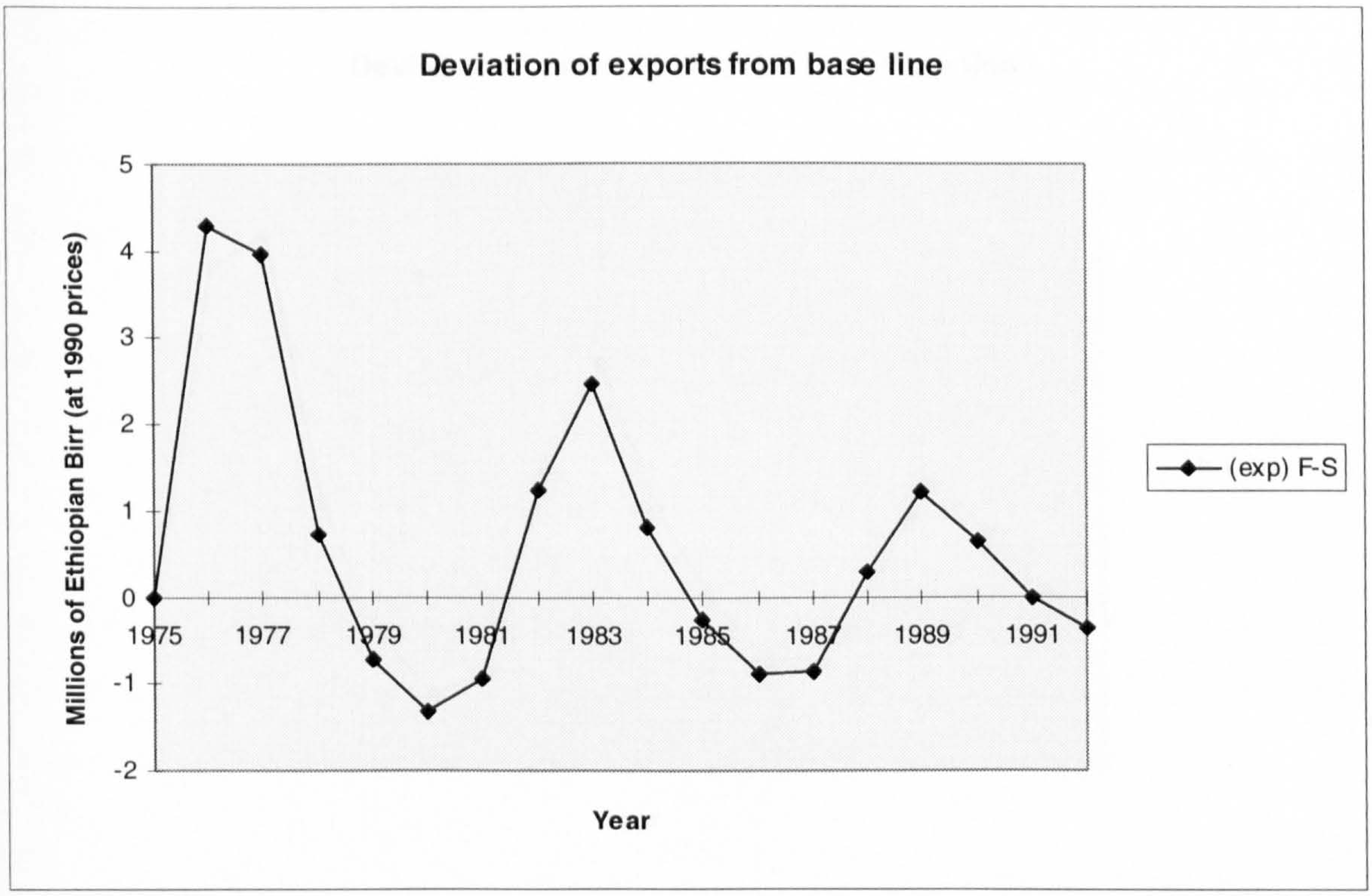


Figure 9- 31: Effect on imports of 10% devaluation of the official exchange rate in 1975

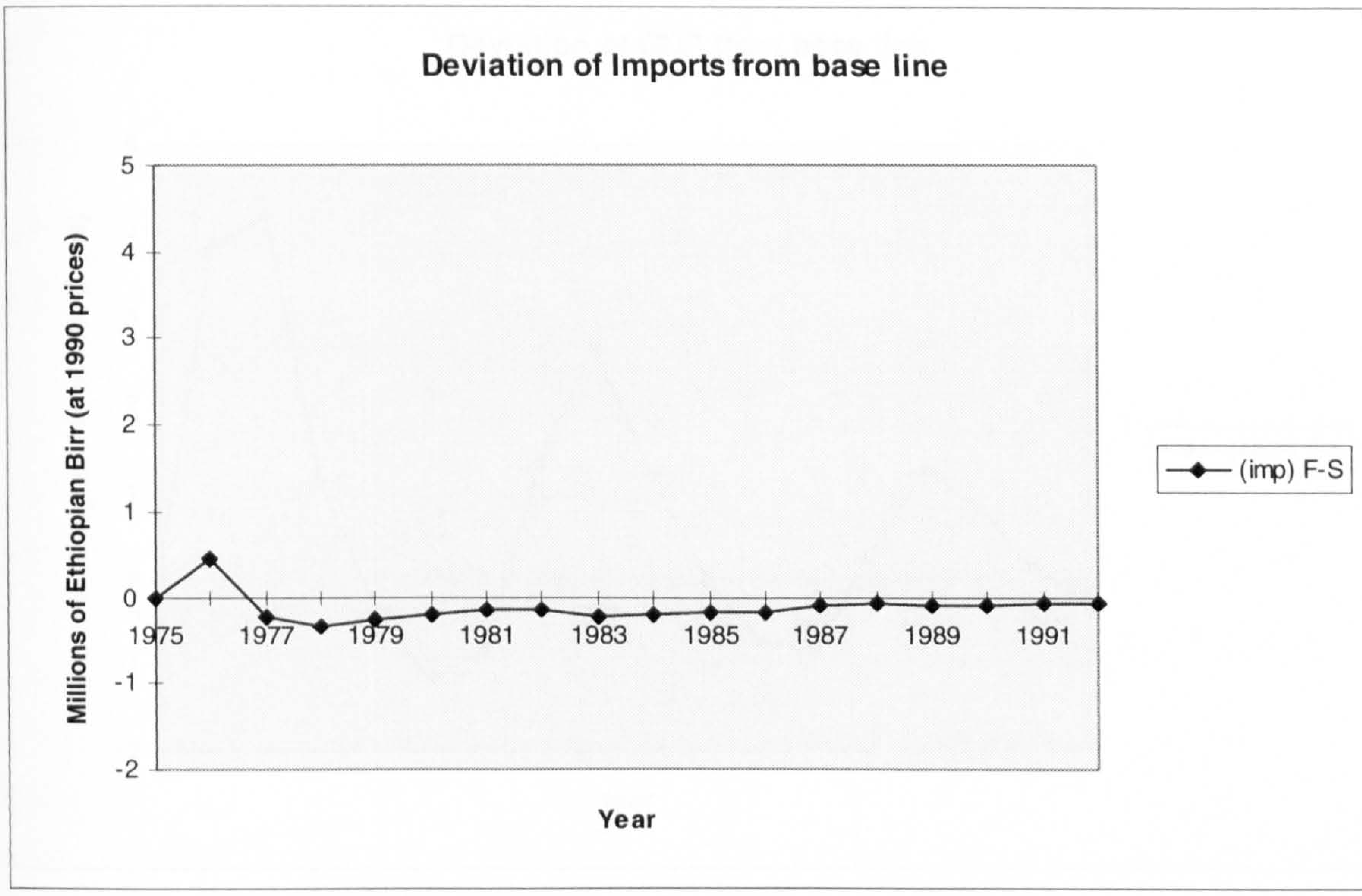


Figure 9- 32: Effect on external balance of 10% devaluation of the official exchange rate in 1975

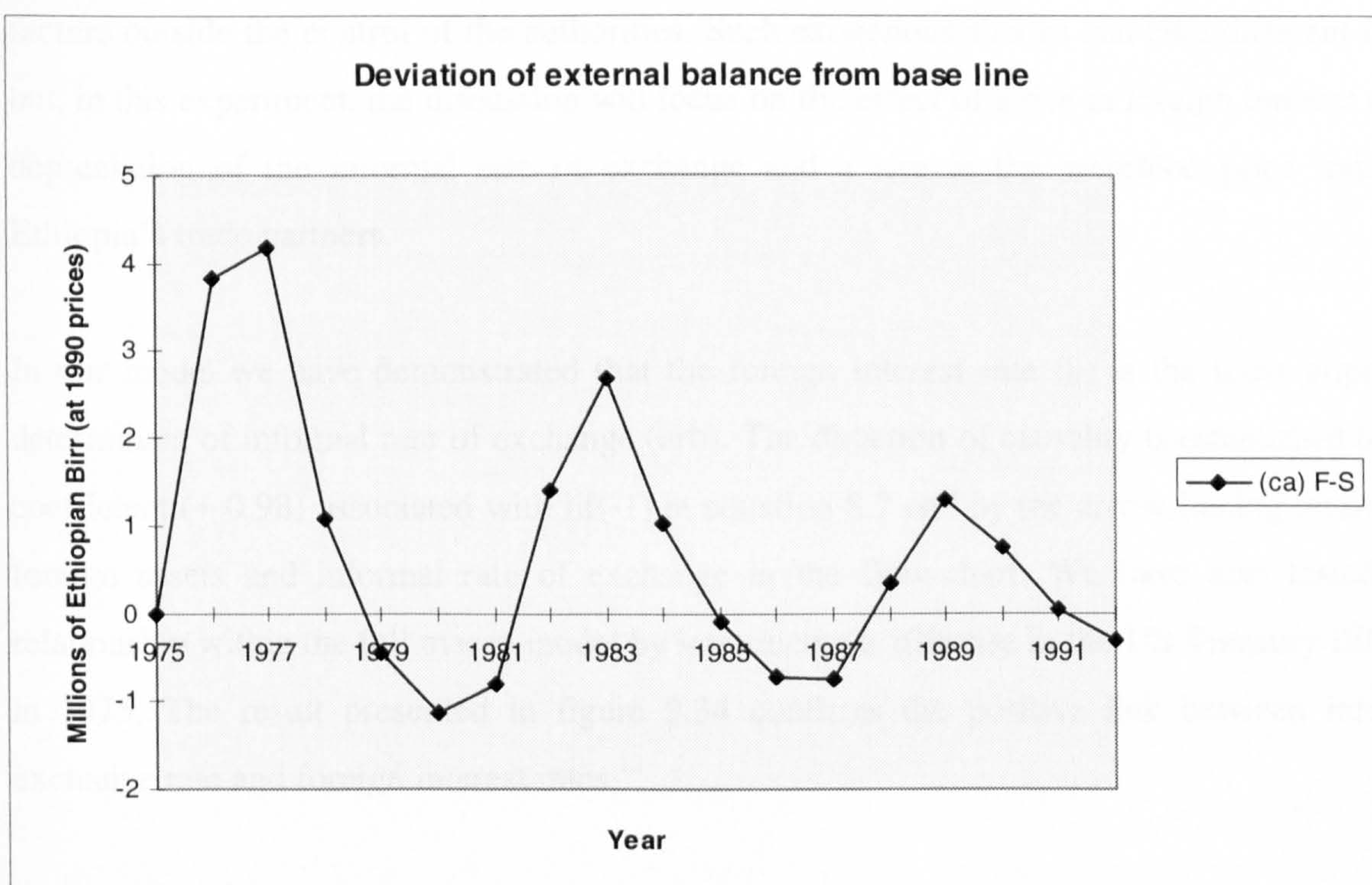
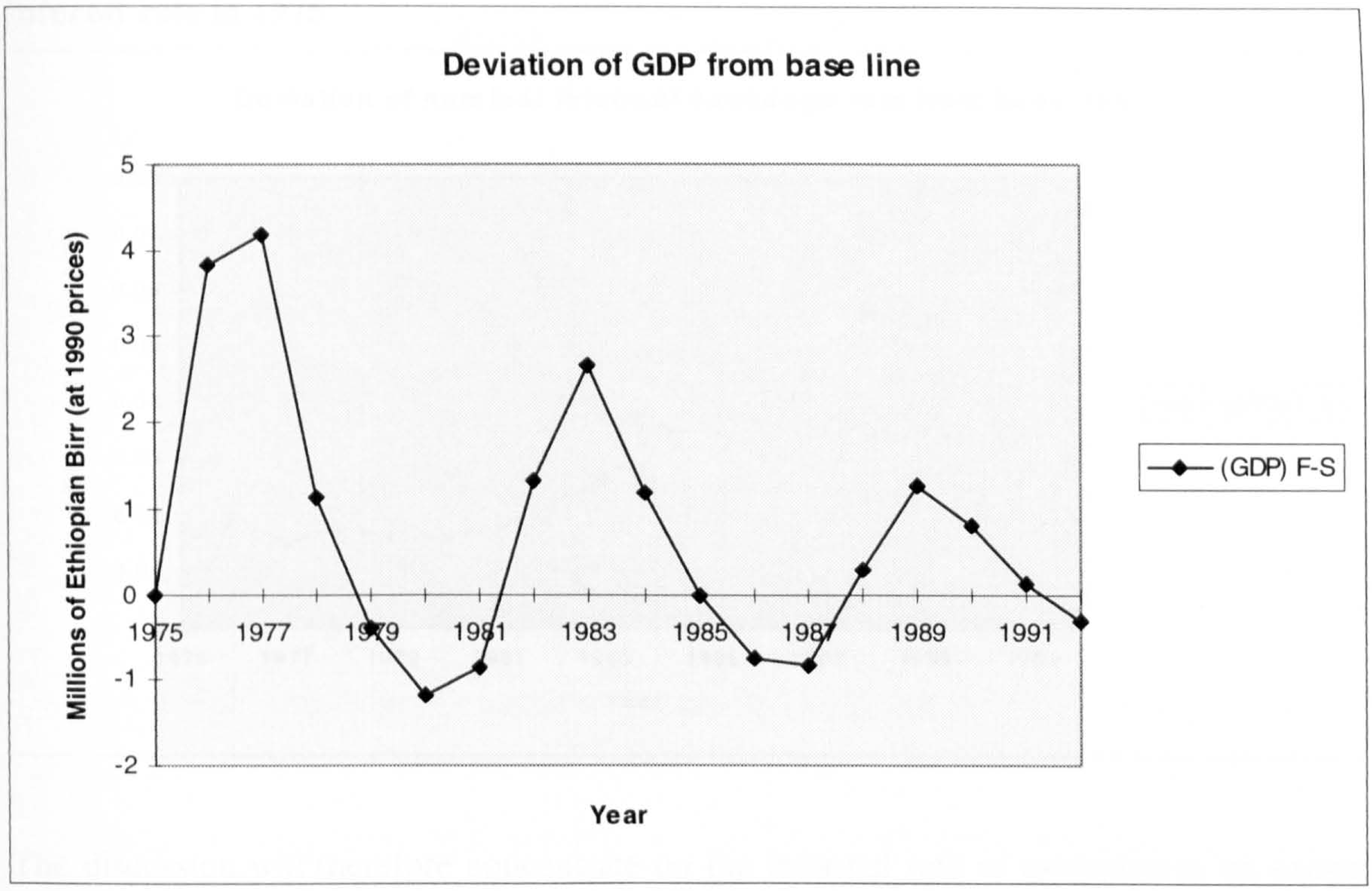


Figure 9- 33: Effect on GDP of 10% devaluation of the official exchange rate in 1975



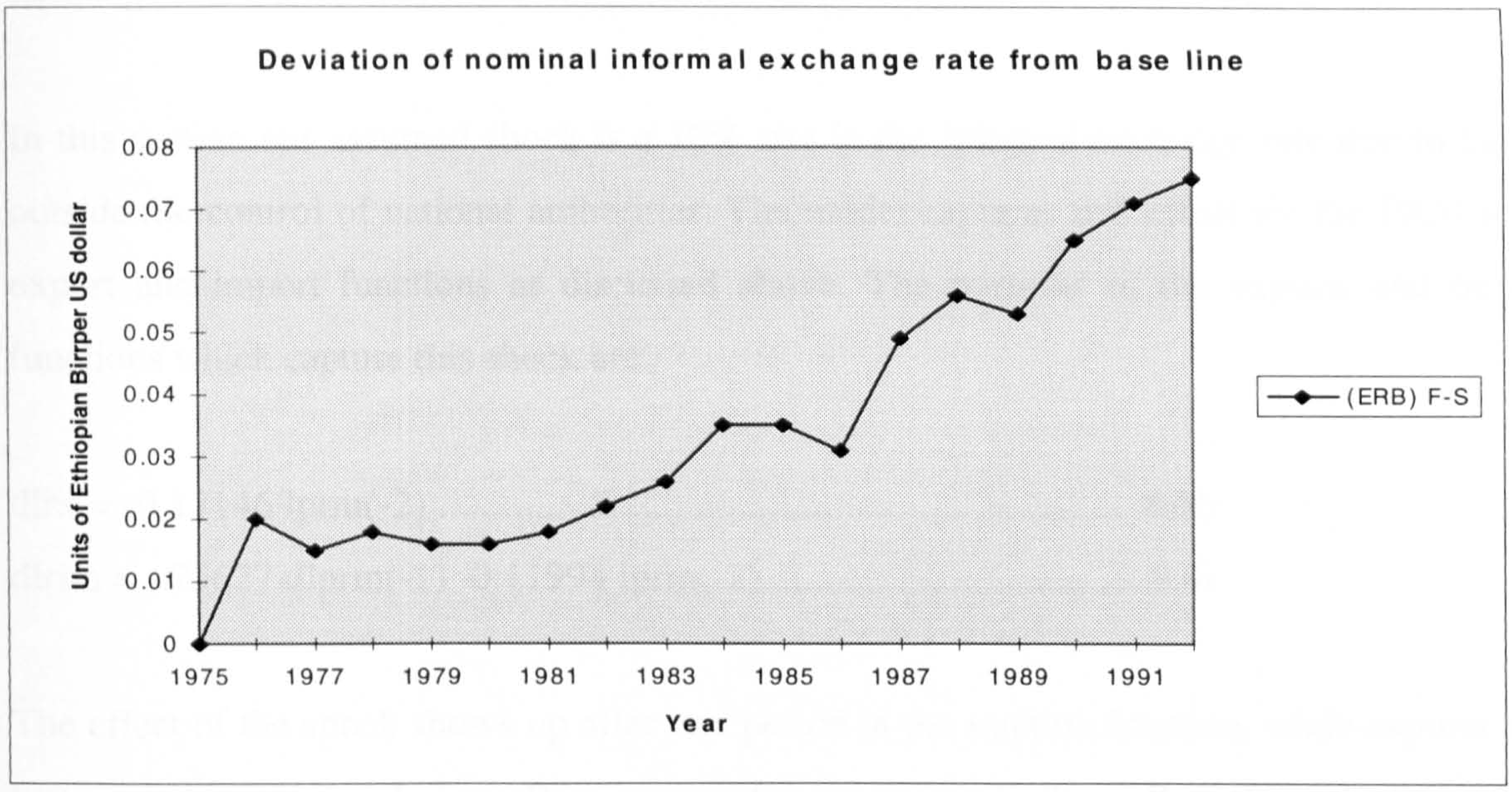
9.3 Exogenous shocks

In this section we will consider the case where the economy faces an unexpected shock due to factors outside the control of the authorities. Such exogenous shocks can take different forms but, in this experiment, the discussion will focus on the effect of a rise in foreign interest rates, depreciation of the informal rate of exchange and a rise in the weighted price index of Ethiopia's trade partners.

In our model we have demonstrated that the foreign interest rate (i_f) is the most important determinant of informal rate of exchange (erb). The direction of causality is established by the coefficient (+ 0.98) associated with lif(-1) in equation 8.7 and by the arrow linking returns on foreign assets and informal rate of exchange in the flow-chart. We have also tested this relationship within the full macro-model by introducing a 10% rise in the US Treasury Bill rate in 1975. The result presented in figure 9.34 confirms the positive link between informal exchange rate and foreign interest rates.[12]

[12]Note that the expected returns on foreign assets are defined on the assumption that agents operating in the foreign exchange market have a 'perfect foresight' of the one-period-ahead change in the rate of exchange. The result therefore suggests that the shock triggers an upward spiral of demand for foreign exchange thereby triggering capital flight unless the authorities move to counteract the trend.

Figure 9- 34: Effect on informal rate of exchange of a 10% increase in the foreign interest rate in 1975



The discussion will therefore concentrate on the informal rate of exchange as an exogenous variable partly because it responds to variables such as foreign interest rates which are clearly exogenous to the domestic economy. Foreign prices will also be treated as exogenous in this policy-experiment on the assumption that the Ethiopian economy, as a junior player in the international market, is more of a price-taker and almost powerless to affect world prices.

9.3.1 Informal exchange rate

The movement in the rate of exchange responds to a number of real and perceived changes in the economic and political scene of a country and its partners. The relevant variables include changes in the rate of return on foreign assets (as discussed above), the periodic publication of economic data such as the balance of payments, PSBR, inflation, unemployment, output growth. It also responds (more quickly than its official counterpart) to unexpected natural disasters and political factors such as the electoral cycle, cabinet reshuffles, war and so on.

In a financially-repressed economy, however, governments tend to ignore (or manage) the effects of such fluctuations by fixing the exchange rate at a level which they believe to be optimal. Repressive measures such as exchange controls are used to enforce their policy, which leads to the expansion of the informal market for foreign exchange. Any dramatic events in the foreign exchange market are, therefore, expected to be absorbed by the informal exchange rate and thereby affect the premium on the informal exchange rate.

In this section our assumed shock is a 10% rise in the informal exchange rate due to factors outside the control of national authorities. The model captures this effect via the PRM in the export and import functions as discussed above. The portions of the exports and imports functions which capture this shock are

dlrx = -0.17146 lprm(-2) 8.3b

dlrim = -.25627 dlprm(-1) -0.11994 lprm(-2) 8.4i

The effect of the shock shows up after one period in the imports function, while exports need two periods to respond. The effect is to shift economic activity to the informal sector at the expense of official exports and imports. The effect on the external balance and thereby on aggregate output depends on the relative size of the coefficients. Private consumption is almost unaffected while private investment is expected to decline due to the fall in official imports. The effects on prices and the demand for broad money are negligible. The effect of the shock on each of the equations is reported in table 9.6 and figures 9.35 to 9.39.

Table 9- 6 Effect of 10% depreciation of the informal exchange rate in 1975

Post-shock deviations from base-line (millions of Ethiopian Birr) F-S

	Investment	Exports	Imports	External balance	GDP
1975	0.000	0.000	0.000	0.000	0.000
1976	0.000	0.000	-0.449	0.449	0.449
1977	0.000	-0.370	-0.215	-0.155	-0.155
1978	-0.064	-0.204	-0.130	-0.074	-0.139
1979	-0.175	-0.022	-0.076	0.054	-0.120
1980	-0.055	0.128	-0.103	0.232	0.177
1981	-0.002	0.221	-0.161	0.382	0.381
1982	0.026	0.089	-0.210	0.299	0.324
1983	0.015	-0.182	-0.167	-0.016	-0.001
1984	-0.102	-0.150	-0.082	-0.068	-0.170
1985	-0.104	-0.039	-0.038	-0.001	-0.105
1986	-0.090	0.061	-0.055	0.116	0.026
1987	-0.009	0.145	-0.109	0.254	0.245
1988	0.020	0.097	-0.131	0.229	0.249
1989	0.019	-0.062	-0.080	0.018	0.037
1990	-0.017	-0.092	-0.042	-0.050	-0.067
1991	-0.058	-0.041	-0.014	-0.027	-0.085
1992	-0.014	0.014	-0.011	0.025	0.012
Average	**-0.034**	**-0.023**	**-0.1152**	**0.093**	**0.059**

Figure 9- 35: Effect on private investment of 10% depreciation of the informal exchange rate in 1975

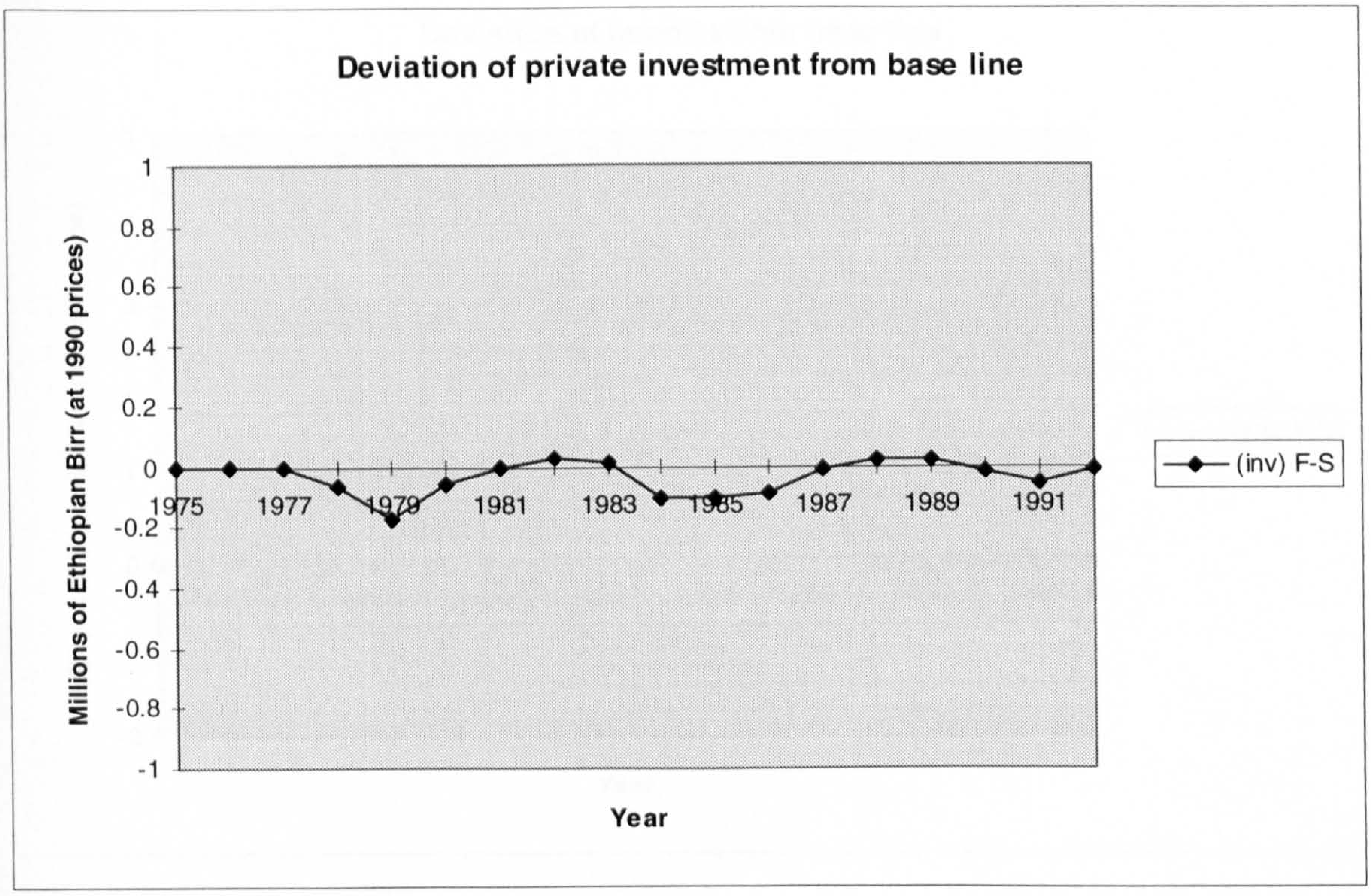


Figure 9- 36: Effect on exports of 10% depreciation of the informal exchange rate in 1975

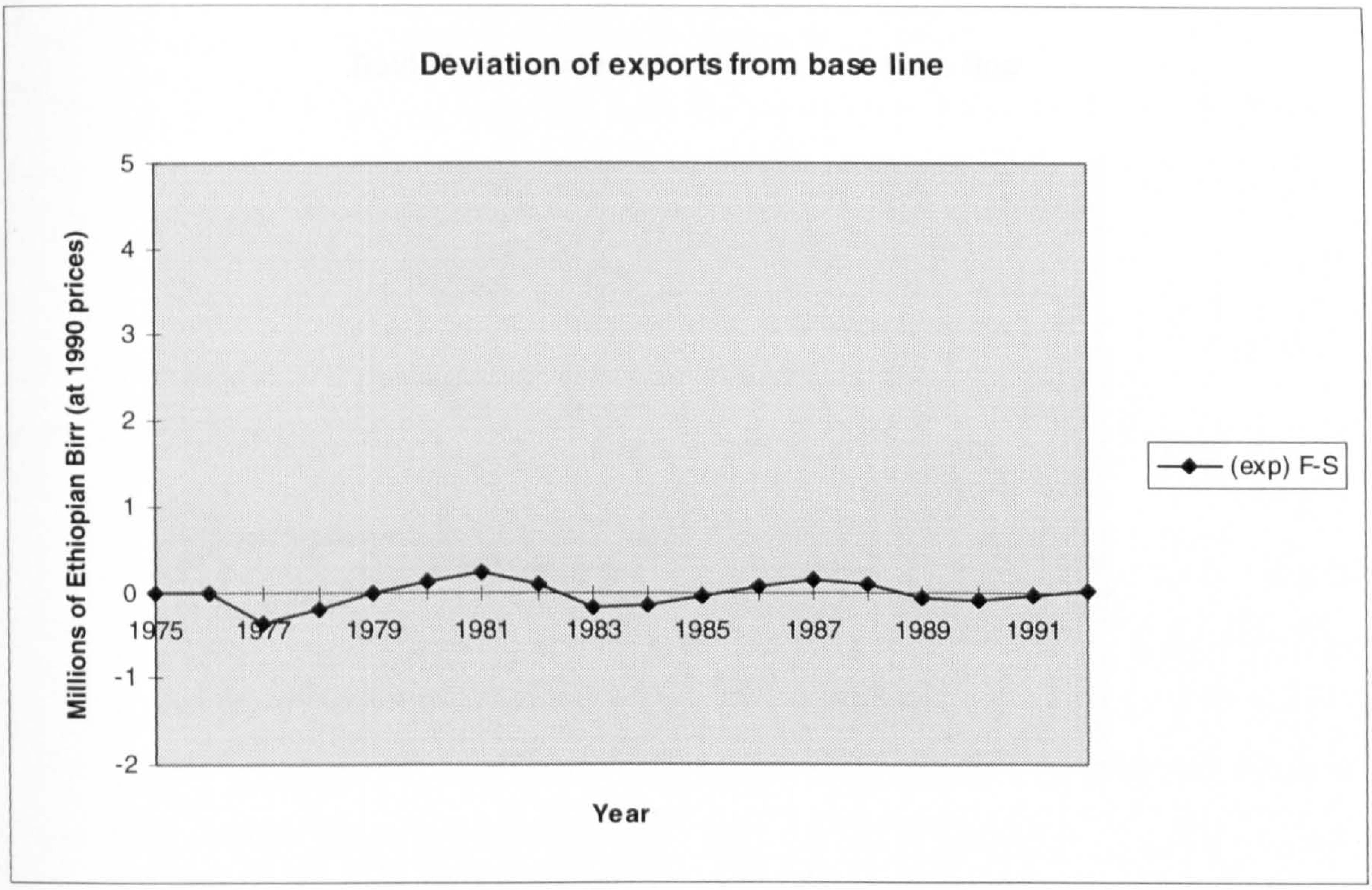


Figure 9- 37: Effect on imports of 10% depreciation of the informal exchange rate in 1975

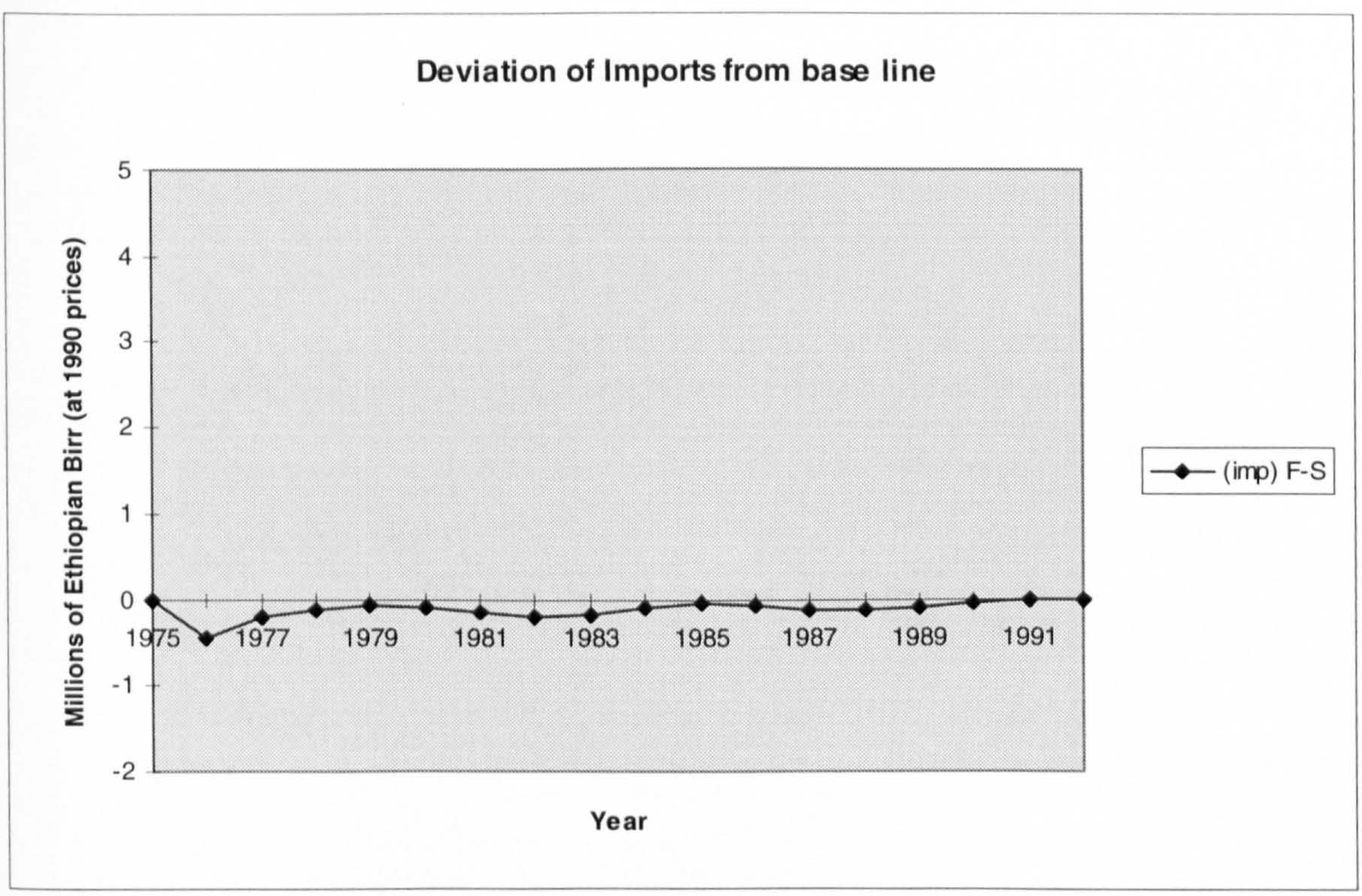


Figure 9- 38: Effect on external balance of 10% depreciation of the informal exchange rate in 1975

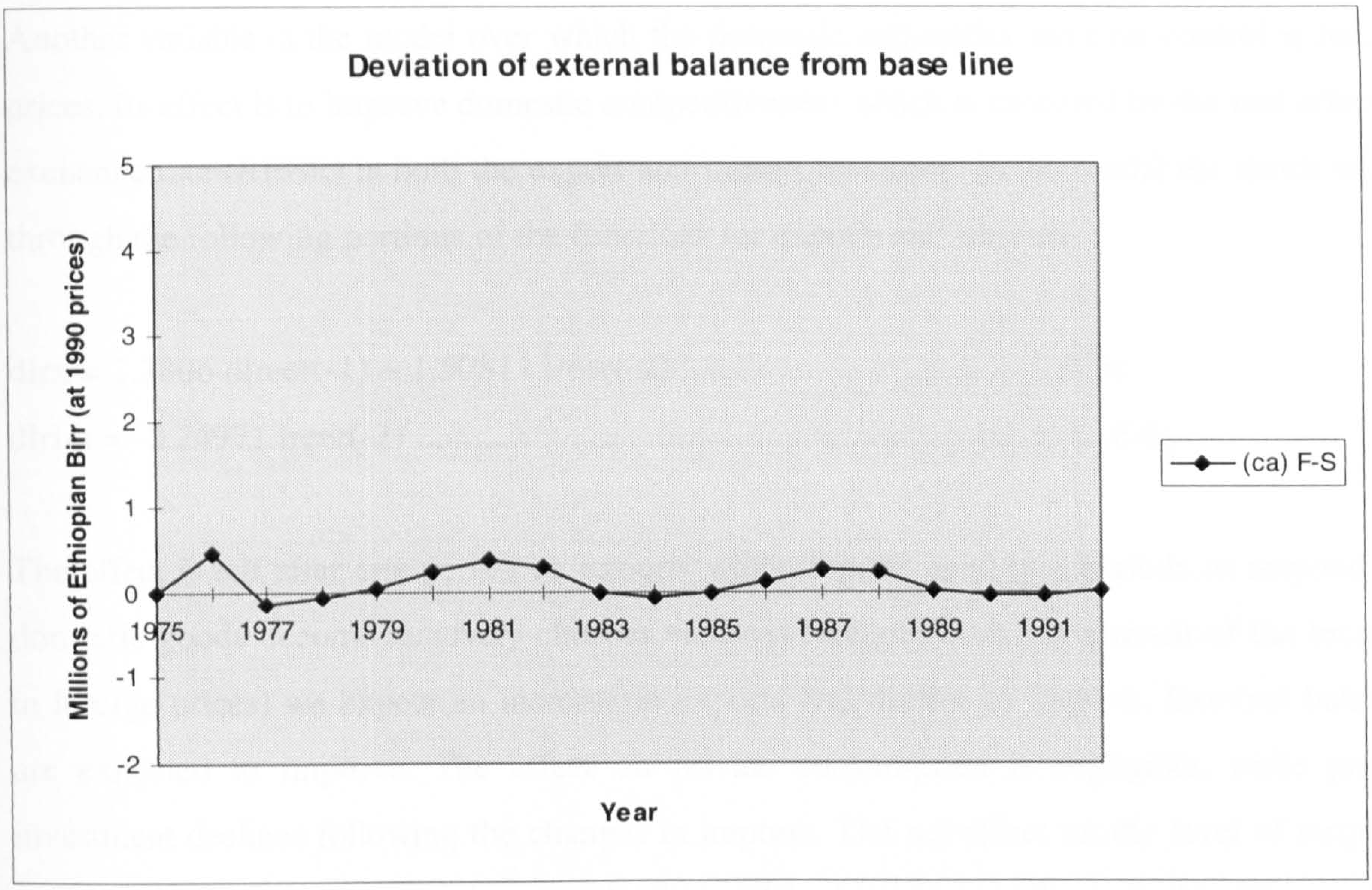
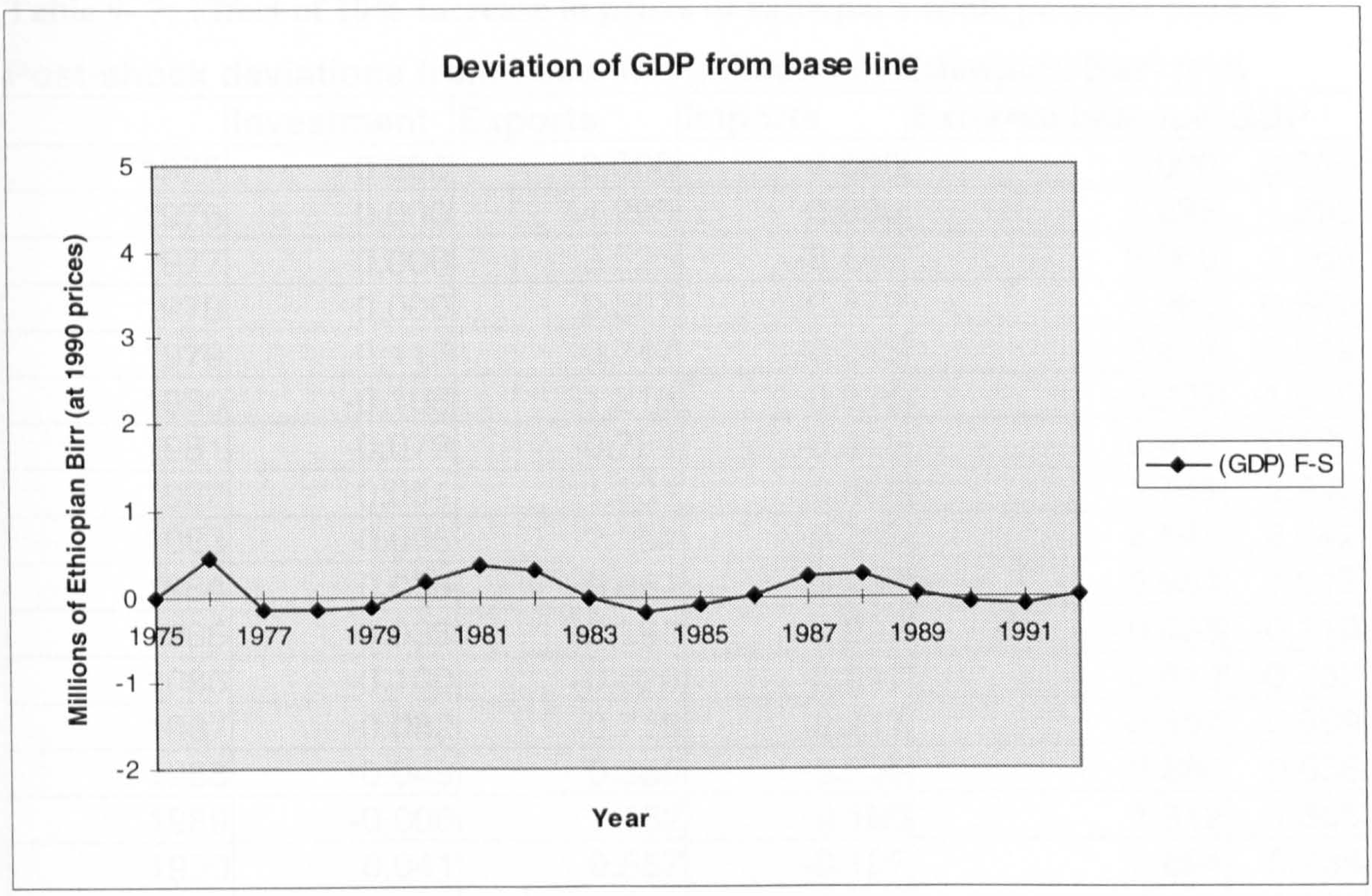


Figure 9- 39: Effect on GDP of 10% depreciation of the informal exchange rate in 1975



9.3.2 Foreign prices

Another variable in the model over which the domestic authorities have no control is foreign prices. Its effect is to improve domestic competitiveness which is captured by the real effective exchange rate (REER) in both the export and import functions. In the model the shock works through the following portions of the functions for exports and imports.

dlrx = 1.2806 dlreer(-1) + 1.50811 lreer(-2) 8.3c

dlrim = -0.24971 lreer(-2) 8.4j

The effect is felt after one period on exports while imports need two periods to respond. As domestic goods become relatively cheaper vis-à-vis foreign goods (as a result of the increase in foreign prices) we expect an increase in exports and decline in imports. External balances are expected to improve. The effect on private consumption is negligible, while private investment declines following the changes in imports. The net effect on the level of output is positive, while the effect on prices and the demand for broad money is negligible. The result of the experiment is summarized in tables 9.7 and figures 9.40 to 9.44.

Table 9- 7: Effect of 10% increase in prices of Ethiopia's trade partners in 1975

Post-shock deviations from base-line (millions of Ethiopian Birr) (F-S

	Investment	Exports	Imports	External balance	GDP
1975	0.000	0.000	0.000	0.000	0.000
1976	0.000	4.295	0.000	4.295	4.295
1977	0.000	3.525	-0.445	3.969	3.969
1978	0.000	0.507	-0.473	0.980	0.980
1979	-0.116	-0.747	-0.345	-0.402	-0.519
1980	-0.108	-1.218	-0.316	-0.902	-1.010
1981	-0.072	-0.724	-0.305	-0.420	-0.492
1982	-0.054	1.334	-0.369	1.703	1.648
1983	-0.005	2.264	-0.383	2.647	2.642
1984	0.058	0.657	-0.296	0.954	1.012
1985	-0.033	-0.290	-0.207	-0.083	-0.116
1986	-0.100	-0.829	-0.217	-0.612	-0.737
1987	-0.082	-0.718	-0.211	-0.507	-0.589
1988	-0.049	0.380	-0.205	0.585	0.536
1989	-0.006	1.152	-0.160	1.312	1.305
1990	0.041	0.557	-0.137	0.694	0.734
1991	0.004	-0.064	-0.088	0.024	0.028
1992	-0.013	-0.347	-0.069	-0.278	-0.291
Average	**-0.030**	**0.541**	**-0.235**	**0.776**	**0.744**

Figure 9- 40: Effect on private investment of 10% increase in price of Ethiopia's trade partners in 1975

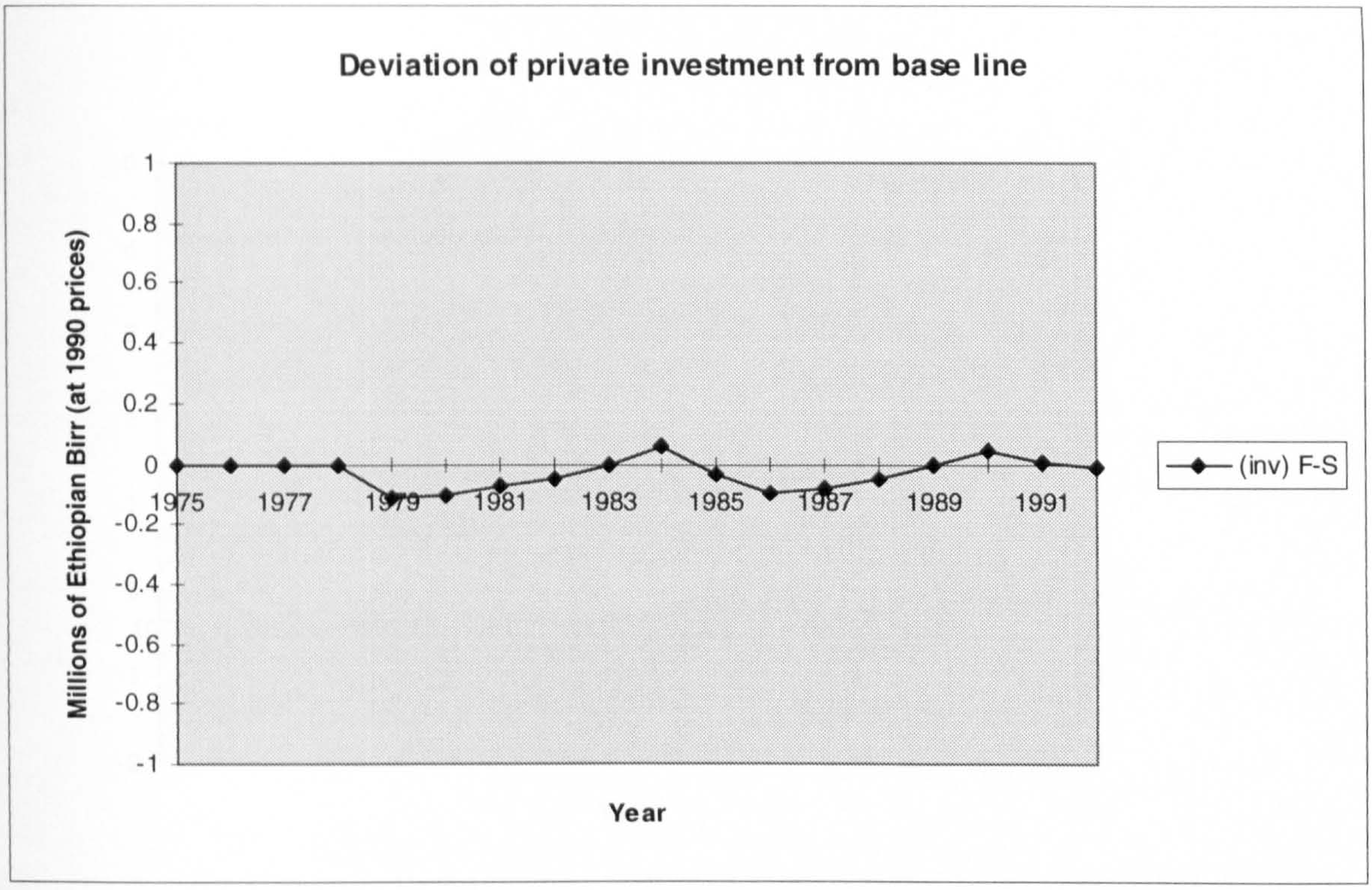


Figure 9- 41: Effect on exports of 10% increase in price of Ethiopia's trade partners in 1975

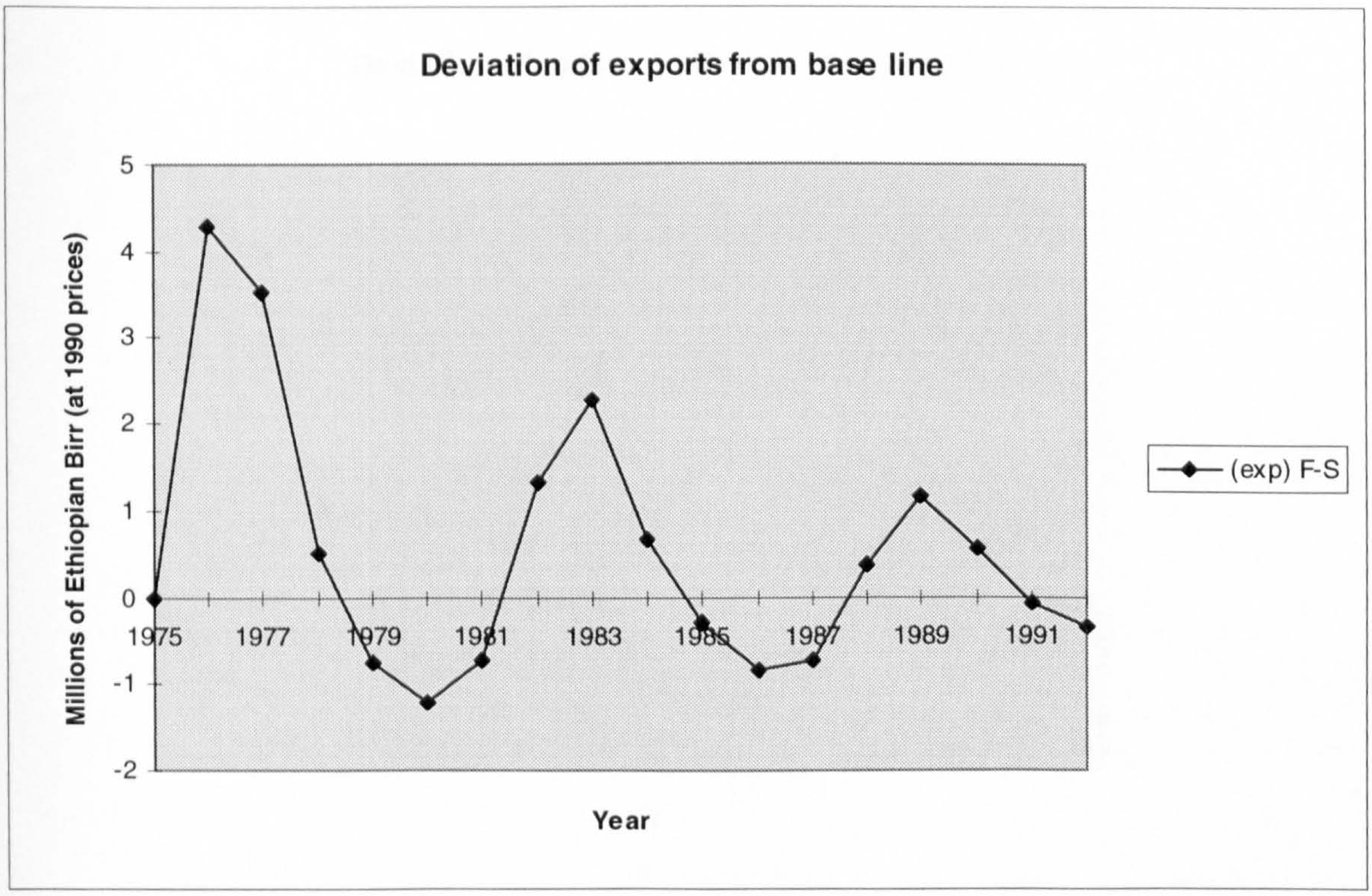


Figure 9- 42: Effect on imports of 10% increase in price of Ethiopia's trade partners in 1975

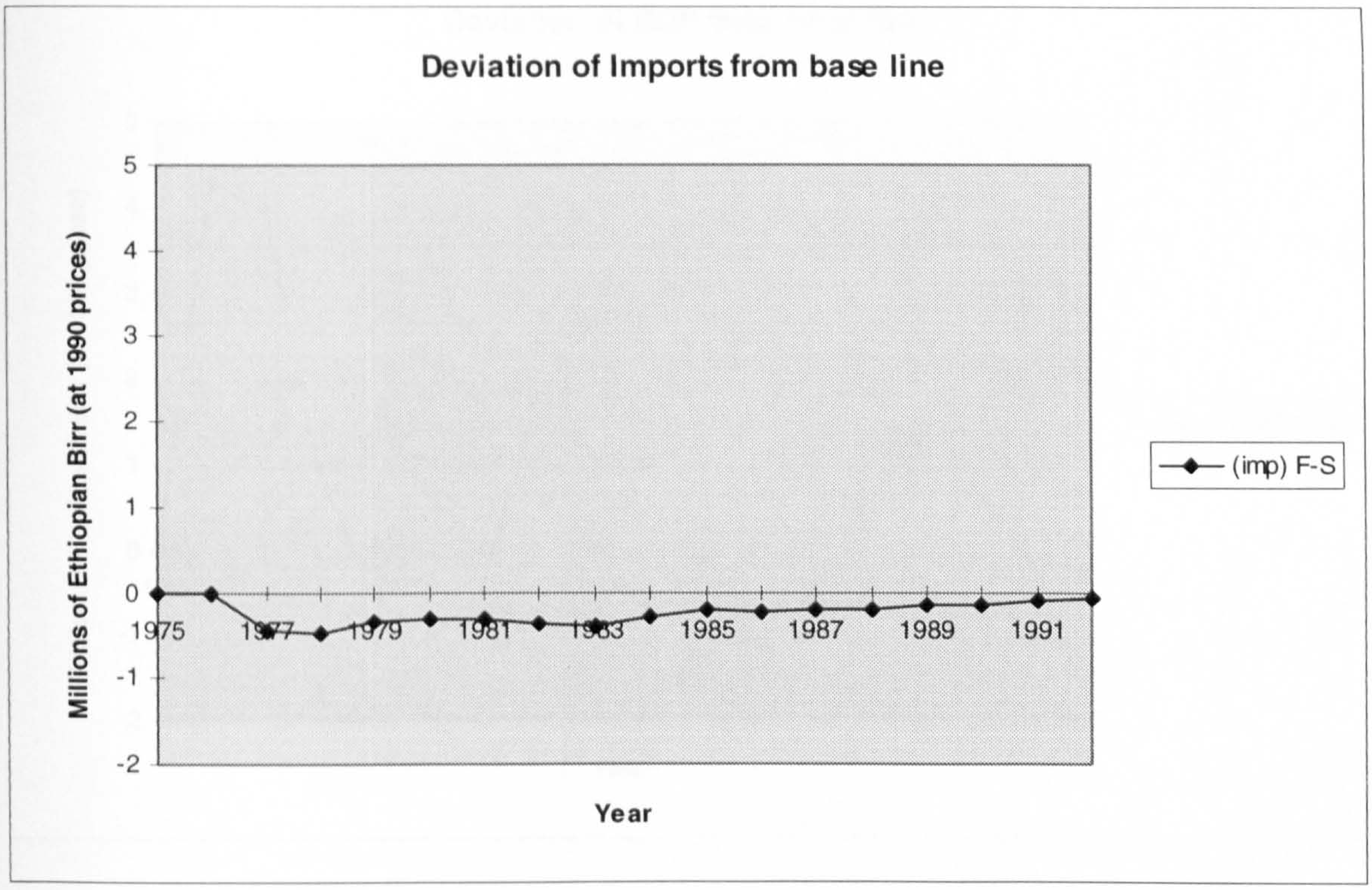


Figure 9- 43: Effect on external balance of 10% increase in price of Ethiopia's trade partners in 1975

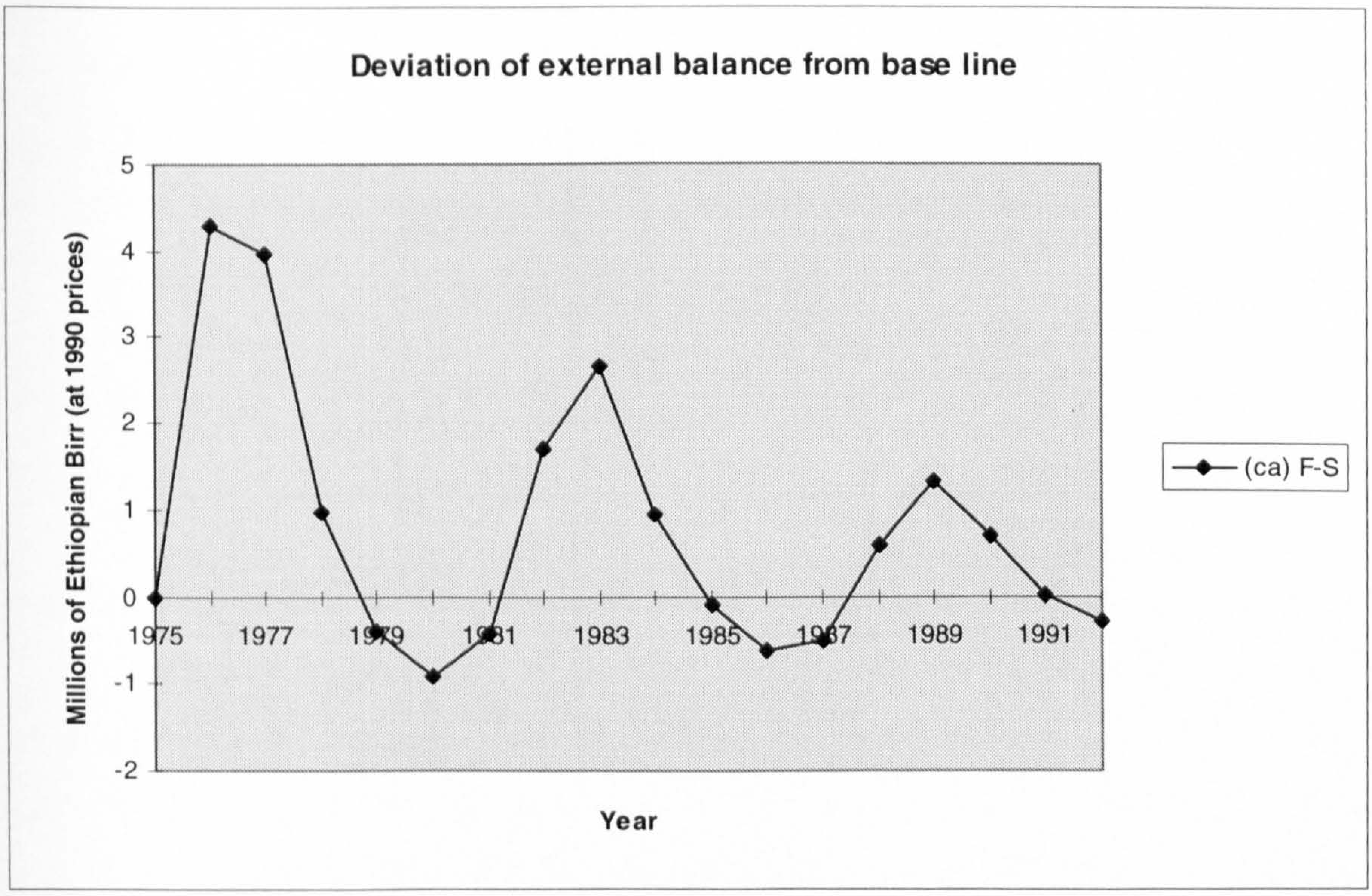
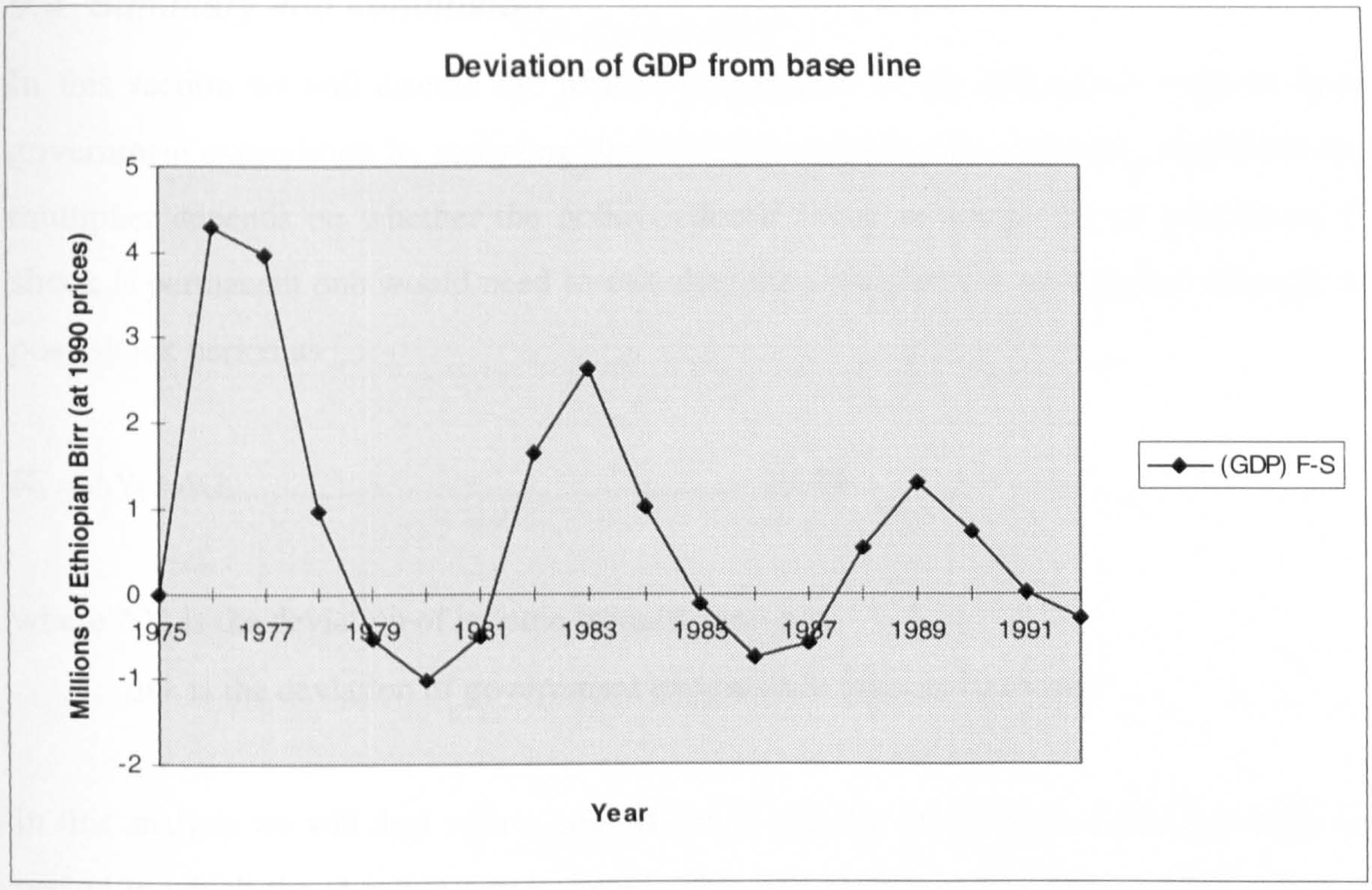


Figure 9- 44: Effect on GDP of 10% increase in price of Ethiopia's trade partners in 1975



9.4 Summary and conclusion

In this section we will discuss the relative importance of the alternative ways of financing government expenditure by analyzing their income multiplier. In a dynamic model the type of multiplier depends on whether the policy-induced shock is temporary or permanent. If the shock is permanent one would need to calculate the multiplier for each period throughout the post-shock period as

$$K_t = \Delta Y_t / \Delta G_t \text{ ....} 9.19$$

where ΔY_t is the deviation of income from its base-run

ΔG_t is the deviation of government expenditure from its base-run

In this analysis we will deal with a one-off shock and the multiplier is calculated only for the period in which the shock is administered. This will enable us to single out the effect of the shock and easily measure the magnitude of its effect.

Given the difference in the lag structure of the equations in the model, however, the effect of the shock is not confined to the first period. Indeed it takes up to three periods for the effect of the shock to show up in some sectors. Furthermore, any deviation from the base-line throughout the post-shock period is by definition attributable to the shock because the shock is administered in such a way that all other variables in the model remain unchanged. Thus, the net income effect of the shock for the full post-shock period (1975 to 1992) is also calculated in the form of summation of the deviations from the base-line. The results of both measures are presented in tables 9.8 and 9.9.

The first row (row 'A') of table 9.8 indicates that the largest initial effect on income comes when the increase in government expenditure is financed by money or bonds. This is followed by credit restraint financing; while the effect of tax financing is relatively low. The overall effect on income (see row 'B') is also higher for money and bond financing. Tax financing results in a net increase in income but it is lower than that of money and bond financing. The crowding-out effect is stronger in the case of financing by credit restraint. The latter results in a net decline in income when the full post-shock period is considered.

The third row compares the size of the overall change in income to the real value of the shock administered in 1975. As mentioned in section 9.1, the increase in government expenditure was 98.58 million Birr at 1975 prices. Since the 1975 prices were 31.3% of 1990 prices, the real value of the shock was 3.15 million Birr (i.e., 98.58/31.3) at 1990 prices.

The overall income multiplier reported in row 'C' is, therefore, calculated by dividing the second row by 3.15 million Birr. The results of the initial year and over-all multiplier can be interpreted as follows. For each one-Birr increase in tax financed government expenditure, income increases over the full post-shock period by 1.19 Birr of which 0.06 Birr is realized in the first year. If on the other hand, the one-Birr increase in government expenditure is financed by money or bonds, the overall increase in income becomes 2.05 Birr of which 0.089 Birr is realized in the first year. The corresponding figure for credit restraint is an overall decline in income by 0.53 Birr in spite of an increase by 0.065 Birr in the first year.

Bond financing has the same effect on income as money financing. This is because we assumed that the issuing of bonds motivates the private sector to swap its idle balances (held as inflation hedges) for bank deposits. It does not lead to the direct reduction of private expenditure discussed in the case of tax financing and credit restraint policy. However, row 'F' indicates that money financing is more inflationary than bond financing. In all cases the external balance deteriorates because part of the increase in government demand is satisfied by increasing imports (see row 'D').

In the initial period all modes of financing lead to an increase in prices although the change is lower for tax and credit restraint financing (see row 'E'). This is because tax and credit restraint are related to the price equation via the aggregate income identity that has a rather small coefficient in the price equation of our model. For the overall change in prices, however, only money financing leads to net inflation (see row 'F'). The remaining three modes of financing lead to a net decline in the price level which can be attributed to their negative impact on private expenditure. The deflation is stronger in the case of bond financing because it is modelled in such a way that the banks would raise the rate of interest so that private agents change their portfolios in favour of savings.

This can be checked by comparing the money demand column in tables 9.2 and 9.4. In the case of bond financing the demand for broad money increased by an average 1.45% per annum during the full-post shock period. The corresponding figure for money financing is only 0.06% per annum. It is also worth noting that the price equation is modelled in such a way that prices are positively related to the supply of money. However, an increase in the demand for real broad money (M2) leads to a fall in prices. Thus, one would expect money financing to be more inflationary than bond financing.

Table 9- 8: Summary of the effects of increase in government expenditure by 98.54 million Birr in 1975

		Mode of financing the increase in government expenditure in 1975			
		Tax	Money	Credit	Bond
A	Income multiplier in 1975	6%	8.9%	6.5%	8.9%
B	Total change on income during 1975-92	3.762 million Birr	6.453 million Birr	-1.662 million Birr	6.453 million Birr
C	Overall Income multiplier for 1975-92	119%	205%	-53%	205%
D	Total change on external balance during 1975-92	-2.93 Million Birr	-0.84 million Birr	-4.363 million Birr	-0.84 million Birr
E	Change in price index in 1975	0.034 units 0.08%	2.822 units 6.74%	0.034 units 0.08%	2.822 units 6.74%
F	Average change in price index during 1975-92	-0.06%	0.31%	-0.06%	-1.00%

Table 9.9 summarizes the effects of changes in the official and informal rates of exchange and the weighted price index of Ethiopia's trade partners. Note that in 1975 official and informal exchange rates were respectively 2.07 Birr per dollar and 5.28 Birr per dollar while the weighted average of foreign price index was 22.85 (given 1990 prices = 100%). The shocks are, therefore, administered to the model as an increase of 0.207 Birr for the devaluation of official exchange rate, 0.528 for the depreciation of informal exchange rate and 2.285 units for the increase in the index of foreign prices.

Table 9- 9: Summary of the effects of 10% change in official and informal rate of exchange and an increase in the index of foreign prices in 1975

	Devaluation of official exchange rate	Depreciation of informal exchange rate	Increase in foreign price index
Size of the shock in 1975	0.207 Birr	0.528 Birr	2.285 units
Total change on external balance during 1975-92	12.438 Million Birr	1.667 million Birr	13.959 million Birr
Total change on income during 1975-92	66.69 million Birr	-1.085 million Birr	64.678 million Birr
Over-all income multiplier for 1975-92	3.22 Million Birr per one cent increase in the official rate of exchange	-0.021 million Birr per one cent increase in the informal rate of exchange	2.83 million Birr per 10 Units increase in the weighted foreign price index

The effect of the shock in 1975 is not reported in table 9.9. Given the lag structure in the model the effect of the shock needs more than one period to show up. The effect on domestic prices is negligible in all three cases. This is mainly because the rate of exchange has no strong link to the monetary sector, while the link of prices with the real sector is weaker than that of the monetary sector. In other words, the magnitude of the shocks proved to be too small to affect the monetary balances and thereby to affect price.

In all three cases the external balance improves although the effect of the informal rate of exchange is relatively small. To some extent this can be taken as an endorsement of devaluation as an effective policy instrument. Furthermore, the relatively lower effect of the informal exchange rate on the officially-reported external balance may also explain the reason why the authorities tend to tolerate the "illegal" trade in foreign exchange. However, a close observation of the effect on the aggregate income suggests otherwise.

The changes in the official rate of exchange and foreign price index have strong and positive net effect on income. The increase in the informal rate of exchange on the other hand, leads to a net decline in the level of aggregate income. Depreciation of the informal rate of exchange leads to a relatively small improvement in the external balance because the rise in the premium on the informal rate of exchange encourages exporters to repatriate their earnings via the informal exchange market instead of using the official banking system. This depresses the size of exports and (thereby income) in the official reports. It is also worth noting that private investment heavily depends on imported inputs. Given the scarcity of foreign exchange and the foreign exchange rationing policy which favours the public sector, private importers are highly dependent on the supply of informal foreign exchange. Depreciation of the informal rate of exchange will therefore, increase the price of imported inputs and thereby reduce private investment (see table 9.6). The overall impact of such a reduction leads to a decline in aggregate income. This suggests that the informal sector in general and the informal foreign exchange market in particular play an important role in the effectiveness of macroeconomic policies and, thus, the integration of this sector with its official counterpart should be an important policy priority for a developing country such as Ethiopia. We will return to this in the next chapter where we summarize the overall findings of this study.

CHAPTER TEN

CONCLUSIONS, POLICY RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The objective of the study is to estimate a macroeconometric model of the Ethiopian Economy that can be used to evaluate the possible impact of monetary union (arising from the existing/proposed regional institutions) on her monetary and fiscal policy. Towards this end the first part of the thesis profiled the Ethiopian economy, articulated the policy implication of the informal sector and its dual structure, and reviewed the literature on macroeconomic modelling. This was followed in part two by chapters on the theoretical specification of a macroeconomic model, and estimating it using Ethiopian data for 1964-93. The model was then used for policy simulations that are relevant to the execution of monetary and fiscal policy under the constraint of a monetary union.

10.1 Summary of part one

Chapter one discussed the performance of the Ethiopian economy vis-à-vis the radical shift in the policy-making regime towards socialist panning in 1974 and back to 'free market' system in 1991. The discussion on key economic variables clearly showed that the 1974-91 period was charcterized by war and political instability, decline in output and famine, and financial repression that drove most private investment out of the official sector. The chapter also discussed the evolution of Ethiopian politics and concluded that any economic integration scheme in the region is likely to have Ethiopia at its core and the current Ethio-Eritrean relationship as its inspiration.

Chapter two focused the discussion on the dual structure of the Ethiopian economy and the repressive policy which led to the expansion of informal trade and credit. It was shown that failure to integrate the large subsistence economy and small (mainly urban) modern sector limits the size of the domestic market. Given such a small domestic market and the resurgence of trade blocs in the world market, therefore, it is feasible for Ethiopia to adopt a policy of collective industrialization. Informal cross-border trade was also discussed as a signal of complementarity of the neighbouring economies upon which regional economic integration schemes can be built. The chapter also suggested ways of modelling the policy implications of the informal and subsistence sectors.

The survey on the literature on macroeconomic modelling presented a classification of existing models based on Schools of Economic thoughts, while stressing the fact that empirical models are likely to incorporate economic principles attributable to more than one schools of economic thoughts. It was also shown that in the post-post cold war period almost all LDCs abandoned models based on Marxist principles in favour of western 'free market' models. These models tend to be adaptations of Western economic theories (usually presented in an IS-LM framework) and their emphasis reflects the objective of the modeller, i.e., national governments, UN, IMF, World Bank, etc. Finally the discussion on Ethiopian Macroeconomic models showed that it is still at its infancy and identified areas in which this study can contribute to the literature.

10.2 The model of the Ethiopian Economy: Econometric evidence

As mentioned above the Ethiopian economy is by far the biggest in the region and it is the only country which shares borders with all countries of the region. Modernization of the economy started in the 1930s and took the form of state socialism during 1974-91. The post-1991 government is reforming the economy by expanding the role of market forces. Nevertheless, Ethiopia is still a predominantly peasant economy with heavy dependence on coffee exports and it has an unenviable record of poor economic performance.

The macroeconomic model developed in this thesis is for the period 1964-1993 and was estimated using cointegration and error correction mechanism. The supply side is not included due to lack of data and the model refrains from disaggregating the type of products produced and consumed in the economy. The demand side is, however, disaggregated and separate behavioural equations are estimated for each component of the aggregate income identity, the demand for broad money, the informal rate of exchange and foreign exchange reserves.

The goodness-of-fit for each of the equations of the model was examined individually and simultaneously. It was shown that the model provides a reasonably good within-sample fit and can be accepted as being representative of the Ethiopian economy. Furthermore, the model developed in this study adopted the following innovative techniques:

(i) The integration of the informal sector into the macroeconomic model addresses one of the least-explored areas of macroeconomic research in developing countries (see Montiel et al. 1993 p. 3). This study establishes an empirical link between the informal rate of exchange, the real and monetary sectors of the domestic economy, and the international financial markets. The informal rate of interest is modelled using credit restraint as a proxy variable and the empirical relationship was found to be significant.

(ii) The flow-chart of the macroeconomic model presented in chapter eight might have been seen as an engineering system had it not been for the inclusion of expectation. Unlike engineering systems, economic systems represent the behaviour of intelligent agents who process current information to anticipate future economic events and act accordingly.[1] Expectations were therefore, modelled on the basis of the adaptive and rational expectations hypothesis. This was done in recognition of the economic dualism that divides the Ethiopian economy into a large subsistence agriculture (with slow information flows) and a small modern market economy.

(iii) Finally the model tried to overcome the problem of financial repression and artificially-low interest rates by developing a proxy for the treasury bill rate. The free-market scenario is simulated by assuming a positive relationship between the PSBR the level of the treasury bill rate.

10.3 Policy recommendations: the case for regional monetary union

The effectiveness of national monetary and fiscal policy was examined in chapter nine. On balance, the evidence suggests that the Ethiopian economy can perform well within the disciplines of free-market forces and regional monetary union. In most cases public expenditure was shown to have a positive impact on real income. If the government resorts to restraining credit extended to the private sector in order to finance its deficits, the crowding-out effect leads to a decline in real income. The dependency of deficit financing on seigniorage revenue, on the other hand, was proved to be inflationary, thereby leaving bond and tax financing as the best instruments of Ethiopian fiscal policy. Such fiscal discipline is supported

[1] See Al-Meshal (1996, p. 209) and Wallis (1993)

by the literature on financial liberalization and is consistent with the requirement of monetary union.

Devaluation of the official exchange rate was shown to have a positive impact on real income. This may be seen as an argument against surrendering sovereignty over exchange rate policy to a common central bank. However, it should be noted that the simulation exercise assumes that Ethiopia's trade partners would not enter into the game of competitive devaluation. In real life this cannot be guaranteed and therefore, the case against monetary union should not be stressed on these grounds.

An increase in the premium on the informal exchange rate, on the other hand, negatively affects real income. This suggests that the informal sector must be unified with its official counterpart in order to eliminate the premiums on the informal exchange rate. To do so, the literature emphasizes the importance of having a credible monetary authority and on this basis monetary union can be recommended as one way of enhancing this credibility .

10.4 Suggestions for further research

Empirical research on macroeconomic modelling of the economies of the Horn of Africa is in its infancy. Furthermore, to the best of my knowledge, the issue of economic and monetary union is not covered in the econometric literature of the region. This offers a promising area of research and, on the basis of the issues raised in this thesis, one can envisage the following research projects:

(a) In some studies (e.g. Mehari 1999) it is shown that there is some evidence supporting the claim that the integrated zones of Africa performed better than the non-integrated zones. It is therefore important to verify 'whether such superior performance is significant' and if so 'is it attributable to union membership'. Pursuing this question was beyond the scope of this thesis but would make an interesting project for future research.

(b) The model built in this thesis is mainly a demand-side model. The supply-side bottlenecks such as shortages of capital stock, and skilled labour, and the problems associated with the transfer of appropriate technology, need to be addressed. In the future, however, one can expect that more data on the labour and capital markets will become available. The macroeconomic model developed in this thesis could then be expanded to accommodate the supply side of the economy.

(c) The econometric analysis of this study was confined to the Ethiopian economy and does not include the post-1993 period. This was mainly dictated by the supply of data. However, in 1991 a new political party assumed power and the economy is undergoing a structural reform towards a free-market system, although very slowly. If successful, this may integrate the informal sector into the formal sector of the economy and thereby enhance the effectiveness of national economic policy. The model developed in this thesis should, therefore, be updated to accommodate any structural shift taking place in the real economy.

(d) Expectations were modelled on the basis of the dual structure of the Ethiopian economy. However, as the economy develops and the effect of real and financial sector liberalization deepens, one would expect the modern market economy to expand and capture the traditional subsistence sector. Such structural changes would call for models based the rational expectation hypothesis and the model developed in this thesis can be modified accordingly.

(e) Finally the issue of economic and monetary union in the Horn of Africa is also an interesting research area. Examining the sensitivity of member economies to variables affected by the change in the policy-making regime is crucial for the success and sustainability of regional monetary union. Such variables have been identified and used for policy simulations in this study. The model developed in this thesis can, therefore, be used as a framework or starting-point for modelling the national economies of the Horn of Africa. The models thus developed can then be used to evaluate the structure of each economy and the simulation procedure used to examine the costs and benefits of joining a regional monetary union.

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