ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

THE SOURCES OF THE RECENT INFLATIONARY EXPERIENCE IN ETHIOPIA

BY

KIBROM TAFERE

June, 2008

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A Thesis submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Master of Science in Economics (International Economics)

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Table of Contents

Acronyms

2SLS	Two Stage Least Squares
ADF	Augmented Dickey-Fuller
ADL	Autoregressive Distributed Lag
AIC	Akaike Information Criterion
CPI	Consumer Price Index
CSA	Central Statistical Agency
DBE	Development Bank of Ethiopia
DF	Dickey-Fuller
DPPA	Disaster Prevention and Preparedness Agency
ECM	Error Correction Model
EDRI	Ethiopian Development Research Institute
GDP	Gross Domestic Product
I(0)	Integrated of Order Zero
I(1)	Integrated of Order One
IFS	International Financial Statistics
IMF	International Monetary Fund
MoFED	Ministry of Finance and Economic Development
NBE	National Bank of Ethiopia
NGO	Non-Governmental Organization
OLS	Ordinary Least Squares
PP	Phillips-Perron
PPP	Purchasing Power Parity
SC	Schwartz Criterion
SVAR	Structural Vector Autoregressive
VAR	Vector Autoregressive
VAT	Value Added Tax
VECM	Vector Error Correction Model

List of Tables

List of Figures

Abstract

One of the prime objectives of governments is achieving stable macroeconomic condition. This objective requires that prices be kept to a reasonably stable level. High and persistent inflation introduces uncertainties into the economy and may lead to slowdown of economic growth by discouraging domestic as well as foreign investments. It may also cause balance of payments problems by eroding a country's competitive advantage. Moreover, because it hits the poor the most it needs to be tackled.

This study aims at understanding the forces behind the current inflationary process in Ethiopia. In order to achieve the stated objective a synthesis model of monetarist and cost-push inflation theories is estimated using vector autoregressive (VAR) and single equation error correction models. The estimated models enable to understand the short run and the long run price dynamics in Ethiopia between 1994/95 and 2007/08.

The findings of the study suggest that the determinants of inflation differ between sectors (food and non-food) and the time horizons under consideration. The most important forces behind food inflation in the long run are real income, money supply, inflation expectation and international food price. The long run determinants of non-food inflation, on the other hand, are money supply, interest rate and inflation expectations. In the short run model, wages, international prices, exchange rates and food supply are found to be prime sources of inflation. There is also evidence of cost mark-up in the short run suggesting the presence of strong monopoly power in price formation.

To contain inflation, therefore, the government needs to exercise prudent fiscal and monetary policies. Inflation expectations need to be tackled by way of credible government policies to change public opinion. In this regard it is important to consider targeting of macroeconomic variables and adhere to announced targets.

1. Introduction

1.1. Background

A stable price level is one of the key indicators of macroeconomic stability. Sharp and persistent price increases may change the course of economic conditions in an economy. Economic growth depends on the domestic saving rate and the external saving the economy manages to attract, and the resulting investment thereof. The level of investment in any economy depends, to a large extent, on macroeconomic stability and the confidence of investors about the future outlook of the economy. Though economic growth on its own is a key macroeconomic objective, its means of financing may have serious repercussions to macroeconomic stability. In order to achieve fast growth governments may end up running fiscal deficits. The sources used to finance such deficits may prove to be inflationary.

There are four means of financing fiscal deficit: printing money, running down foreign reserves, domestic borrowing and external borrowing (Sachs and Larrain, 1993). Excessive use of any of these causes specific macroeconomic problem. Printing money may lead to inflation, running down foreign reserves may lead to exchange rate problems, external borrowing may lead to external debt problem and use of domestic borrowing may crowd out domestic investment.

Inflationary ways of deficit financing may end up eating into the growth momentum they have helped generate by reducing stimuli to growth. First, as persistent inflation sets in investors (both domestic and foreign) may lose confidence in the economic system and in response investments may decline. This effect is particularly severe with foreign investments as investors' decision to pull off their investments may result in massive capital outflows and to foreign exchange shortages. Second, inflation raises the relative price of domestically produced products and reduces the country's international competitiveness. This in turn may produce considerable balance of payments problems. Both of the above effects will dampen the growth prospects of the economy.

Though it is generally considered that inflation has undesirable consequences, its sources and the magnitude of its effects may differ across countries. The structural differences across countries need to be taken in to account in any attempt to understand inflationary processes. Developing countries have far less means for tackling inflation compared to the developed world. On one hand, the financial resources at the disposal of governments are limited, compelling governments into printing money to finance fiscal deficits. As a result of the relatively small size of the economies and presence of large informal sector domestic sources of revenue are limited. Moreover, due to the structure of their economies developing countries are primarily commodity exporters and importers of essential capital goods. With terms of trade deterioration, their export receipts are declining forcing governments into other sources of financing their expenditure. On the other hand, efforts of tackling inflation often have a huge cost of reduced growth.

Besides the general macroeconomic instabilities that result from inflation, its social welfare implication is also considerable. In developing countries like Ethiopia, where the bulk of income is spent on food, inflation reduces the real income of those who live on constant incomes (such as the urban working class) and challenges their basic survival by endangering their ability to afford basic necessities (food).

In Ethiopia, inflation has remained reasonably stable before 2002/03. During this period the government exercised tight fiscal and monetary policies. However, in the post 2002/03 period inflation has kicked in while the government has moved towards less conservative policy exercise. During the same period, the economy has recorded fast growth, export receipts have increased substantially and domestic tax revenue has increased. On the expenditure front, government expenditure has grown considerably. There has also been fast increase in money supply mainly as a result of growth in fiscal deficits. Studying the linkages between domestic price

movements and macroeconomic developments will, therefore, enable understand the causes of the recent inflationary experience in Ethiopia.

1.2. Statement of the Problem

The Ethiopian economy has been characterized by erratic nature of output as the economy has been highly dependent on natural factors. Since agriculture accounted for over 50 percent of GDP for most of the recent past, whenever weather conditions turned to be unfavorable agricultural production contracted as does GDP. With this systematic relationship between GDP (output) and rainfall there followed a systematic price trend. Prices followed the inverse of output trend. During years of good rainfall, as output rises prices often dropped considerably. Even within any particular year prices have been lower during harvest periods.

This trend appeared to have changed in the post 2002/03 period. There has been a reported continuous increase in GDP averaging over 10 percent per annum for five years running. Despite the significant increase in output, prices continued to rise. Every other year the inflation continues to gain momentum. The current inflationary trend is mainly derived by food prices. The agricultural sector has registered a marked growth over the past five years, but this has failed to dampen food price hikes. The food price inflation has reached over 37 percent in April 2008 (CSA, 2008). This seemingly contradictory situation has puzzled many and led many more to suspect the credibility of the stories of fast economic growth over the past five years.

Understanding the sources the current inflationary trend requires closer look at the macroeconomic developments in the post 2002/03 period. Over the last five years there has been sharp increase in money supply. Broad money has grown from 30.5 billion Birr in 2002/03 to 56.7 billion in 2006/07. The share of broad money as a percentage of GDP has also shown a marked increase jumping from 42.7 in 2002/03 to 53 percent in 2006/07 (NBE, 2006/07). On fiscal front, there has been huge increase in government expenditure as the government embarked on huge capital

projects. Despite the fast increase in expenditure, the government's budget deficit (including grants) as a percentage of GDP has fallen considerably. The means of financing the budget deficit has shifted from external to domestic bank and non-bank sources. This has led to the monetization of the deficits. The use of domestic means of deficit financing as percentage of budget deficit has grown from 34.4 percent in 2002/03 to 63.8 percent in 2006/07 (MoFED, 2007/08). There has also been increase in domestic revenue following the introduction of value added tax (VAT). Export receipts have also improved due to diversification of exports and recovery of international prices of commodities.

Since the level of income in Ethiopia is very low, the recent inflationary experience proved unbearable for most. It is essential, therefore, that the government intervenes to contain the price trend in the country. Such interventions, however, require appropriate policies drawn from careful observation of the forces behind the price spirals.

There have been attempts to study inflation in Ethiopia. Demirew (1998) has studied the causal relationship between inflation, budget deficit and money supply. Muche (2007) has estimated a SVAR model to identify whether inflation is mainly driven by demand factors or supply factors. Understanding the sources of inflation, however, requires a more detailed and broader framework for incorporating all factors that may have played role in the process. One study conducted in this line is Yohannes (2007). He estimated a general equilibrium macroeconometric model to show the possible functional relationships between output, prices and various inputs.

In trying to identify the forces that lie behind the current Ethiopian inflation this study uses a monetarist-cost push synthesis model. The model adopts a disaggregated approach to study the contributions of administered prices, prices of traded goods, and non-traded food and non-food items to the inflationary process.

1.3. Objectives to the study

The main objective of this study is to identify the most important determinants of inflation in Ethiopia both in the short run and the long run. To achieve the general objective the targeted specific objectives are:

- To identify the determinants of food inflation
- To identify the determinants of non-food inflation
- To identify the pressure of international prices on domestic prices
- To identify the effect of administered prices on domestic prices

1.4. Significance of the study

The level of income in Ethiopia is one of the very least even by African standards. The livelihood of most Ethiopians is a little more than just survival. As noted above the bulk of household income is spent on food (according to CSA, it stands at 57 percent in 2996/07). There is also no system of real wage indexation in the Ethiopian labor market. Under such situations fast increase in prices will erode the real value of income and renders basic food consumption very difficult.

This study will serve two basic purposes. First, the identification of the key short run and long run determinants of inflation helps policy makers with the appropriate ways of intervention for containing inflation. Second, it may be useful for further research in related area.

1.5. Organization of the study

The study is organized into six chapters. Following the introductory chapter, Chapter two presents the macroeconomic developments in Ethiopia. Chapter three gives a review of literature on inflation followed by Chapter four, which discusses the methodology and sources of data used in the study. Chapter five deals with model estimation and interpretation of results. Finally, Chapter six presents the conclusions and policy implications of the study.

2. Macroeconomic Developments

2.1. General Indicators

The wellbeing of economic agents in an economy depends to a larger extent on how governments manage their macro economy. In macroeconomic management the most important objectives policy makers seek to achieve could be classified into internal and external balance. With internal balance the government wishes to achieve fast growth of income with stable prices while with external balance the objective is mainly maintenance of balance of payments equilibrium. The simultaneous achievement of all these objectives has proved to be difficult.

Various theories postulate tradeoff between growth and inflation. There have been empirical studies that support as well as refute these theories. Recently, both these phenomena have come to co-prevail in Ethiopia. Between 2002/03 and 2006/07, the Ethiopian economy recorded faster growth of output and prices, while the few years before these five years were characterized by erratic nature of growth of GDP and low inflation. It is important, therefore, to understand the forces lying behind these macroeconomic developments. Thus, this chapter discusses the macroeconomic developments between 1997/98 and 2006/07 to see if there have been significant changes after 2002/03 compared to the five years before that could explain the current inflationary process.

2.1.1. Growth

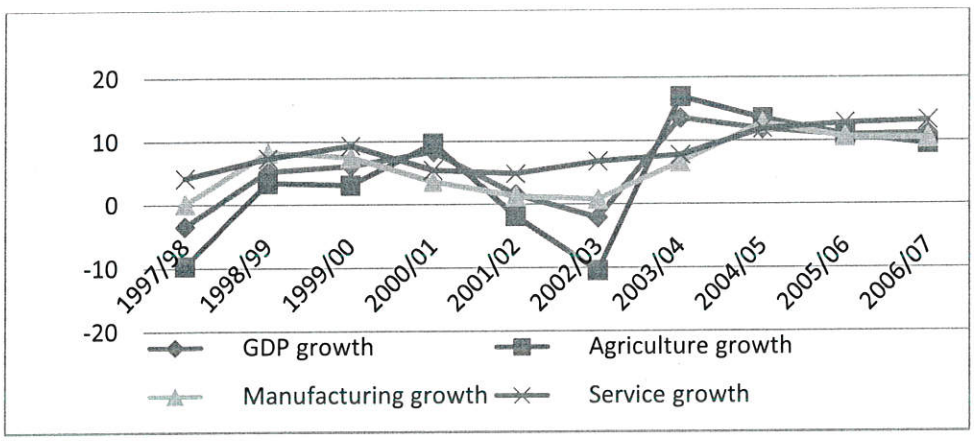
The Ethiopian economy performed fairly well between 1997/98 and 2006/07 registering average annual growth rate of 6.3 percent. The peak growth of the period was 13.6 percent in 2003/04. The high growth of 2003/04 is explained mainly by three factors: high growth in agriculture, low inflation and the negative growth in 2002/03 which served as a lower base. The other year with negative output growth rate is 1997/98. The most probable sources of the fluctuation in the level of output are natural factors, though policies might as well have been

important to a lesser degree. Over the ten years period, the agricultural sector on average accounts for 45 percent of GDP. As a result, variations in GDP tend to be highly correlated with variations in agricultural output.

Figure 2.1 shows the trends in the growth rates of GDP and its sectoral components over the 1997/98-2006/07 period. Though its temporal variation has been relatively low, the growth rate of the manufacturing sector also has followed the trends of GDP growth and agricultural output growth. This could be ascribed to the high agricultural raw material dependence of the manufacturing sector. The service sector, however, enjoyed a steady growth over the period.

The Ethiopian agricultural sector is mainly rain fed. As a result, the sector and hence the economy at large tends to perform better when the weather condition is good and suffers during years of shortage of rainfall. Figure 2.2 below plots the ratio of deviation of rainfall from mean rainfall for the 1997/98-2006/07 period to the mean rainfall of the period against the growth rates of GDP and agriculture at constant prices[1].

Figure 2.1: Growth rates of GDP, Agricultural output, Manufacturing output and Service sector.

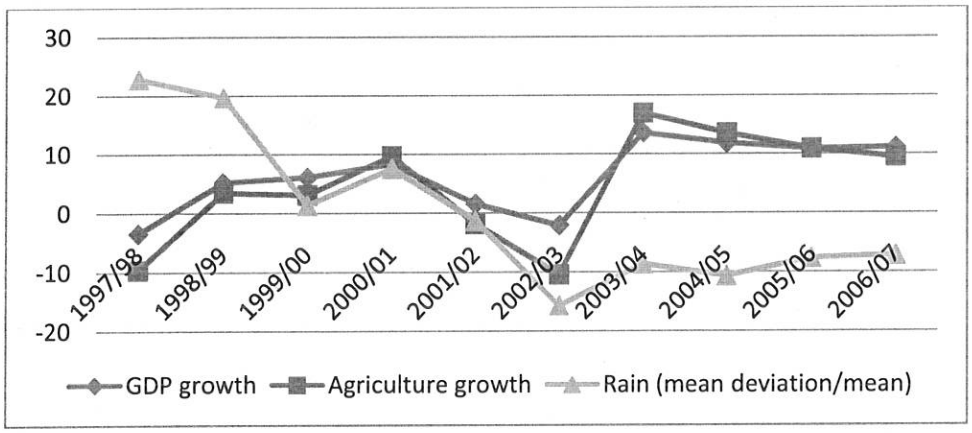


Source: Own computation based on MoFED (2007/08).

[1] The annual rainfall data was obtained in GC. Thus, in using the data I took the rainfall data for 2000, for example to represent, 2000/01 since September, October, November and December are not major rainfall seasons in Ethiopia. The fit of the data shows that there is no significant limitation due to the assumption.

GDP growth, agricultural growth and rainfall have varied together over the ten years period. The growth rates of GDP and agriculture have been erratic as is the mean deviation of rainfall from its mean. During years of good rainfall, such as 2003/04 and onwards, the agricultural sector as well as the national economy tend to perform well and they perform badly in dry years such as 2002/03. It is no surprise, thus, that the drought (and fall in output thereof) of 2002/03 is associated with the lowest level of rainfall in recent history.

Figure 2.2: GDP growth, agricultural growth and mean deviation of rainfall as a percentage of mean rainfall.



Source: Own computation based on MoFED (2007/08) and EEA (2007) data.

Though the agricultural sector remains the most important sector in terms of its contribution to GDP, it is the service sector that stands out as the main source of growth in the Ethiopian economy. Table 2.1 below shows that growth in the service sector accounts for 61 percent of the average growth of the 1997/98-2006/07 period, while the share of agriculture stands at 34 percent (2.1). The share of the manufacturing sector is just 5 percent. The years of negative growth are years of major fall in agricultural output.

Table 2.1: Growth contributions of agricultural, manufacturing and service sectors

Sector	Average growth rate	Growth contribution	Growth contribution (%)
Real GDP	6.28	6.28	100
Agriculture	4.50	2.12	33.5
Manufacturing	6.19	0.32	5.1
Service	8.34	3.89	61.4

Source: Own computation based on MoFED (2007/08).

2.1.2. Inflation

In the past, rise in prices in Ethiopia were associated with fall in output (mainly agricultural harvest) and years of high production were accompanied by fall in price. In 2000/01, for example, output grew by 8.3 percent (mainly due to a 9.6 percent increase in agricultural output) and consumer price index decreased by 5.2 percent (owing mainly to a 10.4 percent decrease in food price). In the following two years there was a significant fall in agricultural production due to unfavorable weather condition. Particularly, in 2002/03 agricultural output decreased by 10.5 percent and the consumer price index increased by 15.1 percent (with food price growing by 24.8 percent). In recent years, however, this trend seems to have reversed with prices soaring despite fast growth in output. From 2003/04 onwards, output on average grew by 11.8 percent per annum while during the same period, prices have grown by 11.4 percent per annum (MoFED, 2007/08 and NBE, 2006/07).

Over the 1997/98-2006/07 period prices have on average increased by a modest 6.2 percent per annum. Inflation has emerged as a serious macroeconomic problem from 2002/03 onwards. Just over the 2002/03-2006/07 period, the general price level has recorded an average annual rise of 12 percent. 2006/07 alone witnessed prices jump by about 18 percent (NBE, 2006/07).

Food expenditures constitute a lion's share of household expenditures. In 2006/07, for example, the share of food expenditures in total expenditures was 57 percent. Thus, the effect of rise in food price on general CPI and social welfare is significant. During the 1997/98-2006/07 period, the average annual rate of food price inflation was 7.4 percent, while non-food inflation stands at 4 percent. Over the 2002/03-2006/07 period food as well as non-food inflation recorded significant increase with food inflation more than doubling (at 15.2 percent) and non-food inflation averaging 6.4 percent. Two different forces may have played role in the fast increase food prices: uniform supply of grains by farmers following the improvement in access to credit and market information which has avoided excess supply and hence fall in price during harvest periods and the fall in supply of cereals as some donors shifted away from food aid to cash aid[2] (see also Mulat et. al. 2007). The fast increase in non-food prices could be attributed to strong demand resulting from huge public investments, fast growth in domestic credit and upward revisions in the administered fuel prices. Since the onset of inflation in 2002/03, the gap between CPI and Food Index has widened owing to higher food inflation than non-food inflation (see Table 2.2).

Over the 1998/99-2006/07 period, among food items, cereals and meat registered the highest increase in price averaging 10 percent and 11 percent respectively. The price increase has been significantly higher over the last five years (2002/03-2006/07) with the price of cereals and meat soaring by 20 percent and 15 percent per annum (see Table 2.2). The sharp rise in food price, especially the price of cereals, has put a lot of pressure on consumers. The rise in food price has especially hit workers engaged in the formal sector, which is characterized by wage rigidity, severely.

[2] For example, the amount of food aid (grains) has fallen from over 14 million quintals to just over 2.8 million quintals between 2002/03 and 2006/07 (DPPA).

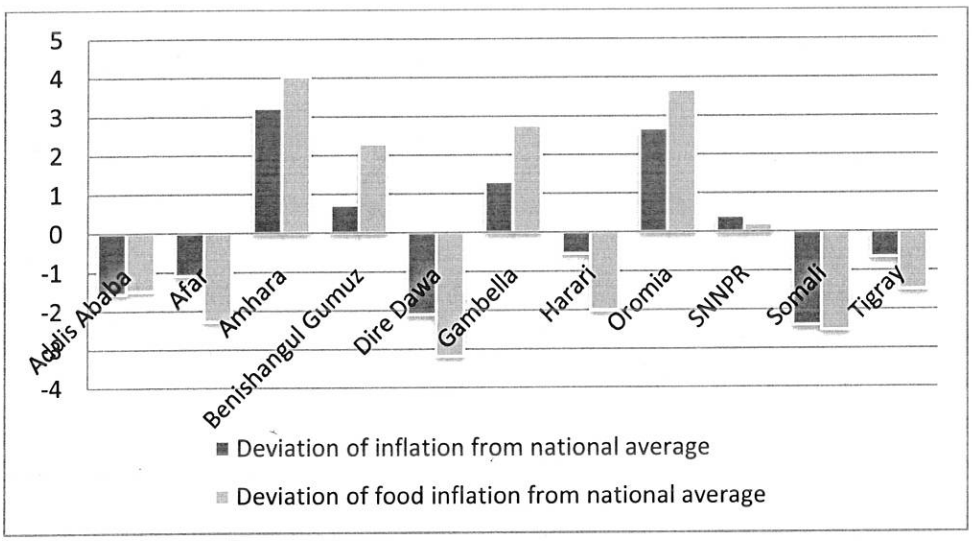
Table 2.2: Inflation rates during the 1997/98-2006/07 period.

Item	Average annual Inflation (%) (1997/98-2006/07)	Average annual Inflation (%) (2002/03-2006/07)
CPI	6.2	12.1
Food Price Index	7.4	15.4
Cereals Index	10.2	20.5
Meat Index	11.3	15.2
Non-Food Price Index	4.0	6.4

Source: NBE (2006/07) and own computation.

The soaring inflation of the 2002/03-2006/07 period has hit every corner of the country. However, the magnitude of the rise in prices varies across regions. Amhara and Oromiya regions saw the highest average annual increase in price of 13.7 percent and 13.1 percent respectively; while Somali and Dire Dawa regions have the lowest inflation at 8.1 percent and 8.4 percent, significantly less than the national average for the period of 10.5 percent (see Figure 2.3 below).

Figure 2.3: Inflation by region (2002/03-2006/07)



Source: NBE (2006/07) and own computation.

The relatively lower inflation in areas not very known for agricultural production (especially crop production) could be attributed to increase in supply to these areas due to improved infrastructure (road network, information communication technologies etc). Mulat et al (2007)[3] offers supporting evidence to the above argument. They indicate that there has been a tendency for prices to converge recently. Smaller markets are growing into independent big markets attracting supplies from adjacent districts and regions.

The regional distribution of food inflation took the same pattern as the general inflation with Amhara (17.2 percent) and Oromiya (16.8 percent) regions suffering the highest increase. Dire Dawa and Somali region recorded the lowest inflation, both of whom hardly major food producing areas.

2.1.3. Saving and Investment

The achievement of the desirable goals of stable macroeconomic condition and faster growth partly depends on the level of investment and its means of financing.

Over the 1997/98-2006/07 period, both gross national saving and gross investment as percentage of GDP remained stable at around 23 percent[4]. The investment to GDP ratio is moderate even by African standards (see World Bank Africa Database, 2005). The stable saving and investment rates during the ten years period despite the erratic nature of economic performance indicates that saving and investment have weak correlation with growth rate. Saving must have been dependent on sectors of the economy that remain relatively stable such as the service sector. The weak relationship between saving and economic performance supports the point that the economy's performance is highly reliant on natural conditions.

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[3] Mulat Demeke, Atlaw Alemu, Bilisuma Bushie, Saba Yifredew and Tadele Ferede, 2007, "Exploring Demand and Supply Factors Behind the New Developments in Grain Prices in Ethiopia: Key Issues and Hypothesis," a paper done for DFID-Ethiopia.

[4] There is considerable discrepancy between the MoFED figure and the figure from World Bank Africa Database, 2005. According to World Bank the figure for Investment-GDP ratio is around 18 percent.

The average rate of gross domestic saving and gross investment as percentage of GDP for the 1997/98-2006/07 period stand at 6.6 percent and 22.8 percent respectively. The saving rate tended to fall overtime while, the investment rate has risen over time leaving an increasingly wider saving gap as a percentage of GDP. In the last five years of the period under consideration, average saving has fallen to 4.2 percent of GDP but average investment has increased to 23.9 percent of GDP (MoFED, 2007/08). This significant internal gap has its equivalent external surplus counterpart. Such gap has implication to inflation through its effect on balance of payments and the resulting financing. Accordingly, the country has been compelled to rely on external sources for financing its expenditure with the financing demand growing in recent periods.

Ethiopia being a developing country highly dependent on foreign inflows, the difference between gross national saving and gross capital formation doesn't equal the foreign gap (the difference between exports and imports). The difference between the saving gap and foreign gap gives net factor payments and current transfers from abroad. During the 1997/98-2006/07 period, private saving has been significantly higher than private investment. It has registered continuous and fast growth during the period except in 2001/02 and 2003/04 averaging 20 percent per annum. As opposed to developments in the private department, fiscal gap (the difference between government investment and government saving), grew by 16.3 per annum over the same period (MoFED, 2007/08). Despite the surplus of private saving over private investment, because the fiscal gap has been huge, the saving gap of the country has grown over the period. This in turn required growing inflow of funds in the form of factor payments and current transfers. Since such inflow has no real goods counterpart in the economy, unless the supply of output is elastic, it could be inflationary.

2.2. Fiscal Developments

To achieve the most important macroeconomic objectives of internal and external balance, governments may want to guide the course of economic activities using fiscal, monetary and/or exchange rate policies. In most developing countries with exchange rates often held fixed the most important tools at the disposal of policy makers are fiscal and monetary policies. With fiscal policies (income and expenditure policies), governments seek to influence macroeconomic activities through their discretion over tax and government expenditure.

2.2.1. Government Revenue

Over the 1997/98-2006/07 period, revenue and grants stand out as the most important sources of expenditure financing. Government revenue on average covers over 61 percent of government expenditure. In government revenue, tax income accounts for 73 percent while non-tax income accounts for 27 percent. Over the ten years period covered in the study, the government's tax income has almost quadrupled. It has grown on average by around 14 percent per annum. The growth though, was not steady over the period. There have been ups and downs with the largest growth being 43 percent in 2003/04 (MoFED, 2007/08). This high growth in tax revenue results mainly from the tax revision of 2003/04.

The share of tax revenue in total government revenue remained stable over the ten years period. But, the share of non-tax revenue and grants decreased after 2001/02 due to fast increase in import duties and taxes despite the fast increase of grants in 2006/07 amounting to 103 percent. Yet, its weight in total government revenue did not grow much relative to the mean share of grants (MoFED, 2007/08). The fast increase in grants may have encouraged government expenditure sprays and, therefore, may have influence in the current inflationary process.

2.2.2. Government Expenditure[5]

In Ethiopia, government expenditure accounted on average for over 24 percent of GDP between 1997/98 and 2006/07 (MoFED, 2007/08). This reflects that variations in government expenditure will have significant effect on the level of aggregate demand and thus on price developments.

The period 1997/98-2001/02 saw the share of government's expenditure in GDP rising from 20 percent to 28 percent. Between 2002/03 and 2006/07, however, the ratio regressed back to around 21 percent. Though the share of government expenditure in GDP was rising in the 1997/98-2001/02 period, the period also saw the government's expenditure shift away from consumption goods. The share of government final consumption expenditure decreased from 14.6 percent of GDP per annum between 1997/98 and 2001/02 to 12.3 percent of GDP per annum over the 2002/03-2006/07 period (MoFED, 2007/08).

Though, the share of government expenditure in GDP on average decreased between 2002/03 and 2006/07, its growth rate tended to rise[6]. This is because in real terms of GDP has grown faster relative to government expenditure. Between 2001/02 and 2006/07, government expenditure has grown by 11 percent annually, while for the last three years the figure rises to over 20 percent.

On average, during the 1997/98-2006/07 period, 61.7 percent of the total government expenditure has been on current expenditure the rest being on capital expenditure. This large size of current expenditure may have impeded growth by reducing the resources available for capital expenditure. Defense expenditure, poverty targeted expenditure (which includes education, health and agriculture) and expenditure on interest payment constitute the most important components of current expenditure with 27.9 percent, 30.7 percent and 9.1 percent respectively. Over 55 percent of the interest obligation has been on domestic borrowing and the

[5] For the summary of government revenue and expenditure see Appendix 1(a).
[6] There was a sharp decrease in the growth rate of government expenditure following the draught of 2002/03. This is also reflected in the growth rate of capital expenditures (see Figure 10).

rest on external borrowing. Over the ten years period, current expenditure has grown steadily at a rate of 12 percent per annum (MoFED, 2007/08).

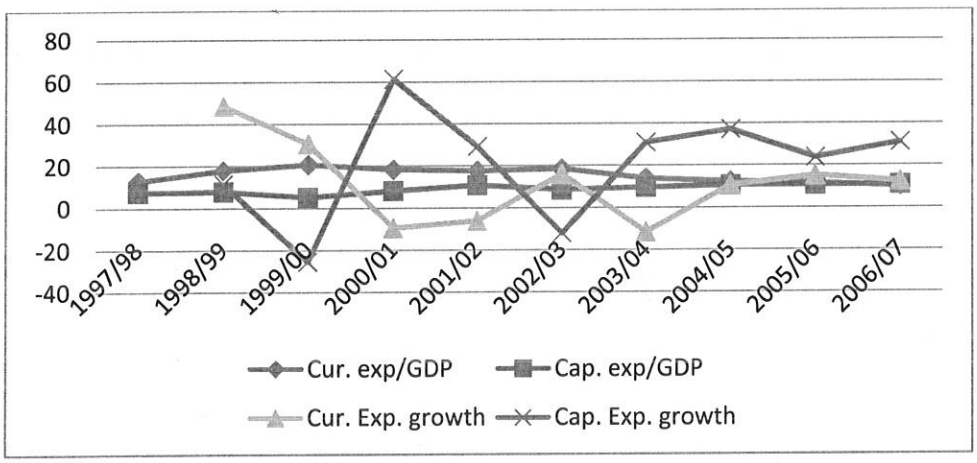
The nature of current expenditures does not make them that suspect to the fast growing prices except under conditions of major revision in wage rates or wage structures. In relation to the effect of current expenditure growth on inflation we may consider the wage revision of 2007/08. But, this could have influenced the inflation in prior years only through agents' expectations as the rise in wages was already anticipated. The evolution of capital expenditure, however, needs to be seen carefully in relation to the current inflationary trend. Capital expenditure accounts for 10.6 percent of GDP and 37.1 percent of government expenditure over the 1997/98-2006/07 period (MoFED, 2006/07).

Though its share in government expenditure for the 1997/98-2006/07 period was, on average, less than that of current expenditure, capital expenditure has grown at a higher rate (21 percent per annum) compared to current expenditures. As a result, the gap between the shares of the two in government expenditure has continuously fallen in recent periods. The share of capital expenditure has overtaken that of current expenditure in 2006/07 reaching 52 percent (see Figure 2.4). Growth in capital expenditure is often considered as a welcome development as it serves as an impetus to future output growth. Yet another important aspect of capital expenditures is that often capital projects do not go into operation within the year in which expenditures are made. Thus, at least for some time the money injected into the economy for financing such projects might produce inflationary pressure. The magnitude of such inflationary pressure, however, depends on the source of finance used.

The government has financed its capital expenditure from three sources. About 66 percent of capital expenditures were financed from central treasury while the rest came from external assistance (15 percent) and external loans (19 percent) (MoFED, 2007/08). All of these sources of finance might have considerable effect in price

developments. Especially, the lion's share of the means of capital expenditure financing coming from central treasury indicates that domestic money creation might have played significant role in the current inflationary process. Between 2002/03 and 2006/07, the National Bank of Ethiopia's direct advance to the government has almost quadrupled while there has been no major change in central government deposit with NBE or the foreign assets of the NBE (NBE, 2006/07). This indicates that the expenditure financing from the central treasury might have mainly come from money creation, not running down of central government deposits with NBE or foreign assets.

Figure 2.4: The evolution of current and capital expenditures.

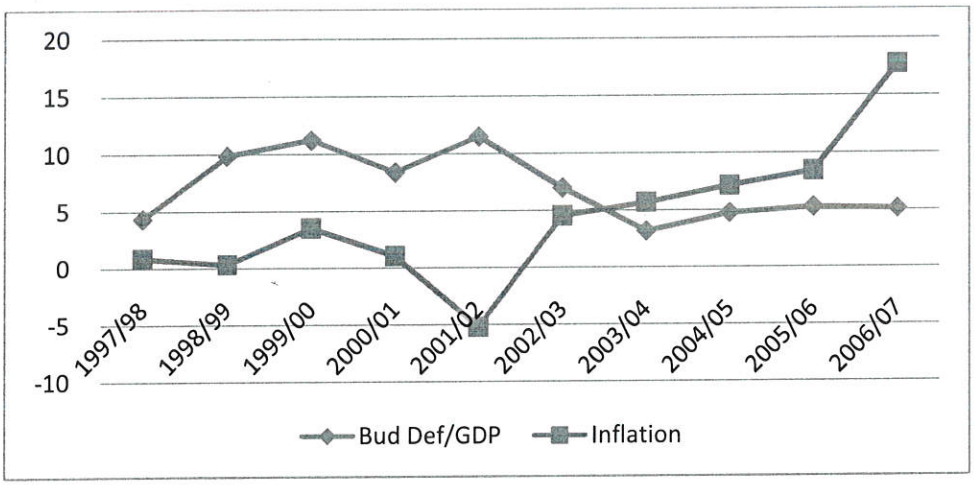


Source: Own computation based on MoFED (2007/08).

Over the 1997/98-2006/07 period, national accounts recorded persistent budget deficit. The government's income including grants falls considerably short of its expenditure. The average budget deficit stands at 7 percent of GDP while the figure for the last three years of the period is 5 percent of GDP. If grants are excluded the period average and the last three years average deficit would jump to 11.7 percent and 9.6 percent respectively. Though budget deficit as a percentage of GDP tended to fall in recent years, it has continued to grow in absolute terms. The average growth rate of deficits for the period has been 25.3 percent while this figure has increased to 40 percent over the last three years (MoFED, 2007/08).

To finance the budget deficit, the government resorted to external and domestic borrowing as well as privatization of public enterprises. For the 1997/98-2006/07 period external borrowing and domestic borrowing each accounted for around half of the total deficit with the balance slightly swinging towards domestic borrowing, while a very small share (4 percent) is taken up by receipts from privatization. The budget deficit and the means of financing it thereof might have played some role in the current inflationary process. As can be seen from Figure 2.5, before 2002/03, budget deficits (including grants) were not associated with inflation mainly due to the more conservative monetary policy followed by the government. After 2002/03 however, any given level of budget deficit has been associated with ever growing inflation. This could partly be due to the government following a less conservative monetary policy and its growing reliance on domestic borrowing. Domestic borrowing reached over Birr 6 billion in 2006/07, with around 70 percent coming from the banking system (MoFED, 2007/08).

Figure 2.5: Trends of Inflation and Budget deficit



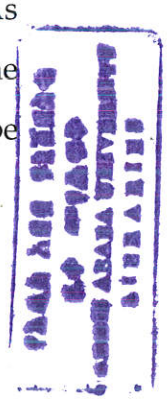
Source: NBE (2006/07)

The current expenditure account of the government of includes the value of external food and relief related aid. The value of such aid during the major drought year (2002/03) was Birr 2.9 billion while this value fell to just Birr 0.7 billion in 2003/04. As a result of this fall in food and relief related aid, current government

expenditure decreased by 11.6 percent in 2003/04 and caused decrease in budget deficit (MoFED, 2007/08).

From the discussion above, the inflation of the last three years could well be linked to the rising government expenditure, the resulting budget deficit and the ensuing financing problems thereof.

Before 2004/05 the government ran IMF programs (such as Structural Adjustment Program (SAP), Enhanced Structural Adjustment Facility (ESAF) and Poverty Reduction and Growth Facility (PRGF)). During this era, the IMF encouraged (forced) the government to follow strict fiscal policies[7]. This had compromised growth for macroeconomic stability. Sooner than these programs were terminated in 2004/05 did the government embarked on less stringent fiscal policy exercise. As a result the country has experienced growth and significant rates of inflation. The rise in prices has become massive in recent years. This situation can partly be ascribed to the government's expansion of expenditure and credit.



2.3. Monetary developments

2.3.1. Money supply4[8]

Money supply is the second key instrument with which governments try to exercise stabilization policies. Money supply fluctuations have implications to growth, unemployment and inflation. The control that governments have over money supply is, however, limited due to the role commercial banks and the general public play in the determination of money supply.

Between 2002/03 and 2006/07 money supply (M2)[9] has on average grown by over 16.5 percent, while real GDP has grown by 9 percent over the same period (NBE, 2006/07 and MoFED, 2007/08). Assuming money is held only for transactions

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[7] For detailed discussion of the recommendations of IMF to the government of Ethiopia, see Joseph E. Stiglitz, 2001, *Globalization and Its Discontents*, W. W. Norton & Company, Inc., New York.

[8] Narrow money (M1) includes currency in circulation and demand deposits while broad money (M2) includes (M1), savings deposits and time deposits.

[9] Official data for M2 doesn't include credit by microfinance institutions as well as credit by DBE. In computing money supply (M2) growth I have included the credit by microfinance institutions.

purposes and the velocity of money is roughly constant, the growth rate of money supply should be equal to the growth rate of real GDP to leave the price level intact. However the significant difference between the two in Ethiopia may have been overcome by rise in the general price level. Before 2002/03 velocity of money on average was falling but after 2002/03, this trend has been reversed and it has continuously grown (*Ibid*). In the face of rising velocity of money, to keep the price level stable the corresponding monetary growth should have been slower.

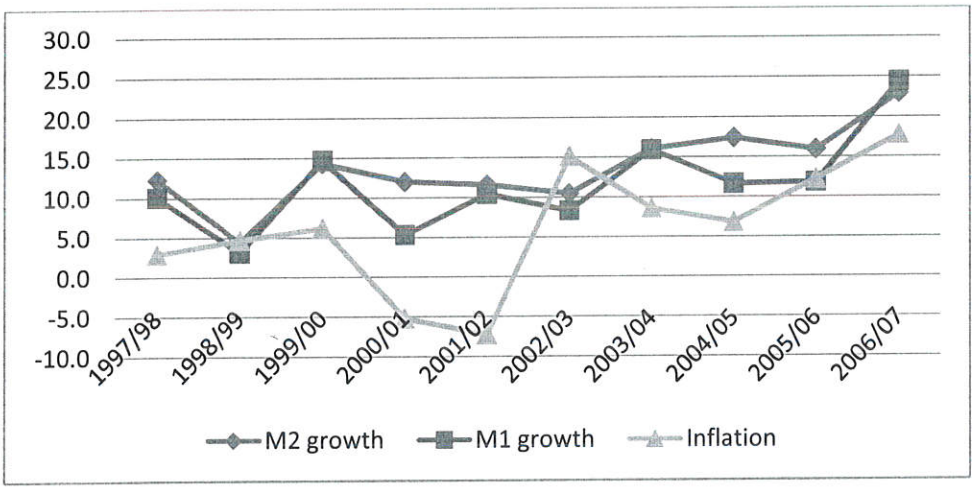
An important point worth mentioning in relation to money supply growth is the role of credit by microfinance institutions. Over the 2002/03 -2006/07 period, it has grown on average by over 48 percent annually, from Birr 527.5 million in 2002/03 to Birr 2735.7 million in 2006/07 (NBE, 2006/07). Similarly the credit by Development Bank of Ethiopia (DBE) is quite very significant. The outstanding credit by DBE in the third quarter of 2007/08 stands at Birr 6204 billion. Excluding the whole of credit by microfinance institutions and DBE from the money supply, thus, may lead to a completely wrong conclusion about the role of money supply in the current inflationary trend in the country.

Over the ten year period covered in the study, money supply has grown faster than real GDP. Both M1/GDP ratio and M2/GDP ratio have continuously grown with the growth slightly higher in 2002/03, due to the drought in the same year, and in 2006/07, due to fast growth of money supply. Other things constant, the fast growth of money supply to real GDP ratio indicates that money supply was growing at a rate higher than that required for transactions purposes and thus may have been inflationary. This is supported by the fact that the fast increase in the growth rates of M1 and M2 from 12 percent and 16 percent respectively in 2005/06 to 24 percent and 23 percent respectively in 2006/07 was accompanied by faster increase in the growth rate of nominal GDP from 24 percent to 30 percent and inflation soaring from 8 percent to 18 percent while the real GDP growth rate

remained stable around 11 percent (see Appendix 1(b)). This confirms the importance of monetary development in the inflation process in Ethiopia.

Not only money supply but also the growth rates of M1 and M2 have been growing over time. Compared to the year before, M2 increased by 7 more percentage points in 2006/07. The co-movement of money supply and inflation in Figure 2.6 indicates that the growth in money supply has had implication to the price developments in the country during 1997/98-2006/07 period.

Figure 2.6: Evolution of money supply and inflation



Source: NBE (2007/08) and own computation.

During most of the 2001/02-2006/07 period, M2 has grown at a faster rate than M1 due to faster increase in savings deposits. The fall in saving deposits in 2006/07 is associated with fall in growth rate of M2 below M1, confirming the importance of savings deposits in money supply (see Appendix 1(b)).

2.3.2. Exchange rate

The Ethiopian exchange rate market trades only in US dollars. There is no quotation of the Birr against other currencies. The exchange rate of Birr against dollar is

determined in an interbank foreign exchange market[10]. The foreign exchange system has over time evolved into a relatively flexible regime. Yet, in addition to its regulatory role National Bank of Ethiopia maintains the right to interfere in the exchange rate market as a buyer and supplier of foreign exchange. One of the criteria it uses in determining the extent of its intervention is the target exchange rate it sets. It tries to regulate fluctuations around the target rate through purchase and sells of foreign exchange and moral suasion. Despite the exchange rate being mainly determined by the interaction of demand and supply in the interbank foreign exchange market, often demand is by far higher than the supply of foreign exchange. In effect, supply remains the main determinant of exchange rate. Practically, therefore, exchange rates remain largely unresponsive to changes in economic conditions. Accordingly, the 1996/97-2006/07 period registered quite low depreciation of the domestic currency. The average rate of depreciation of the Birr against US dollar stands at 3.1 percent per annum while this figure is very low (0.6 percent) for the last five years of the period. The period saw the depreciation rate decreasing over time (MoFED, 2007/08).

The stable exchange rate of the Birr against US dollar could partly be explained by the weakening of the dollar against other major currencies such as the Euro and Pound Sterling. The depreciation of the US dollar against other major currencies is fully reflected in the exchange rate between Birr and the major currencies due to absence of direct quotation of Birr against other currencies like Euro or Pound Sterling. This can be seen from the fact that the Birr depreciated more against Euro and Pound Sterling than against US dollar. In 2006/07 for example, Birr depreciated by 2.7 percent against US dollar but by 9.1 percent and 10.2 percent against Euro and Pound Sterling respectively, while US dollar depreciated by 7.3 percent and 8.8 percent against Euro and Pound Sterling respectively (NBE, 2006/07). Between

[10] For a detailed discussion of the Ethiopian exchange rate system see Alemayehu Geda (1999), "The New Financial Sector and Its Regulation: The Case of Ethiopia". Paper presented at the UN-WIDER workshop on Transition and Reconstruction in Sub-Saharan Africa, Helsinki.

1996/97 and 2006/07, the US dollar depreciated against Pound Sterling by an average of 1.6 percent per annum[11] (IFS, 2007). The depreciation of the Birr against all major currencies makes Ethiopian exports cheap to foreigners and its imports very expensive. With the import to GDP ratio for the 2002/03-2006/07 period as high as 27 percent, the depreciation of Birr only helps exacerbate the inflationary pressure (MoFED, 2007/08).

In 2007/08, however, the Ethiopian Birr has considerably depreciated against the US dollar. This sharp depreciation of the Birr could be attributed to a host of factors. First, the growing importance of the parallel market and the oligopolistic power of the dealers in this market may have caused exchange rate volatility. This, in the face of the growing demand for imports, may have induced fall in the value of Birr. Second, due to the current inflationary situation people may have begun to keep their wealth in terms of hard currencies. The ensuing fall in demand for Birr may have led to depreciation of the Birr against the US dollar. These two points are substantiated by the fact that for a long time the parallel market premium has been very low and relatively stable. But, it has began rising significantly recently.

2.3.3. Interest Rate

The Ethiopian financial sector is not well developed. The market offers only a few financial assets. Accordingly, there are a few rates of interest to consider when looking at the interest rate movements; the major ones being the lending and deposit rates. The government sets minimum deposit rate on savings and time deposits and maximum lending rate except for central government loans. There was a major interest rate revision in January 1998 with the minimum deposit rate having been reduced from 7 percent to 6 percent, the maximum lending rate was abolished and the central government borrowing rate reduced from 12 percent to 6 percent. In March 2002 the minimum deposit rate was again revised down to 3

[11] This average doesn't include 2006/07. In computing the periodic average exchange rate in I used the formula $EX_{yt/yt+1}=(EX_{yt}+EX_{yt+1})/2$.

percent. The central government borrowing rate was further reduced in August 2002, and February 2005 down to 5 percent and 3 percent respectively (NBE, 2006/07).

Of all the interest rate revisions, the 2002 revision was more significant both in terms of its size and its possible relationship to the price development from 2001/02 onwards. The onset of the price rise spiral coincides with the interest rate revisions. The relatively small reduction in the minimum deposit rate might not have affected the behavior of depositors but the abolition of maximum lending rate might have encouraged lending on the part of banks at a higher premium in the presence of the high demand for loan in the country. Most importantly, the reduction of central government rate of borrowing might as well have encouraged government expenditure financing from domestic borrowing. At the current central government loans rate (3 percent) and inflation rate (18 percent), the government's interest obligation at debt settlement would be negative 15 percent. Thus, domestic borrowing proves an inexpensive means of government expenditure financing. The government used no domestic sources to finance its deficit in 2001/02. But from 2002/03 onwards, the government relied heavily on domestic financing of deficits. The rate of domestic deficit financing has on average grown by around 50 percent per annum between 2002/03 and 2006/07. In 2006/07 alone the government's use of bank and non-bank domestic sources of financing has recorded a growth rate of 128 percent (NBE, 2006/07). As discussed in previous sections, domestic bank borrowing has been the most important source of domestic expenditure financing. Such means of financing are highly inflationary.

Due to higher inflation the real interest rate (both deposit and lending) is negative. Yet the disadvantage weighs against depositors, who for example, faced a negative 14.6 percent interest rate in 2006/07. The inflation seems to affect lenders, who receive a negative 7.2 percent interest, less as they only have to pay their depositors

the negative 14.6 percent interest and make a 7.4 percent profit in the process[12]. As a result, the disbursement of fresh loans by public and private commercial banks continued to grow despite the negative real interest rates. In 2006/07, for example, the amount of fresh loans disbursed has grown by 25.5 percent (NBE, 2006/07).

The revisions of 2002 may have had a part to play in the upturn in the trends of prices and GDP through two likely roots. First, the reduction in deposit rate may have induced rise in aggregate demand by lowering the cost of holding money. During the year immediately following the interest rate revision (2003/04), real consumption expenditure growth rate jumped to 12.4 percent from -0.1 percent in 2002/03, the fastest growth coming from private consumption expenditure. Second, the reduction in lending rate may have encouraged investment and government expenditure and hence led to growth in aggregate demand. The growth rate of real investment jumped from -10.7 percent in 2002/03 to 32.4 percent in 2003/04 (MoFED, 2007/08). The growth in consumption expenditure and investment may as well have resulted from the recovery of the economy following the drought of 2002/03. But still, the data suggest that the revision of the interest rates may have contributed to fast growth of aggregate demand and hence to price hikes, ceteris paribus.

2.4. Balance of Payments Developments

As much as any economy wishes to achieve internal balance, it also wants to achieve external balance, which is usually reflected in healthy balance of payments. Countries may incur balance of payments deficit, but the deficit cannot be sustained for economic and political reasons. In the long-run, any sustained deficit/surplus in current account has to be balanced against capital account surplus/deficit.

Over the 1997/98-2006/07 period, the current account of the country recorded sustained deficits amounting to 17 percent of GDP. The deficit has grown to 21

[12] One may be led to think that banks are losing out due to the current inflation. Yet, they receive deposits at a negative real rate anyway (much less than they pay out).

percent of GDP during the later half of the period (2002/03-2006/07). Over the ten years period covered in the study, current account deficit showed no sign of falling over time. Rather it has on average increased by around 22 percent per annum. The 2002/03-2006/07 period saw the growth rate rise to over 26 percent (MoFED, 2007/08).

During the 1997/98-2006/07 period the country's exports on average grew by 11 percent while imports grew by 18 percent per annum. Compared to the first five years of the period, the country's external sector performed better during the last five years, with exports having grown by 23 percent while imports have grown by 25 percent (MoFED, 2007/08). Though likely very small since the export of food grains is occasional and small in amount, this expansion of the export sector may have had its effect on inflation trough reducing domestic supply of agricultural products.

Ethiopian exports are predominantly agricultural products and commodities while its imports are dominated by capital goods and raw materials. The former have low price and income elasticity while the later have higher elasticity. Moreover, the country's exports are characterized by supply rigidity. Such structural problems have in the past been the source of severe macroeconomic crisis. Good cases in point would be the recurrent droughts and the world coffee price slump.

The fast increase in exports could be explained by increase in the export of Ethiopian traditional export commodities; i.e, coffee, oil seeds and pulses and leather and leather products. Especially, coffee receipts have grown by over 163 percent between 2002/03 and 2005/06. The rise in coffee export receipts could partly be ascribed to the relative improvement in world coffee price. The volume of coffee export has also grown considerably (40 percent) over the same period. Moreover, the growing importance of meat and meat products and gold as well as the emergence of new export items such as cut flowers has also contributed to the rise of export revenue (NBE, 2006/07).

The most important import items are petroleum products, machinery & aircraft, road motor vehicles, electrical materials, metal and metal products, food and live animals, medical and pharmaceutical products, textiles, and fertilizers. These items on average accounted for over 73 percent of annual imports between 2004/05 and 2006/07. The major import items registered fast increase during the 2002/02-2006/07 period. For example, the value of petroleum products, which account for about 20 percent of imports, has more than quadrupled between 2002/03 and 2006/07 (NBE, 2006/07). This is partly due to rise in demand for petroleum as a result of the economic growth and partly due to the fast increase in the world price of petroleum products. The rapid increase in imports, with the world price for commodities and raw materials rising, may introduce imported inflationary pressure.

The capital account of the country has been in a better situation than the current account between 1999/00 and 2005/06. During this period there has been continuous capital account surplus, with the surplus growing over time mainly due to fast increase in net direct investment. Between 2001/02 and 2003/04 the current account deficit was relatively low due to huge official transfers. Thus capital account surplus accompanied by low level of current account deficit led the country experience balance of payments surplus. After 2003/04, though, there has been massive increase in current account deficit mainly due to huge increase in imports. In 2004/05 and 2005/06 alone imports grew by 37 percent per annum. Such developments, with exports growing at a much lower rate (19 percent per annum) and official transfers remaining reasonably stable, have led to the overall balance of payments returning back into deficit (NBE, 2006/07).

2.5. Output Supply

In addition to the factors that lead to growth of aggregate demand discussed above, another aspect that may have contributed to the current inflationary process is the development in supply of output over the period under consideration. This is

interesting given that despite the reported fast increase in output (GDP) over the last five years, prices continued to rise. Especially, the supply of food requires a closer look since it accounts for about 60 percent of total household expenditure.

Between 1997/98 and 2006/07 crop production has shown an average annual growth rate of 5.9 percent. The first half of the period is characterized by erratic movement of crops with output falling in 1997/98, 2001/02 and 2002/03. During the drought year of 2002/03, as expected food prices have recorded a 24.8 percent increase. In the four years following 2002/03, grain production is reported to have recorded fast increase growing by 17.8 percent per annum (MoFED, 2007/08). This fast increase, however, has not prevented food price growing fast. Over the same four years period food inflation stood at 13.1 percent (NBE, 2006/07). The fact that food prices responded negatively to supply (level of production) of grain in the past but continued to rise recently despite the rise in reported output calls two possible explanations into attention. Either the marketed supply of total grain production has fallen short of demand or the reported figures of grain production are not correct.

The marketed surplus of food depends mainly on two factors: domestic marketed surplus which is the difference of total grain production and on farm consumption of farmers, food aid and the net of commercial food exports and imports also needs to be taken in to account.

In relation to food aid what matters to the domestic price of food is not the food aid that comes into the country. Rather it is the amount of food aid that is distributed which has direct effect on food prices. Between 2003/04 and 2007/08 the amount of food aid domestically distributed by NGOs and DPPA in constant 2000 prices has on average fallen by over 35 percent per annum. On the other hand food import has remained reasonably stable over the same period.

3. Review of Literature

3.1. Introduction

Maintaining reasonable degree of price stability while allowing for a minimum acceptable level of growth of the economy and hence of employment is a key goal of most governments. Tackling high inflation is necessary not only because it causes macroeconomic instability, but also because it hits the poor particularly hard as they lack effective hedges against inflation (Callen and Chang, 1999).

Over the above side effects, inflation may lead to fall in both domestic and foreign investment due uncertainties in the economy, thus lowering growth rates. It may also lead to erosion of a country's competitive advantage, because it makes domestic goods relatively expensive to foreigners (Fullerton 1999, Isakova 2007).

Inflation could be considered as an outcome of demand side (monetary) shocks, supply side (real) shocks, price-adjustment (inertial) factors and/or political (institutional) factors (Kibritçioğlu, 2002).

Kibritçioğlu, (2002) argues that inflation could result from high public sector budget deficits, monetization of public sector budget deficits, massive infrastructure investments of governments, high military expenditures, political instability which results in inflationary pressures due to populist policies that have ensued prior to each general election, persistent inflationary expectations of economic agents, international price pass through effects of rise in import prices due to rise in foreign price of imports and/or exchange rate movements, increases in regulated prices of public sector products which are mainly used as input by the domestic private sector, and rising interest rates resulting from the crowding-out effect of public sector borrowing in the shallow domestic capital market.

Different schools of thought emphasize one or a combination of the above possible sources of inflation. The major debate, though, lies between demand-pull and cost-push explanations for inflation. The main proponents of demand-pull inflation are

monetarists. For them, inflation is always and everywhere purely a monetary phenomenon (Friedman, 1956).

The proponents of the cost-push theory of inflation attribute inflation to a host of non-monetary, supply-oriented influences that alter the unit cost and profit markup components of the prices of individual goods (Humphrey, 1998). According to this theory cost-disinflation serves as a check to inflationary pressures. For these economists, the chief factors holding inflation at bay are increased global competition and rapid technological progress.

Conventional monetary theorists have always had a problem with the cost-push view. In their opinion, cost-push can only at best explain relative price changes not the average price (aggregate) price changes. It could, however, explain aggregate price changes if it can show how cost pressures in specific sectors of the economy can markedly influence the money stock, its velocity, and the aggregate level of output (Humphrey, 1998).

3.2. Theoretical Literature

Various factors have been ascribed as the prime sources of inflation in literature by various schools of thought. Important variables such as monetary and fiscal developments may be crucial in explaining inflationary processes. Yet, the sources of inflation in all countries need not be the same. The peculiarities of economies may play a part in inflationary processes.

Any attempt of understanding inflation needs to start from theoretical considerations and empirical findings of other inflationary experiences. In this regard, first the various theories of inflation are discussed followed by empirical studies of inflation. In the review of theories of inflation the alternative theories are grouped into two broad categories; the demand-pull theories and cost-push theories of inflation.

3.2.1. Demand-pull theories of Inflation

3.2.1.1. Classical/Neoclassical and Monetarist theories

Classical and neoclassical economists use the quantity theory of money to explain the sources of inflation. In its transactions version the QTM states that "the value of all sales of goods must necessarily equal the value of all purchases" (Kibritçioğlu, 2002).

As Barenjee (1975) puts it the original QTM as expressed by Fisher's equation of exchange is given as:

$$M \cdot V = P \cdot T \tag{3.1}$$

where, M is money supply, V is velocity of money, P is general price level and T is real volume of transactions[13].

The theory is built around two assumptions: constant velocity of money and full employment of resources. The assumption of full employment implies that the volume of transactions (T) is constant.

In the QTM framework aggregate supply is gives and is equal to T while aggregate demand is defined as:

$$AS = T \tag{3.2}$$

$$AD = (M \cdot V)/P \tag{3.3}$$

In the goods market equilibrium, we have

$$T = (M \cdot V)/P. \tag{3.4}$$

Rearranging,

$$P = (\tfrac{V}{T}) \cdot M \tag{3.4a}$$

[13] The derivation of inflation function in the context of QTM is taken from Barenjee (1975). A similar derivation can also be found in Kibritçioğlu (2002).

Taking the logs and differentiating with respect to time, we come up with an inflation equation of the QTM:

$$\pi = (v - t) + m \tag{3.5}$$

where π is the annual rate of inflation, v is the growth rate of velocity, t is the growth rate of the volume of transactions and m is the growth rate of money supply. But from the basic assumptions of the model, V and T are constant. Thus, the growth rate of V and T must be zero. The conclusion of the model is, therefore, that any increase in money supply translates into proportionate increase in the price level.

Alfred Marshall modified the quantity theory of money by introducing liquidity preference into the quantity equation:

$$M = k \cdot (P \cdot Y) \text{ or } P = M/(k \cdot Y) \tag{3.6}$$

where M is money supply, k is the fraction of income people wish to hold in the form of money, P is price level and Y is real output. Change in the preference of holding money reflected in change in k may produce large and quick changes in output and prices (Barenjee, 1975).

Rewriting the above equation in terms of growth rates we have:

$$\pi = m - k^* - y \tag{3.7}$$

where π is the growth rate of price, m is the growth rate of money supply, k^* is the growth rate of the fraction of money in peoples' income and y is the growth rate of output. The implication of Alfred Marshall's version of QTM is that inflation is explained not only by increase in money supply, but also by psychological change in liquidity preference (*Ibid*).

Monetarists follow the same line of reasoning as the classical/neoclassical theorists. But they differ in their treatment of V and T. They don't take V and T to be constant

a priori. Money is considered as an asset or capital good thus, its demand is like the demand for a capital good (*Ibid*).

In his restatement of QTM, Friedman, unlike classical/neoclassical economists, considers the theory as a theory of demand for money not of demand for output. The quantity of money people wish to hold depends on their money income and cost of holding money. The cost of holding money depends on interest rate and inflation (Barenjee 1975, Patinkin 1972).

If $\frac{M^*}{P \cdot Y}$ is the desired ratio of money to money income consistent with the equilibrium condition $M \cdot V = P \cdot Y$, increase in money supply at any particular time will make the ratio more than desired. People respond to this by spending part of their money holdings until the desired ratio is reached. This in turn derives the price level or output up. Similarly, starting from an equilibrium condition, a given rise in money income causes money demand to grow by higher proportion to the rise in income due to the need to carry out increased volume of transaction at the new level of income. In the long run, real income exhibits secular rise thus, forcing a downward drift in velocity (V) (Barenjee, 1975).

The classical/neoclassical theory of inflation has two essential characteristics: first, inflation is a full employment phenomenon and second, inflation is a money supply phenomenon. These two features are reflected by the equal percentage change in price for any percentage growth in the stock of money supply. This assumes unit elasticity between prices and money supply. The condition of proportionality will hold only if certain conditions are satisfied: the economy should *always* be operating at full employment, money demand should be stable, money supply needs to be exogenous and money must be neutral. In addition to these conditions, given the definition of inflation as continuous rise in price level, parameters in the economy should remain unchanged over the period under investigation (Weeks, 1989). In a real world economy, however, most of these assumptions are unlikely to hold. Most economies, at least the developing world, are operating below full employment as

evident in the rapid growths of late, money supply is not purely exogenous and economic parameters exhibit temporal variation. Most importantly, the theory fails to explain inflationary pressures that have set in with money supply kept tighter. Thus, applying the classical/ neoclassical theory on its own to understand inflation in developing countries may not produce the whole picture.

One of the most widely used inflation theories within the neoclassical tradition in and open economy context is the purchasing power parity (PPP) theory of inflation.

The starting point in PPP is the law of one price, which states that abstracting from tariffs and transportation costs trade should ensure identical prices across countries for identical products. For any good i and time t,

$$p(i) = p_t^*(i) + e_t \tag{3.8}$$

where $p_t(i)$ is the log of the domestic currency price of good i at time t, $p_t^*(i)$ is the log of the foreign currency price of good i at time t and e_t is the log of the relevant nominal exchange rate at time t.

If the law of one price holds for every individual good it must also hold for identical basket of goods (Ginting, 2007). Thus, after accounting for exchange rate between currencies, the price of basket of goods must be equal across countries at any given period of time.

$$p_t(CPI) = p_t^*(CPI) + e_t \tag{3.9}$$

where CPI denotes the basket of goods used in forming the consumer price index. In most cases, however, countries do not have exactly the same basket of goods. To allow for constant price differential between baskets, following Ginting (2007), relative PPP can be derived by taking the difference of the above equation.

$$\Delta p_t(CPI) = \Delta p_t^*(CPI) + \Delta e_t \tag{3.10}$$

This equation requires that change in relative price be offset by change in exchange rate.

The implications of the PPP approach depend on the exchange rate regime in place. If the exchange rate regime is fixed, then under the assumption of price taking behavior by a small open economy, foreign prices will lead domestic prices. In this case the influence of domestic factors over inflation is just transitory, at most. If however, the exchange rate is depreciating, it indicates that domestic factors are contributing to long run inflation and pushing it permanently higher than the world inflation (Kenny and McGettingan, 1996). Thus, if PPP is accepted as a valid proposition, the size of the domestic contribution to inflation "could be accurately gauged from movements of the nominal exchange rate" (Kenny and McGettingan, 1996: pp. 55).

The PPP approach has some serious limitations. Most of its limitations relate to its implicit assumptions. First, the model assumes away market imperfections: no price or wage rigidities in the small open economy and no trade barriers such as tariff and quota. It also assumes there are no transportation costs. Transportation costs, however, constitute important part of costs and could lead to price differentials across countries, particularly in developing countries. Second, it assumes absence of structural differences across countries. Such structural differences may lead to different basket of goods across countries and thus, difference in prices. Moreover, no consideration is given to the possibility of structural inflation in the context that different sectors may contribute differently to aggregate inflation. It is assumed that international price movements affect price both in tradable sector and non-tradable sector equally. The most appalling assumption of the model is that the effect of domestic factors on the general price level (or CPI) is only transitory.

3.2.1.2. Keynesian theories of inflation

Keynes' (1936) most famous work, the *General Theory of Employment, Interest and Money* was based on the assumption of underemployment. Kibritçioğlu (2002) argues that this work of Keynes' was not designed to analyze the dynamics of inflation. Keynes (1940), however, provides an alternative theory of inflation in a

full employment condition, which represents a marked deviation to his previous works which serve as basis for stabilization policies.

In his theory, Keynes sites short run price rigidities in the labor market as the force behind inflation. He considers inflation as means of income redistribution that "acts like a pump that transfers income from wage earners who have a low propensity to save and a low marginal tax rate to the entrepreneurial sector with a higher propensity to save and a higher marginal tax rate" (Frisch, 1983: 230). According to Keynes, unexpected increase in aggregate demand creates "inflationary gap" and leads to inflation under full employment conditions. This in turn creates unanticipated profits for firms while nominal wages remain temporarily constant. The rising profit creates excess demand in the goods market. The rise in profit compels firms to expand their production there by creating excess demand in the labor market. The competition for fully employed labor among firms pushes nominal wages until real wage is restored at its initial level. The increase in real wage in turn produces excess demand in the goods market and hence inflationary pressure. The interaction of the labor and goods market produces wage-price spiral that can only be reversed by checks to aggregate demand (see Kibritçioğlu, 2002).

Barenjee (1975) indicates that some writers[14] have traced two different theories of inflation in Keynes' writings. "It has been pointed out that *The General Theory of Employment, Interest and Money* emphasizes inflation as a situation of excess demand and his later booklet *How to Pay for the War*, inflation as the result of autonomous increase in cost"(Barenjee, 1975: 25-26).

3.2.1.3. Keynesian-Neoclassical synthesis

The standard Keynesian IS-LM framework had no room for continuous rise in price. The Keynesian-Neoclassical synthesis, thus, incorporated labor market

[14] See for example S. Weintrub, "The Keynesian Theory of Inflation: Two Faces of Janus", International Economic Review, 1960.

dynamics into the IS-LM framework by considering Phillips curve (PC) in the analysis. The Phillips curve links inflation to labor market dynamics.

$$\pi = \alpha U \tag{3.11}$$

where π is inflation rate, U is unemployment rate and $\alpha < 0$.

In line with the demand-pull theories, decrease in U is interpreted as excess demand both in labor market and goods market (Kibritçioğlu, 2002).

The IS-LM-PC formulation, however, failed to explain the stagflation of the 1960s and 1970s. Particularly, the oil price shocks of 1973-74 and 1978-79 led to the rise of both inflation and unemployment. Monetarist economists had predicted the failure of negative relationship between inflation and unemployment in the 1960s. Milton Friedman and Edmund Phelps held the position that there is no relationship between inflation and unemployment in the long run. Thus, they have developed expectations-augmented Phillips curve (*Ibid*).

$$\pi = \alpha U + \beta \pi^e \tag{3.12}$$

where π^e is inflation expectation and β is expectation adjustment parameter. The expectation formation is backward looking, with agents adjusting partially to past expectation errors.

$$\pi_t^e = \pi_{t-1}^e + \varphi(\pi_{t-1} - \pi_{t-1}^e) \tag{3.13}$$

The expectation augmented Phillips curve of monetarists indicates the importance of inflation inertia in the inflation process. In this specification, there is still negative relationship in the short run between inflation and unemployment since it is assumed $0 < \beta < 1$. In the long run, however, $\beta = 1$ and $\pi = \pi^e$. Phillips curve is, thus, vertical in the long run (*Ibid*).

3.2.2. Cost-push theories of Inflation

The origin of cost push theories of inflation can be traced back to James Steuart (1767). In his '*Inquiry into the principles of Political Economy*,' he argues that inflation

is in way a monetary phenomenon. In his claim he offers three different but related cost-push arguments to inflation. First, he argues that "real forces derive individual and aggregate prices alike" (Humphrey 1998, pp. 55). This implies general price level, and hence inflation, is determined by forces that determine the prices of individual goods. The forces governing the prices of specific goods are competition and cost. Competition lowers prices as do falling costs. Second, general prices are real phenomena and thus are not affected by changes in money stock. He cites hoarding-dishoarding as a factor checking the spillover of monetary excess into goods market. Wealth holders will hoard monetary excess (coins in his time) and dishoard in times of shortage, effectively preventing monetary movements affecting commodity markets. If monetary excess happens to spill over into goods market, there will be matching shift in demand and supply. The output response to monetary excess will leave prices intact. Third, rather than money affecting prices, it is prices that determine money supply. First, prices are determined by the forces of competition and cost. Then, velocity adjusts to ensure the existing stock of money is just enough for the current level of transaction at the predetermined prices. In this line of reasoning, the effect of monetary variations is just velocity adjustment with prices remaining unchanged (Humphrey, 1998).

Other notable contributions to cost-push theories are by Thomas Tooke and J. Laurence Laughlin. In his six-volume '*History of Prices*' (1837-1857), Tooke presents a staunch support to cost-push theories, particularly supply shock theories and factor cost theories. He, like Steuart, seems to believe factors that determine the prices of individual commodities affect general price movements (Gregory, 1962; Humphrey, 1998).

In his supply shock theory, Tooke considers factors such as harvest failures, extraordinary weather changes, freight rate alterations, removal, installation or revision of trade restrictions, import cost variations, exchange rate movements and cost-reducing technological progress as causes of inflation. In his factor cost theory,

on the other hand, Tooke states that general price level is determined by factor incomes: rents, profit, salaries and wages, rather than money supply relative to output. In his argument as to why monetary shocks do not contribute to general price movements, he employed Steuart's argument of reverse causality (Gregory [1928], 1962). Humphrey (1998) notes that Tooke's theory of inflation is "suggestive of recent theories attributing disinflation to any one of a multiplicity of nonmonetary elements in the institutional environment such as deregulation, the removal of production bottlenecks and particular supply inelasticities, increased global competition, a decline in the power of trade unions, reductions in the non-accelerating inflationary rate of unemployment and the like" (Humphrey 1998, pp. 60-61).

Laughlin, another proponent of cost push theories, shares Steuart's and Tooke's view that general price level is determined by forces that determine the prices of specific goods. He asserts that these forces include "increased wages, higher cost of materials, customs-duties, and monopolies" (Laughlin 1909, pp. 266 cited in Humphrey, 1998). He also shares the view of reverse causation with his predecessors. Humphrey (1998, pp. 67) argues that Laughlin "employed his theory of antecedent pricing to deny money a role in price determination". According to this theory since price setting precedes sales, instead of the predetermined prices adjusting to monetary fluctuations, money supply adjusts to ensure the existing supply is just sufficient for transaction. Three mechanisms of cost-push come out of Laughlin's analysis of causes of inflation. First, there is rise in wage cost, which constitutes important cost element in production. In this regard, he emphasized the role of ratchet effect[15] and unilateral wage setting by trade unions. Second, prices could be pushed up due to markup pricing stemming from monopoly-administered price setting. Third, he holds that shortage of raw materials, due to for example crop failures, will contribute to rise in price of specific products and thus the

[15] Ratchet effect here represents the possibility of wages not coming down (falling) once they grow.

general price level. He sees two routes through which such shortages contribute to price rise: directly via rise in the price of raw materials and indirectly via a feedback effect into higher wage demands. Wage-price spiral may set in if the rise in price "wipes out all the gains of previous increases of wages, and drives laborers to repeat their demands for higher pay, thus working again to increase expenses of production" (Laughlin, 1909 pp. 184 cited in Humphrey, 1998).

In sum, early writers in the cost-push paradigm based their arguments on two propositions to show that inflation is an outcome of real not monetary phenomenon [see Steuart (1767), Tooke (1964) and Laughlin (1909)]. First, they hold that general prices are determined by forces that determine the prices of specific products. Second, they emphasize reverse causation, with money supply endogenously adjusting to predetermined prices. Their assumption of endogenous money supply implies that money is demanded only for transactions purposes and effectively ignores money demand for speculative and precautionary motives.

Post-Keynesians try to extend the radical element in Keynes' analysis and discard conservative elements that associate Keynes to classical/neo classical, such as the assumption that in the long run equilibrium real wage equals the marginal product of labor. The key deviation, however, relates to their treatment of money. They consider money to be endogenous while Keynes considers it exogenous (Cottrell, 1994).

3.2.3. Structural/Post-Keynesian Theories of Inflation

Theories of inflation that fall within this category highlight the role that peculiarities in economies play in inflationary processes. Economists in this category emphasize the link between inflation, food supply, and competing claims of the distribution of income (Agenor and Montiel, 1996).

Streeten (1962) and Baumol (1967) show the importance of country specific structural factors in inflationary process. They used the coexistence of segmented

sectors: a progressive (industrial) sector and a traditional (agricultural) sector to show the link between inflation and income distribution. It is assumed that the industrial sector is sensitive to policies while the agricultural sector less so. Growth in aggregate demand results in output and employment of the industrial sector rising in the short run. This increases wages in the industrial sector with the consequence of rise in demand and, hence, price of agricultural products (food). This rise in agricultural prices will induce rise in wages of the sector, which results in rise in demand for industrial products. This cycle of income distributional conflict pushes prices continuously. Kalecki (1963) offers a related but a slightly different rationalization based on an economy producing two types of goods (necessities and non-essentials) to explain the inherent distributional conflict that derives inflation. He argues that if national income grows at a rate faster than warranted by supply of necessities, price of necessities will rise. The equilibrium condition will be restored "through a fall in the real income of the broad masses of the population" (Kalecki, 1963: pp. 52). The process generates extra profit to "capitalists" who spend it mainly on non-essentials and fuels economic growth. He believes that price increases serve as effective means of transferring income from the poor to the rich. This type of "growth involving inflationary price increases of necessities...is definitely to the advantage of the upper classes" (Ibid, pp. 52).

One of the mostly applied theories of inflation within cost-push tradition in an open economy context is the Scandinavian approach. The other such theory is Kalecki's approach.

3.2.3.1. The Scandinavian Approach

The PPP approach discussed above ignores the influence that the structure of an economy might potentially have in the determination of price. The Scandinavian model of inflation, on the other hand, emphasizes the structure of economies in inflationary process. To this effect, it introduces a two sector dichotomy in

analyzing inflation. The two sectors considered are tradable[16] and non-tradable sectors; with the tradable sector being one that is exposed to international competition and the non-tradable sector is one that is sheltered from international competition. Earlier works along this line include Edgren et al. (1973) and Aukrust (1977).

Aukrust's (1977) formulation seeks to explain the influence of world prices on the prices of a small open economy (SOE) that operates under fixed exchange rate regime. Like PPP, this model tries to show why inflation in SOE deviates from world inflation even in the long run (Kenny and McGettingan, 1997; Ginting, 2007). The aggregate inflation is given as the sum of weighted inflation of the tradable and non-tradable sectors.

$$\pi = \alpha\pi^T + (1-\alpha)\pi^N \tag{3.14}$$

where π is aggregate price inflation, π^T is tradable price inflation, π^N is non-tradable price inflation and α is the weight of the tradable sector in output/consumption basket used in forming CPI.

Under the assumption of small open economy, the price of the tradable sector is determined by world price. Thus, tradable price inflation is always equal to world inflation assuming exchange rate remains constant.

$$\pi^T = \pi^* \tag{3.15}$$

where π^* is world inflation.

Growth in wage rate in the tradable sector is determined by the price increase and productivity growth in the tradable sector.

$$w^T = \pi^T + q^T \tag{3.16}$$

[16] The tradable sector is made up of industries producing goods that are (potentially) either exportable or importable.

where w^T is growth rate of wages in the tradable sector and q^T is the productivity growth rate. The model also assumes homogenous labor market so that there is wage equalization across sectors.

Price in the non-tradable sector is independent of external constraints and is determined by markup over wages adjusted for exogenous productivity growth.

$$\pi^N = w^N - q^N \tag{3.17}$$

Under the above assumptions and equations (3.15), (3.16) and (3.17), (3.14) can be rewritten as:

$$\pi = \pi^* + (1-\alpha)(q^T - q^N) \tag{3.14a}$$

Equation (3.14a) produces two important implications. First, even under fixed exchange rate regime, a SOE with higher productivity growth differential between its tradable and non tradable sector will have persistently higher inflation compared to the world inflation/inflation of its trade partners. Second, any change in world prices will be transmitted one for one to domestic prices (Kenny and McGettigan, 1997).

The assumptions of the Scandinavian model regarding price determination could hold in Ethiopian context. Ethiopia being a small open economy, the prices of its imports as well as exports are determined by international forces. Domestic cereals markets could be considered markets for non-tradable. Mulat et al (2007), indicate that "domestic cereal markets are largely insulated from international price trends because of high transportation costs and poor infrastructure" (pp. ii).

Though the Scandinavian model allows a separate determination of prices it has serious shortcomings. The most important is that "its predictions are long-run in nature and demand is assumed to play no independent role in the inflation process" (Kenny and McGettigan, 1997: pp. 165). Moreover, the Scandinavian model assumes that tradable sector inflation is led by world prices. Thus, domestic factors play no role on tradable sector inflation. On the other hand, the non-tradable

sector is assumed to be completely insulted from external influences. By implication, the two sectors of the model (tradable and non-tradable) have completely separate price determination mechanisms. Thus, the model ignores the possibility of indirect effect of external factors on non-tradable sector price via its effect on tradable sector price.

The assumption of homogenous labor market, in which there is uni-directional causations of wages with the non-tradable sector wages just adjusting to wage variations in the tradable sector, is also questionable in Ethiopian context. In Ethiopia there is no significant distinction between the wage setting mechanisms of the two sectors. Moreover, the wages in the Ethiopian tradable sector remains largely unaffected by international price movements owing to persistent wage rigidities.

3.2.3.2. Kalecki's Approach

In his 1963 work "Problems of Financing Economic Development in a Mixed Economy," Michal Kalecki discusses how the financing of economic development impacts on the domestic price level[17]. In his argument, he distinguishes between necessities and non-essentials and maintains that economic development and its financing thereof should adhere to two important premises: "no inflationary price increases of necessities, in particular staple foods" and "no taxes should be levied on lower-income groups or necessities" (Kalecki 1963, pp. 45). Thus, restraining of consumption required for financing of economic growth should be effected through progressive taxation of high-income groups or indirect taxes on non essentials.

Assuming average national income growth rate of r, growth rate of supply of necessities c_n, growth rate of consumption c, growth rate of domestic production of necessities p_n, and population growth rate q, he shows that the supply of necessities is an effective check to the growth of national income without violating the two

[17] All page references of Kalecki's 1963 work are as given in Jerzy Osiatyński (year) "Collected Works of Michal Kalecki: Developing Economies" Volume V, Clarendon Press Oxford.

assumptions above. If consumption grows proportional to national income and "national income growth rate r is equal to the rate of increase of the population q, so that per capita consumption remains unaltered, the rate of increase of demand for necessities is equal to q as well" (Kalecki 1963, pp. 46). If however if r is greater than q, then approximately, the demand for necessities will grow by c_n-q. The relationship between the growth rate of per capita consumption and growth rate of per capita demand for necessities can be stated as:

$$c_n - q = e(r - q) \tag{3.18}$$

where e is income elasticity of demand for necessities and is between zero and one. The required rate of growth of the supply of necessities to warrant national income growth rate of r can be defined from (3.18) as:

$$c_n = q + e(r - q). \tag{3.18a}$$

If e is assumed to be constant, the required rate of growth rate of necessities to warrant income growth of r, is a linear increasing function of r.

He later relaxes the assumption that consumption varies proportionally to income and argues that for a faster growth of national income it is necessary to restrain consumption and allow more resources for investment. This implies that as r increases, the relative share of investment increases; i.e., r-c rises as r increases. Thus, at higher level of r, "the average rate of growth of consumption c will be lower than that of the national income r" (Kalecki 1963, pp. 48).

Kalecki argues that the supply of necessities in developing countries is limited by institutional factors such as land ownership structure and domination of peasants by merchants (Kalecki, 1963). If the growth rate of national income r is greater than that is warranted by the growth rate of supply of necessities c_n, price of necessities will rise since the supplies of necessities forthcoming are inadequate to meet demand. The warranted rate of growth of national income need not depend, however, on domestic production of necessities. Rather, what matters is the supply

of necessities. A country's ability of sustaining faster growth rate of national income than that warranted by domestic production of necessities depends on its import capacity. Kalecki emphasizes that import capacity depends on its export capacity. However, in developing countries the rate at which exports can expand to support the imports of necessities is limited. Inflow of capital can also serve as a means of raising the supply of necessities and thus the warranted rate of growth of national income without violating the basic premises of the model.

In his treatment of inflation, Kalecki appears to have adopted the position taken by structural economists before him. Like Steuart, Tooke and Laughlin, Kalecki believes in reverse causation of monetary growth. Monetary policy is considered as "strictly passive in the sense that the authorities need only respond to increased transactions demand for money, whether due to increases in output or prices" (Fitzgerald 1993, pp. 55).

In Kalecki's model inflation is mainly an outcome of two factors: structural factors and wage-profit struggle due to degree of monopoly. In the course of rapid economic growth, "the inelasticity of supply in agriculture and the monopolistic tendencies in industry emerge as important factors underlying inflationary effects" (Kalecki 1976, pp. 50-51 cited in Fitzgerald 1993, pp. 56).

In relation to external means of supply of necessities (export receipts and capital inflows), Kalecki assumes that 'foreign credit' is used only for the purchase of goods from abroad (no spending on domestically produced goods). This, however, is unrealistic assumption in developing countries like Ethiopia. Governments often use such types of income for financing their expenditure on imports as well as domestically produced goods and services. As he points out, increase in autonomous expenditure allows the mark-up by monopolists to rise as part of macroeconomic adjustment process.

3.3. Empirical Literature

3.3.1. Studies of Inflation in Developing Countries

Several cross-country and country specific studies have been conducted to find out the determinants of inflation in developing countries. Cross country studies, found mixed results regarding the effect of openness on inflation. Romer (1993) found that inflation and openness are negatively related. He states that openness puts a check on the government's incentive to engage in inflationary expansions due to induced exchange rate depreciations. Terra (1998), however, indicates that Romer's result holds only for severely indebted countries. When all countries are considered, she found no significant relationship between inflation and openness. Other studies, on the other hand, found that countries that are more open are likely to face higher inflation than those that are relatively less open. Chhibber (1991) found that in Africa, countries with flexible exchange rate system (or auction system) faced higher inflation than those with exchange rate regime. The devaluations that followed the exchange rate liberalization in Africa (as part of the Structural Adjustment Programs of IMF and World Bank) had in most cases introduced inflationary pressures. Isakova (2007) also found that devaluation of domestic currencies had inflationary effect in Central Asian countries.

Monetary developments also appear to be among the key determinants of the inflationary process in Africa. Edwards and Tabellini (1990), Chhibber (1991), and Barnichon and Peiris (2007) show that huge fiscal deficits led to inflationary pressures in Africa via monetization of the deficits and/or devaluation of domestic currencies. Isakova (2007) also indicates that money supply played role in inflationary process of Central Asia. But its effect was not direct, rather through money supply adjustments to interest rate variations by authorities.

Other key determinants of inflation in developing countries include output gap (Isakova 2007, Barnichon and Peiris 2007), international price movements and nominal exchange rate (Isakova 2007) and political instability and political

polarization (Edwards and Tabellini 1990). In African case, however, most studies point out that the most important determinant of inflation remains monetary growth.

Despite their importance in determining the inflationary processes in Africa, many argue targeting monetary aggregates to control inflation often doesn't produce success. Masson, Savastano and Sharma (1997), Özdemir, Kadioğlu and Yilmaz, (2000) and Barnichon and Peiris (2007) indicate that inflation targeting can be more effective in controlling inflation in developing countries than monetary and/or exchange rate targeting if there is high degree of monetary policy independence, freedom of fiscal dominance and absence of any firm commitment to particular levels of variables.

Most country specific inflation studies in Africa found that money supply is the prime source of inflation. Laryea and Sumaila (2001) studied the determinants of inflation in Tanzania. They found that in the short run output and monetary factors stand as the main factors behind Tanzanian inflation. In the long run, in addition to output and monetary factors parallel exchange rate was also found to be significant. The most important factors both in the short run and long run, though, are monetary factors. Akinboade, Niedermeier and Siebrits (*n.d.*) indicate that the short-run determinants of inflation in South Africa are money supply, inflation expectation and structural factors (labor costs). They also found that PPP holds in the long-run. Similarly, monetary factors stand as the prime source of inflation in Ghana in Chhibber and Shafik (1990), while Simwaka (*n.d.*) finds that exchange rate movements had strong effects in Malawi's inflation followed by monetary growth and supply constraints, especially of food. As opposed to the African cross-country studies reviewed above, Chibber and Shafik (1990) found that in the presence of active parallel exchange rate market, official devaluation of the domestic currency doesn't cause inflation since prices have already adjusted for the parallel exchange rate. Ubide (1997) also found that the monetary supply stand out as the most

important determinant of inflation in Mozambique together with exchange rate movements and agricultural shocks. As opposed to Akinboade, Niedermeier and Siebrits (*n.d.*), Ubide finds that PPP doesn't hold in Mozambique in the long run.

Another set of country specific studies in Africa find structural factors as the main forces behind inflation. Money supply and exchange rate also affect inflation, but less so. Dlamani, Dlamani and Nxumalo (2001) studied the determinants of inflation in Swaziland and found that exchange rate, foreign prices and cost mark-ups are the main causes of inflation. They found that money supply was not an important determinant of inflation in Swaziland since the country is a member of a common monetary area[18] and has no direct control over money supply. Nell (2000) also found the South African inflation after 1983 has largely been cost-push as substantial capital outflows, the decline of the mining sector and the undiversified export sector exposed the economy to imported inflation. Ocran (*n.d.*) found that in the long-run the determinants of inflation in Ghana are exchange rate, foreign prices and terms of trade. Excess supply of money was found to be insignificant. In the short-run the determinants are inflation inertia, money growth, changes in Treasury bill rates, and exchange rate. The dominant determinant of inflation in the short-run is inflation inertia.

Cooper (1971), Krugman and Taylor (1978) and Taylor (1979, 1981) cited in Yiheyis (2006) argue that devaluation serves as a cost push factor in inflationary process via three routes: cost of imports, labor cost and the cost of working capital. In the presence of working capital constrains, the effect of devaluation is severe in countries where production involves significant use of imported raw materials and wage is indexed.

3.3.2. Studies of Inflation in Ethiopia

There have been a few attempts to study the determinants of inflation in Ethiopia. The studies came up with various conclusions. Demirew (1998) used the Aghevli

[18] Other members of the common monetary area are South Africa, Namibia and Lesotho.

and Khan (1978) type model to study the relationship between budget deficit, money supply and inflation in Ethiopia using data from 1965 -1997. The study applied 2SLS technique of estimation in estimating the coefficients of the model. The study found persistent budget deficit explains Ethiopian inflation during the period via its effect on money supply growth.

Semu (1994) identifies real GDP, expected inflation, and budget deficits as the factors behind Ethiopian inflation. He found that monetary variables were not significant determinants of inflation refuting the monetarist thesis.

Muche (2007) used structural vector autoregressive model (SVAR) with two variables-real output and CPI. He tried to study the effect of demand and supply shocks on real output so as to determine the current inflationary in Ethiopia is an outcome of demand and/or supply shocks. He found that in recent periods inflation is mainly driven by demand factors.

Yohanis (2007) estimated a general equilibrium macroeconometric model to study the sources of the current inflation in Ethiopia. He found that inflation in Ethiopia is explained by a combination of factors including real GDP, money supply, consumer price indices of major trading partners and exchange rate. He also emphasizes the role of "rural transformation" reflected in terms of improved access to information and credit has played a role in Ethiopian inflation.

3.3.3. Modeling Inflation in Developing Countries

The most commonly used techniques of estimation in inflation studies in developing countries are single equation error correction models, vector autoregressive (VAR) models and two stage least square (2SLS) estimation. Below the estimations techniques, explanatory variables used and the type of data used in some African inflation studies are summarized.

Dlamani, Dlamani and Nxumalo (2001) applied single equation error correction model using annual data to study the determinants of inflation in Swaziland. The

model includes real income, nominal money supply, nominal interest rate, nominal exchange rate, nominal wages, and South African consumer prices as explanatory variables.

Laryea and Sumaila (2001) estimated a simple structural inflation equation using quarterly data to study the determinants of inflation in Tanzania. The model includes the usual suspects of inflationary process: money supply, output, exchange rate, lagged price level and foreign prices. Price is assumed to be a weighted sum of the prices of traded and non-traded goods. The price of traded goods is determined by exchange rate and foreign prices (PPP is assumed to hold). Non-traded price is assumed to be determined by money market equilibrium condition. Money demand is assumed a function of real income (output) and expected inflation. OLS regression was used after correcting for autocorrelation and heteroskedasticity to identifying long run relationships while error correction model was estimated for short run relationships.

Ocran (*n. d.*) and Simwaka (*n. d.*) used vector autoregressive (VAR) model in their inflation studies. In fact, Ocran (*n. d.*) combines Engel-Granger two-step procedure and VAR model in his study of the determinants of inflation in Ghana. Lagged inflation, money supply, real output, the cost of holding money, exchange rate, terms of trade and foreign prices are included as explanatory variables in the study. The study assumes that in the long run PPP holds in and the money market is in equilibrium. But since the standard PPP breaks down for Ghana, the author includes TOT as an additional mechanism that ensures that domestic prices and the domestic currency value of foreign prices are equal. The model, thus, effectively combines standard monetarist theory with the "law of one price". For the two long run relationships hypothesized in the study (money supply and external sector) two separate vector autoregressive (VAR) models are estimated to avoid problems in interpretation of the cointegrating space. Simwaka (*n. d.*), similarly, uses a VAR

model to estimate the contribution of the macroeconomic variables (money supply, real income, exchange rate and price expectations) to inflation Malawi.

Chhibber and Shafik (1990), Nell (2000) and Ubide (1997) employed highly disaggregated models of inflation. The first two attempted to see the relationship between exchange rate movements (devaluation) and inflation, while the third tries to identify the determinants of inflation. Chhibber and Shafik (1990) studied the effect of exchange rate reform on African inflation using annual data from Ghana. The study assumes a segmented goods market and independent price formation in the different segments of the goods markets. Theoretically, the model employed in the study is, in a way, a synthesis of monetarist and cost push theories of inflation. They assumed that inflation operates through three transmission mechanisms: excessive monetary growth, cost push factors such as exchange rate movements and food prices, and real factors. Thus, they hypothesized that exchange rate (both official and parallel), foreign prices, wage cost, money demand and supply, and an exogenous price of controlled goods may have played role African inflation experiences. Equations of the model were estimated using two stage least square (2SLS) estimation. Nell (2000), on the other hand, evaluates the relationship between inflation and exchange rate in South Africa. The study combines demand pull theories of inflation with cost push theories. Demand pull theories are captured by excess demand (output gap) while cost push theories are captured by private sector wages, import pass through of exchange rate devaluation and labor productivity. The study employs distributed lag (DL) and autoregressive distributive lag (ARDL) models are estimated using quarterly data.

Ubide (1997) studies the determinants of inflation in Mozambique using monthly data. The study uses three approaches to identify the determinants of inflation in Mozambique. First an ARIMA model based method was used to decompose the various series (CPI, agricultural output, money supply and exchange rate) used in the study into trend, seasonal and irregular components. By comparing the patterns

of the series, the study tries to identify the channel through which the variables above contributed to inflation. Then once the decomposition is done, to analyze the effect of each variable on inflation a variant of the Scandinavian model of inflation is estimated. The economy is segregated into tradable and non-tradable. The tradable price is determined by world price and exchange rate (assumes PPP holds) while the non-tradable price is assumed determined by money market equilibrium. Equations of the model are estimated using ordinary least squares (OLS). Finally, to study the dynamic nature of inflation in Mozambique the author estimated a VAR model.

4. Methodology

4.1. Theoretical Model

The approach used in this study hypothesizes that there are three transmission mechanisms through which the price level in Ethiopia might be affected: monetary factors, cost push factors and real factors. The three transmission mechanisms are not independent of one another. Rise in the price level due to (say) rise in raw materials or exchange rate depreciation may have budgetary implications. High budget deficits may, in turn, lead the government into monetization of the deficits and hence growth of money supply. This, then, may lead to another round of price hikes. Associated with such price rises is the possibility of price-price and wage-price spirals as workers demand higher nominal wage rates to mitigate the rise in price. On the other hand, contractionary monetary policies may lead to contraction of investment which may have consequences for the supply of real output. This, in turn, reduces the room the government has for maneuvering inflation in the short run.

The model used in this study is a synthesis of monetarist, cost push/structural models (see Chhibber and Shafik, 1990; Callen and Chang, 1999; Ubide, 1997; and Kenny and McGettigan, 1996). Such an approach encapsulates standard (classical/neoclassical) approaches and a set of other pragmatic approaches and enables better understand the inflationary process in Ethiopia by taking aboard the likely effects of factors peculiar to the economy.

The model assumes a segmented goods market. There is a tradable sector comprising goods that are either traded or potentially tradable at price P_1. There is also a non-tradable sector with price P_2. The third market is one in which goods are offered at subsidized price P_3 (eg. fuel, transport, and utilities such as electricity, water, and telephone). We call this sector an administered sector.

4.2. The Model

As discussed in previous chapters, Ethiopia doesn't seem to have significant role to play in the determination of the prices of goods and services that it trades with others. One wouldn't be at fault at assuming that Ethiopia is an open economy given its large imports and exports as a percentage of GDP. Assuming Ethiopia is a small open economy, purchasing power parity (PPP) holds in the Ethiopian tradable sector. The tradable price is, thus, defined as the product of foreign price and exchange rate[19].

$$P_1 = E \cdot P_f \tag{4.1}$$

where E is nominal exchange rate and P_f is foreign price.

Taking the log of equation (4.1), we have

$$p_1 = e + p_f \tag{4.1a}$$

where the lower case variables, p_1, e and p_f are the logs of P_1, E and P_f.

For various reasons (such as lower quality of the domestically consumed tradable items such as coffee, oil seeds and hides and skins, and the profit margin of intermediaries etc.), there has been gap between the domestic prices of Ethiopian tradable items (especially export items) and their foreign prices, rendering the assumption of PPP unrealistic. However, recent evidence suggests that the gap has continuously narrowed in recent years[20].

The tradable sector inflation can, thus, be specified as:

$$\Delta p_1 = \Delta e + \Delta p_f \tag{4.2}$$

In the non-tradable sector price is split into two: food price and non-food price. The non-tradable inflation is computed as a weighted sum of food inflation and non-

[19] Here, the Ethiopian exchange rate is defined as units of Birr per Dollar. Until very recently, the parallel market premium remained very low and stable. Thus, no distinction between parallel and official rate will be considered in this study.

[20] This can be seen, for example, by comparing the CSA figure for domestic price of coffee and the international price of coffee in IMF's IFS database.

food inflation. It is assumed that the price setting processes in the two segments of the non-tradable sector are different as discussed in detail below.

The share of food expenditure in total household income depends on the level of income. Where the level of income is very low, like in Ethiopia, the share of food expenditure in total household expenditure tends to be very high[21]. With rise in income, the share of food expenditure in total expenditure is, on average, likely to rise in the short run and medium run, though the share is believed to fall in the long run[22]. Thus, faster growth of income (GDP) due to deliberate monetary and fiscal expansionary measures or unanticipated positive supply shocks may induce greater increase in demand for food (see Kalecki, 1963). If the price level is to remain stable, the supply of food must grow at a rate faster than the income growth rate since demand for food grows at a higher rate relative to income. However, as the economy experiences fast increase in income, if the supply of food falls short of the fast growing demand, it may result in rising prices of food which may easily and significantly transmit into general inflation. As noted in chapter 2, the developments in Ethiopia seem to suggest that price movements are influenced not only by supply factors, as the reported fast growth of agricultural products failed to oppress food prices of late, but also by demand factors.

Thus, food price developments could be considered as an outcome of the interaction of supply of and demand for food in a competitive market setup. The supply of food is assumed to be exogenously determined by weather condition, international prices and political conditions[23]. It is defined as the sum of total cereal output, imports of food and food aid. Total cereals output is composed of the on farm consumption of farmers and marketed surplus. Imported food and food aid similarly have a bearing on food price determination. Their size has often been

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21 As noted in Chapter two, in 2006/07 the share of food expenditure in total expenditure stands at 57 percent.
22 This phenomenon is popularly known as the Engel law after the 19th century German statistician Ernst Engel.
23 This assumption is in line with Kalecki (1963), who holds that the supply of food in developing countries is constrained by institutional factors. He suggests that agrarian reform is required to achieve fast growth of income. He seems to suggest that the supply of agricultural products (necessities) is roughly constant in the short run as the reforms indicated in his writings are likely to take longer time to materialize.

considerable and served ease the need for domestic marketed surplus. The demand for food can be split into two parts. First, there is autonomous part which is necessary for survival of the producers (farmers). Second, there is a section of food demand that depends on the level of income (see Alemayehu and Huizinga, 2006).

The supply of food is given as:

$$P_2^f S_f = P_2^f Y_c + P_f^f E M_f + P_2^f A \tag{4.3}$$

where, $P_2^f S_f$ is the value of food supply, P_2^f is domestic price of food , Y_c is the quantity of cereals production, P_f^f is the foreign price of imported food, M_f is the quantity of imports of food and A is the quantity of food aid.

It is hypothesized that PPP also holds in the case food imports. This is a plausible assumption given that Ethiopia purchases its food imports at the ruling market price of food. Thus the domestic price of imported food reflects movements in international food price and exchange rate. The equation that relates the domestic price of food to foreign price of food is, thus, specified as:

$$P_2^f = P_f^f E \tag{4.4}$$

Substituting (4.4) in (4.3) and rewriting (4.3) in real terms gives:

$$S_f = Y_c + M_f + A \tag{4.3a}$$

Equation (4.3a) summarizes the exogenous quantity of food supply.

The demand for food is defined as:

$$C_f = \bar{C}_f + \mu_1 Y - \mu_2 P_2^f + \mu_3 ES, \qquad \mu_1,\ \mu_2,\ \mu_3 > 0 \tag{4.5}$$

where, C_f is real food consumption, $\bar{C}_f$ is autonomous real food consumption, Y is real income, ES is excess money supply defined as the difference between money supply and money demand, μ_1 is marginal propensity to consume food, μ_2 and μ_3 measure the change in food demand resulting from a unit change in domestic food CPI and excess money supply respectively.

The money demand equation is specified as

$$\frac{Md}{P} = \sigma_1 Y - \sigma_2 i - \sigma_3 \Pi^e \qquad \sigma_1,\ \sigma_2,\ \sigma_3 > 0 \tag{4.6}$$

where $\frac{Md}{P}$ is the demand for real money balances, Y is real income (GDP), i is interest rate and Π^e is expected inflation.

The food demand equation can, thus, be written as

$$C_f = \bar{C}_f + \mu_1 Y - \mu_2 P_2^f + \mu_3 (\frac{M}{P} - \sigma_1 Y + \sigma_2 i + \sigma_3 \Pi^e) \tag{4.5a}$$

where M is stock of money supply and P is domestic price level (CPI).

Collecting like terms together, the (4.5a) will be

$$C_f = \bar{C}_f + (\mu_1 - \mu_3 \sigma_1) Y - \mu_2 P_2^f + \mu_3 (\frac{M}{P} + \sigma_2 i + \sigma_3 \Pi^e) \tag{4.5b}$$

In order to avoid the complications that may result from non-linear relationships between food price and the components of demand for and supply of food, the food demand and supply equations could be re-specified in logarithm form.

$$s_f = y_c + m_f + a \tag{4.3b}$$

$$c_f = \bar{c}_f + (\mu_1 - \mu_3 \sigma_1) y - \mu_2 p_2^f + \mu_3 (m - p + \sigma_2 i + \sigma_3 \pi^e) \tag{4.5c}$$

The small case variables in (4.3b) and (4.5c) (except interest rate[24]) are the logarithms of their upper case counterparts in (4.3a) and (4.5b).

Food price is determined by the interaction of supply of and demand for food. Since food supply is assumed exogenous, food price movements adjust any disequilibrium in the market for food. Thus, equating equations (4.3b) and (4.5c) gives,

$$p_2^f = \frac{1}{\mu_2} \left[(\mu_1 - \mu_3 \sigma_1) y + \mu_3 (m - p + \sigma_2 i + \sigma_3 \pi^e) - m_f - a - (y_c - \bar{c}_f) \right] \tag{4.7}$$

[24] In many studies interest rates come into estimation models in their level. This is justified by the fact that interest rates are often very small numbers (less than one) and their logarithms are, thus, negative.

Since $\frac{1}{\mu_2} > 0$, equation (4.7) indicates real income and excess money supply are positively related to domestic price of food while food imports, food aid and marketed surplus $(y_c - \bar{c}_f)$ are negatively related to domestic price of food.

The inflation equation for the food non-tradable sub-sector can easily be found by taking the first difference of equation (4.7).

$$\Delta p_2^f = \frac{1}{\mu_2}[(\mu_1 - \mu_3\sigma_1)\Delta y + \mu_3(\Delta m - \Delta p + \sigma_2\Delta i + \sigma_3\Delta\pi^e) - \Delta m_f - \Delta a - \Delta(y_c - \bar{c}_f)] \quad (4.7a)$$

where is Δ the first difference operator.

The discussions in chapter two have indicated that the non-food price developments may have been driven mainly by strong growth in demand following fast growth in income. Associated with this is the resulting growth of market power (or influence) of producers (or traders) reflected in higher profit margins as supply may not expand at the rate of growth of demand in the short run. The non-food non-tradable sector[25] price is, therefore, assumed to be determined by markup over cost. The Ethiopian manufacturing industry is characterized by labor intensity and high use of imports. Likewise, the service sector is the second largest employer of labor force. Thus, the production process is assumed to involve the use of labor and imported raw materials[26].

$$P_2^n = (1 + \beta)(EP_f^n)^{\alpha_1} W^{\alpha_2} \quad (4.8)$$

P_2^n is domestic non-food non-tradable price, E is official exchange rate, P_f^n is foreign non-food price, β is the markup factor and W is unit labor cost.

Taking the logarithm of equation (4.7) gives,

$$p_2^n = \theta + \alpha_1(e + p_f^n) + \alpha_2 w \quad (4.8a)$$

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[25] This sub sector includes domestic manufacturing and service sectors.

[26] Any price movements of domestically produced inputs used by the sub sector are assumed captured by the food non-tradable inflation equation.

where θ is the logarithm of $1+\beta$ and the small case variables represent the logarithms of the upper case variables in (4.8). The non-food non tradable inflation can, thus, be stated as:

$$\Delta p_2^n = \Delta\theta + \alpha_1(\Delta e + \Delta p_f^n) + \alpha_2 \Delta w \qquad (4.8b)$$

Equation (4.8b) indicates that non-food non-tradable inflation results from increase in the markup factor, exchange rate depreciation, increase in foreign price of non-food items, and rise in unit wage cost.

Variations in θ can only drive from variations in the markup factor β. The markup (β) is a function of the degree of monopoly of producers/traders[27]. The monopoly power, in turn, is assumed to derive from excess demand (ED) in the economy. Thus, variation in theta ($\Delta\theta$) is considered to be a function of variation in excess demand. It is assumed that excess demand[28] in the goods market derives from excess supply in the money market. This is because, in the absence of well functioning financial system, such as the case in Ethiopia as noted in chapter 2, with limited financial assets, there is strong substitution between money and goods than money and other financial assets (see Chhibber et al, 1989).

$$\Delta\theta = \gamma \Delta ED \qquad (4.9)$$

$$ED = \emptyset\left[\log\left(\frac{M}{P}\right) - log\left(\frac{Md}{P}\right)\right] \qquad (4.10)$$

By substitution (4.8) can be rewritten as:

$$\Delta\theta = \gamma\emptyset\left[\Delta\log\left(\frac{M}{P}\right) - \Delta log\left(\frac{Md}{P}\right)\right] \qquad (4.9a)$$

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[27] Fitzgerald (1993) notes that in Kalecki's model industrial prices are determined as unit labor costs with fixed mark-up derived from the degree of monopoly (see also Chilosi, 1999). Sawyer (1985) cited in Fitzgerald (1993) notes that in his early works Kalecki explicitly indicates the applicability of the pricing rule in developing countries.

[28] The effect of budget deficit on inflation is captured by the excess demand equation. Expansionary fiscal policies of the government lead to huge budget deficit, which would compel the government to monetize the deficits unless it decides to scale down its expenditures. Moreover, it is hypothesized that the degree of monopoly of producers or traders depends on the size of excess demand.

where $\emptyset$ measures the degree of interaction of the money market and the goods market, and the other variables are as specified above. Assuming a standard money demand function as in (4.6), (4.9a) can be rewritten as

$$\Delta\theta = \gamma\emptyset(\Delta m - \Delta p - \sigma_1\Delta y + \sigma_2\Delta i + \sigma_3\Delta\pi^e) \tag{4.9b}$$

Equation (4.9a) indicates that change in excess demand in the economy depends on the degree to which excess supply in the money market translates into excess demand in the goods market ($\emptyset$) and the growth differential of money supply and money demand.

Substituting equation (4.9b) in equation (4.8b) we come up with a final equation for non-food non-tradable inflation.

$$\Delta p_2^n = \gamma\emptyset(\Delta m - \Delta p - \sigma_1\Delta y + \sigma_2\Delta i + \sigma_3\Delta\pi^e) + \alpha_1(\Delta e + \Delta p_f^n) + \alpha_2\Delta w \tag{4.8c}$$

The non-tradable sector inflation equation is stated as the weighted sum of food inflation and non-food inflation within the non-tradable sector.

$$\Delta p_2 = \delta_1 p_2^f + \delta_2 p_2^n \tag{4.11}$$

Thus, substituting (4.7a) and (4.8c) equation (4.11) can be rewritten as:

$$\Delta p_2 = \frac{\delta_1}{\mu_2}[(\mu_1 - \mu_3\sigma_1)\Delta y + \mu_3(\Delta m - \Delta p + \sigma_2\Delta i + \sigma_3\Delta\pi^e) - \Delta m_f - \Delta a - \Delta(y_c - \bar{c}_f)] + \delta_2[\gamma\emptyset(\Delta m - \Delta p - \sigma_1\Delta y + \sigma_2\Delta i + \sigma_3\Delta\pi^e) + \alpha_1(\Delta e + \Delta p_f^n) + \alpha_2\Delta w] \tag{4.11a}$$

The third category of goods (administered goods) is that of those goods whose prices do not automatically adjust as market conditions change. Rather, the revision of the prices of such goods is done once in a while by the government or relevant authorities. Thus, the price of administered goods is assumed exogenously determined.

The general price inflation is a weighted average of the tradable (exposed) sector inflation, the non-tradable (sheltered) sector inflation and the administered sector inflation.

$$\Delta p = \varphi_1 \Delta p_1 + \varphi_2 \Delta p_2 + (1 - \varphi_1 - \varphi_2)\Delta p_3 \tag{4.12}$$

Combining equations (4.2) and (4.11a) and adding the exogenously determined price of administered items, equation (4.12) becomes:

$$\begin{aligned}\Delta p = {} & \varphi_1(\Delta e + \Delta p_f) + \varphi_2 \frac{\delta_1}{\mu_2}[(\mu_1 - \mu_3\sigma_1)\Delta y + \mu_3(\Delta m - \Delta p + \sigma_2 \Delta i + \sigma_3 \Delta \pi^e) - \\ & \Delta m_f - \Delta a - \Delta(y_c - \bar{c}_f)] + \varphi_2 \delta_2 [\gamma \emptyset(\Delta m - \Delta p - \sigma_1 \Delta y + \sigma_2 \Delta i + \sigma_3 \Delta \pi^e) + \\ & \alpha_1(\Delta e + \Delta p_f^n) + \alpha_2 \Delta w] + (1 - \varphi_1 - \varphi_2)\Delta p_3 \end{aligned} \tag{4.12a}$$

Collecting like terms in (4.12a) together:

$$\begin{aligned}\Delta p = {} & (\varphi_1 + \varphi_2 \delta_2 \alpha_1)\Delta e + \varphi_1 \Delta p_f + \varphi_2 \delta_2 \alpha_1 \Delta p_f^n + \varphi_2 \frac{\delta_1}{\mu_2}[(\mu_1 - \mu_3\sigma_1)\Delta y - \Delta m_f - \\ & \Delta a - \Delta(y_c - \bar{c}_f)] + \left(\varphi_2 \delta_2 \gamma \emptyset + \varphi_2 \frac{\delta_1 \mu_3}{\mu_2}\right)(\Delta m - \Delta p - \Delta \sigma_1 y + \Delta \sigma_2 i + \\ & \Delta \sigma_3 \pi^e) + \varphi_2 \delta_2 \alpha_2 \Delta w + (1 - \varphi_1 - \varphi_2)\Delta p_3 \end{aligned} \tag{4.12b}$$

Equation (4.12b) indicates that the Ethiopian inflationary process could be defined to be a function of exchange rate, world price level, world non-food prices, real income, excess money supply, food imports, food aid, marketed surplus, unit wage costs and the exogenous administered prices.

4.3. Data Analysis

The classical time series regression model is based on the assumption that the data generating processes are stationary, i.e., the moments of the variables under consideration are time invariant. However, as the economy grows and evolves over time, most macroeconomic variables are likely to grow over time rendering them non-stationary (Granger and Newbold, 1974). Regression using non-stationary variables will only reflect a relationship that is not real, and accordingly such regression is termed as "spurious regression". In this case, as the sample size increases, the coefficient variance doesn't tend to be constant and the consistency

property of OLS estimators breaks down. The sampling distribution of the estimators will be non-standard and the usual statistics (t and F) based on normal become invalid (Maddala, 1992).

Nelson and Plosser (1982) distinguish between two types of stationary series: trend stationary processes (TSP) and difference stationary processes (DSP). These two distinctions derive from the two widely used techniques of converting non-stationary series into stationary series: de-trending and differencing. Though both techniques may lead to stationary series, caution is needed in choosing between the two as de-trending a DSP series or differencing a TSP series may lead to spurious autocorrelation (Nelson and Kang, 1984). Nelson and Plosser (1982) indicate that in most economic time series DSP is more appropriate and the TSP should be applied only if we assume the residuals exhibit strong autocorrelation.

4.3.1. Unit Root Tests

For testing the stationarity/non-starionarity (i.e., to test for the existence of unit roots) of the variables used in this study Dickey-Fuller (DF)/Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used. For the derivation of Dickey-Fuller test (Dickey and Fuller, 1979) for an arbitrary series y_t, consider the model below

$$y_t = \beta_0 + \beta_1 t + u_t \tag{4.13}$$

$$u_t = \alpha u_{t-1} + \varepsilon_t \tag{4.14}$$

where t is time and ε_t is a zero mean covariance stationary process. Using (4.14) the reduced form of (4.13) can be written as:

$$y_t = \delta_0 + \delta_1 t + \alpha y_{t-1} + \varepsilon_t \tag{4.13a}$$

where $\delta_0 = \beta_0(1-\alpha)$ and $\delta_1 = \beta_1(1-\alpha)$.

The Dickey-Fuller test tests the null hypothesis of unit root ($\alpha = 1$) against the alternative hypothesis of $\alpha < 1$ in (4.13a).

The general price inflation is a weighted average of the tradable (exposed) sector inflation, the non-tradable (sheltered) sector inflation and the administered sector inflation.

$$\Delta p = \varphi_1 \Delta p_1 + \varphi_2 \Delta p_2 + (1 - \varphi_1 - \varphi_2)\Delta p_3 \tag{4.12}$$

Combining equations (4.2) and (4.11a) and adding the exogenously determined price of administered items, equation (4.12) becomes:

$$\begin{aligned}\Delta p = {} & \varphi_1(\Delta e + \Delta p_f) + \varphi_2 \frac{\delta_1}{\mu_2}[(\mu_1 - \mu_3\sigma_1)\Delta y + \mu_3(\Delta m - \Delta p + \sigma_2 \Delta i + \sigma_3 \Delta \pi^e) - \\ & \Delta m_f - \Delta a - \Delta(y_c - \bar{c}_f)] + \varphi_2 \delta_2 [\gamma \emptyset(\Delta m - \Delta p - \sigma_1 \Delta y + \sigma_2 \Delta i + \sigma_3 \Delta \pi^e) + \\ & \alpha_1(\Delta e + \Delta p_f^n) + \alpha_2 \Delta w] + (1 - \varphi_1 - \varphi_2)\Delta p_3 \end{aligned} \tag{4.12a}$$

Collecting like terms in (4.12a) together:

$$\begin{aligned}\Delta p = {} & (\varphi_1 + \varphi_2 \delta_2 \alpha_1)\Delta e + \varphi_1 \Delta p_f + \varphi_2 \delta_2 \alpha_1 \Delta p_f^n + \varphi_2 \frac{\delta_1}{\mu_2}[(\mu_1 - \mu_3\sigma_1)\Delta y - \Delta m_f - \\ & \Delta a - \Delta(y_c - \bar{c}_f)] + \left(\varphi_2 \delta_2 \gamma \emptyset + \varphi_2 \frac{\delta_1 \mu_3}{\mu_2}\right)(\Delta m - \Delta p - \Delta \sigma_1 y + \Delta \sigma_2 i + \\ & \Delta \sigma_3 \pi^e) + \varphi_2 \delta_2 \alpha_2 \Delta w + (1 - \varphi_1 - \varphi_2)\Delta p_3 \end{aligned} \tag{4.12b}$$

Equation (4.12b) indicates that the Ethiopian inflationary process could be defined to be a function of exchange rate, world price level, world non-food prices, real income, excess money supply, food imports, food aid, marketed surplus, unit wage costs and the exogenous administered prices.

4.3. Data Analysis

The classical time series regression model is based on the assumption that the data generating processes are stationary, i.e., the moments of the variables under consideration are time invariant. However, as the economy grows and evolves over time, most macroeconomic variables are likely to grow over time rendering them non-stationary (Granger and Newbold, 1974). Regression using non-stationary variables will only reflect a relationship that is not real, and accordingly such regression is termed as "spurious regression". In this case, as the sample size increases, the coefficient variance doesn't tend to be constant and the consistency

Dickey-Fuller test is based on the assumptions that residuals are while noise and the data generating process is autoregressive of order one (AR(1)). It may lead to wrong conclusions if the data generating process is autoregressive of higher order or if the errors are autocorrelated. The Augmented Dickey-Fuller test (Dickey and Fuller, 1981) includes additional higher order lagged differences to the DF test model. Inclusion of the lagged difference term allows autoregressive moving average (ARMA) errors (Maddala, 1992). ADF test is specified as:

$$y_t = \delta_0 + \delta_1 t + \alpha y_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta y_{t-1} + \epsilon_{1t} \quad (4.15)$$

where Δ is a first difference operator and n is the lag length in the model. The lag length is determined based on Akaike information criterion.

ADF test is biased towards accepting the null hypothesis of unit root in the series if the series exhibits significant structural break (Badawi, 2007; Kim, 1990 cited in Maddala, 1992). In the presence of structural breaks, the Phillips-Perron test (Phillips and Perron, 1988) gives more robust estimates. The Phillips-Perron test is specified as:

$$y_t = \delta_0 + \delta_1 (t - \frac{T}{2}) + \alpha y_{t-1} + \sum_{i=1}^{m} \gamma_i \Delta y_{t-1} + \epsilon_{2t} \quad (4.16)$$

where T is the number of observations and m is lag length. The lag length is determined based on Newey and West (1987) suggestions.

Although differencing may transform non-stationary series into stationary ones, it leads to the loss of important long run information about the variables. To deal with this problem of differencing, Engle and Granger (1987) recommend cointegration.

4.3.2. Cointegration and Error Correction

As noted above using non-stationary variables in a regression analysis may result in spurious regression, a problem usually dealt with by differencing the series. Differencing, however, leads to the loss of important information about the series. Cointegration offers a way of mitigating the problem of non-stationary series

without loss of long run relationships, if any. According to Engle and Granger (1987), for any non-stationary series (i.e., I(p) series where p is order of integration), if there exists a linear combination of the series that is stationary [I(0)], the series are referred to as cointegrated and the resulting regression is not spurious. Such series come closer to one another over time and a long run relationship exists between them. If two series are not conintegrated then they drift away from one another and there exists no long run relationship (Maddala, 1992). There are three ways of testing the presence of cointegration between various series: Engle-Granger Procedure, Single Equation Error Correction Model and Johansen Procedure.

There is a strong linkage between cointegration and error correction models. This linkage derives from Granger representation theorem. According to this theorem if two or more time series are cointegrated, they have an error correction representation, and two or more time series that are error correcting are cointegrated. One implies the other with cointegration preceding error correction (Keele and De Boef, 2004).

4.3.2.1. Engle-Granger Procedure

The Engel-Granger procedure for testing cointegration involves two stages. First, a regression of the levels of the I(1) variables is conducted using OLS. Secondly, ADF unit root test of the residual from the first stage is carried out. If the residual, which is a linear combination of the I(1) variables, is I(0), then the variables are cointegrated and the cointegrated series may be interpreted as a long run equilibrium relationship among the variables (Engle and Granger, 1987).

Given two series y_t and x_t, such that

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t, \tag{4.17}$$

the condition for cointegration requires that $\varepsilon_t = y_t - \beta_0 - \beta_1 x_t$ must be stationary. Stationarity of ε_t indicates the presence of long run relationship between y_t and x_t.

The error correction model shows the short run relationships in terms of differenced variables and the lag of the long run relationship estimated in (4.17).

$$\Delta y_t = \alpha_0 + \alpha_1 \varepsilon_{t-1} + \alpha_2 \Delta x_t + u_t \quad (4.18)$$

In (4.18) α_2 measures the contemporaneous effect of change in x_t on y_t and y_t measures the magnitude by which y_t adjusts to disequilibrium between y_t and x_t from last period (i.e., it is the long run adjustment parameter).

This problem, however, has serious limitations. First, it may not yield a unique cointegrating vector the equation involves more than two variables. Second, unless there is a clear theory, the interpretation of the outcome vector is problematic (see Geda, Ndung'u and Zerfu, 2007). The approach is also static in the sense that it ignores any dynamic adjustments in the model (Ericsson and MacKinnon, 1999).

4.3.2.2. Single Equation Error Correction Model

In single equation error correction model the starting point is autoregressive distributive lag (ADL) model (Hendry, 1998 cited in Keele and De Boef, 2004). Following Keele and De Boef (2004), single equation error correction model is derived below. Consider ADL (1,1) model:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + e_t \quad (4.19)$$

After first differencing and some rearrangements (4.19) yields:

$$\Delta y_t = \alpha_0 + \delta y_{t-1} + \theta_1 \Delta x_t + \theta_2 x_{t-1} + e_t \quad (4.20)$$

where $\delta = (\alpha_1 - 1)$, $\theta_1 = \beta_0$ and $\theta_2 = (\beta_0 + \beta_1)$. Equation (4.20) can be rewritten in an error correction form as:

$$\Delta y_t = \alpha_0 + \delta(y_{t-1} - \theta_2 x_{t-1}) + \theta_1 \Delta x_t + e_t. \quad (4.20a)$$

δ captures the long run relationships between y and x and is interpreted as the speed at which y adjusts to any discrepancy between y and x in the previous period. It is expected to have a negative sign. θ_1 captures any contemporaneous effects that may occur in the model.

The benefit of single equation error correction model is that is convenient for modeling general to specific approach in a single equation context. The assumption of weak erogeneity often holds and the model is robust to dynamic analysis. Keele and De Boef (2004) note that the single equation error correction model is found to be superior to the Engle-Granger two-step estimator both empirically (De Boef, 2001; Durr, 1993a), and theoretically (Beck, 1993). Its main problem is that it assumes existence of only one cointegrating vector.

4.3.2.3. The Johansen Procedure

Both the Engle-Granger and single equation error correction model assume the existence of at most one cointegrating relationship. The Johansen procedure, however, enables the identification of multiple cointegrating vectors for any number of non-stationary series. The starting point in Johansen's approach is Gaussian vector autoregression (VAR) (Ericsson and MacKinnon, 1999).

Following (Davidson and MacKinnon, 1999), the system for determining the cointegrating vector in Johansen's procedure is specified as:

$$x_t = \sum_{i=1}^{p} \pi_i x_{t-i} + \Phi D_t + \varepsilon_t, \quad \varepsilon_t \sim IN(0, \Omega), \quad t = 1, \ldots, T \tag{4.21}$$

where x_t is a vector of n variables at time t; π_i is an n x n matrix of coefficients on the i^{th} lag of x_t; p is the lag length in the model; Φ is an n x m matrix of coefficients on D_t, which is a vector of m deterministic variables (such as a constant term, a trend and dummies).

The VAR in (4.21) can be rewritten as a vector error correction model:

$$\Delta x_t = \Pi x_{t-1} \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \Phi D_t + \varepsilon_t \tag{4.22}$$

where Π and Γ_i are:

$$\Pi = \left(\sum_{i=1}^{p} \pi_i\right) - I_n \tag{4.23}$$

$$\Gamma_i = -\left(\pi_{i+1} + \cdots + \pi_p\right), \quad i = 1, \ldots p-1 \tag{4.24}$$

I_n is an identidy matrix or order n, Δ is adifference operator and r, $0 \leq r \leq n$ is the rank of the martrix Π and represents the number of cointgrating vectors in the system. If $r = 0$ it indicates the absence of cointegrating vector; if $r = n$ then the martrix Π is said to have full rank and $0 < r < n$, Π is said to have reduced rank.

Π can be rewritten as:

$$\Pi = \alpha\beta' \tag{4.25}$$

where both α and β are n x r matrices of full rank. Thus substituting (4.25) in (4.22) gives:

$$\Delta x_t = \alpha\beta' x_{t-1} \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \Phi D_t + \varepsilon_t. \tag{4.22a}$$

In (4.22a) β represents the matrix of conintegrating vectors and α is matrix of weighting elements. The matrix of the cointegrating vectors β has the property that $\beta' x_t$ is stationary despite x_t being non-stationary. Testing for cointegration amounts to finding the number of r linearly independent columns in Π, which is equilivalent to testing that the last (n - r) columns of α are insignificantly small (Harris, 1995).

Johansen (1988, 1991) gives two likelihood ratio tests for determining the rank of Π and hence for testing the number of cointegrating vectors in (4.22): the maximum eigenvalue test (λ_{max}) and the trace test (λ_{trace}).

$$\lambda_{max} = -T \ln(1 - \hat{\lambda}_{r+1}) \tag{4.26}$$

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \tag{4.27}$$

In (4.26) and (4.27), $\hat{\lambda}$s are eignevalues estimated from the Π matrix ordered from the largest to the smalles where $\hat{\lambda}_1 > \hat{\lambda}_2 > \cdots > \hat{\lambda}_n$, and T is the number of observations.

The maximum eigenvalue test tests the null hypothesis of existence of r cointegrating vectors against the alternative of r+l cointegrating vectors. The trace test, on the other hand, tests the null hypothesis of r_1 cointegrating vectors against the alternative of r_2 cointegrating vectors, for $r_1 < r_2 \leq n$. Cheung and Lai (1993)

suggest that trace test shows more robustness to both skewness and excess kurtosis in the residuals than the maximum eigenvalue test.

4.3.3. Data Source and Description

Data on Ethiopian macroeconomic variables differs between sources. The data from national sources such as MoFED and NBE are different from those from IMF and World Bank. For data consistency attempts have been made to rely on national sources. However, for some variables for which data from national sources are unavailable are taken from international sources. Table 4.1 lists the different sources of data used in this study.

Table 4.1: Sources of Data

IMF(IFS database)	MoFED	NBE	DPPC	CSA
Foreign CPI	Real GDP	M1	Food Aid	Cereals Output
Foreign Food CPI	Nominal GDP	M2		Wages
Foreign Non-Food CPI		Interest rate		
		Exchange rate		
		Domestic CPI		
		Domestic Food CPI		
		Domestic Non-Food CPI		

The domestic consumer prices are compiled by CSA. The various CPIs measure the average change in price paid by consumers for a fixed basket of goods of services. In compiling the indices, CSA gathers market price data on large number of goods and services in 119 representative markets in different regions. To get the prices represent the market condition, price information is taken from three sources:

consumers, traders and the market place. This price data is then weighted by the household expenditure weights of each item in consumption basket. The weights are derived based on results of Household Income, Consumption and Expenditure Survey (2004/05). A geometric mean of this price data is, then, taken to compute the monthly consumer price indices[29].

The foreign price level *Pf* is computed as a weighted[30] index of Ethiopia's major trading partners (China, Italy, India, Unites States, Japan, United Kingdom, Netherlands and Sweden). The price indices of Ethiopia's major trading partners are obtained from IMF's IFS data base. The prices foreign food indices are also obtained from IFS database, while the foreign non-food indices are obtained as weighted differences of foreign price index and foreign food price index.

Marketed surplus is computed as total cereals output weighted by the share of marketed output in total farm production. The weight is obtained from Atlas of Ethiopian Rural Economy-mapped variables (2006).

The shares of food and non-food components of non-tradable products as well as the weights of tradable, non-tradable and administered products in CPI are computed from CPI weights based on CSA's Household Income, Consumption and Expenditure Survey (2004/05).

Interest rate is computed as simple average of saving deposit, time deposit and lending rates. Due to lack of accurate data on demand deposit rate, it is not included in computing the average interest rate.

The administered price index is computed as the weighted average of water, electricity, transport and communication and fuel indices. The weights applied are the shares of the items in household expenditures based on the results of Household Income, Consumption and Expenditure Survey (2004/05).

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[29] See any edition of CSA's country and regional level consumer price indices publications of 2008.
[30] The weight of each country is obtained as the average trade share of each country with Ethiopia for 2005/06 and 2006/07.

4.3.4. Data limitations

The data used in this study covers all four quarters of the 1996/97 - 2006/07 period and three quarters of 2007/08. However, for foreign price indices, cereals output and GDP data for 2007/08 is absent. Thus, forecast values of these variables for the last three quarters are used. Moreover, due to absence of quarterly data for cereals output, GDP, food aid and wages the quarterly data of cereals output, GDP and food aid used in the study are generated from annual data using quadratic-match sum method of series conversion and that of wages is converted using quadratic-match average technique of conversion.

4.3.5. Definitions of variables used in estimation

CER = cereals output in thousands of Birr

DCPI = domestic CPI

DFCPI = domestic food CPI

DNFCPI = domestic non-food CPI

EXR = exchange rate expressed as units of Birr per dollar

FAID = food aid in thousands of Birr

FCPI = foreign CPI

FFCPI = foreign food CPI

FIMP = food imports in thousands of Birr

FNFCPI = foreign non-food CPI

GDPN = nominal GDP in millions of Birr

GDPR = real GDP in millions of Birr

INT = interest rate

M1 = narrow money in millions of Birr

M2 = broad money in millions of Birr

MSUR = marketed surplus in thousands of Birr

NM2 = broad money including microfinance credit and DBE outstanding credit in millions of Birr

RM1 = narrow money divided by price level in millions of Birr

RM2 = broad money divided by price level (real money supply) in millions of Birr

WAGES = average manufacturing industry monthly wages

L in front of the variables above in any of the equations to be estimated represents the logarithm of the level variables.

5. Model Estimation and Interpretation of Results

5.1. Unit Root Test Results

One of the major problems encountered in studying economic relationships is the likelihood of spurious regression (seemingly related variables). To deal with this problem it is crucial to study the long run relationship of the variables. This is often done by checking if the variables are cointegrated. The first step in cointegration analysis is studying the order of integration of the variables under consideration. The order of integration of the variables in this study is determined using unit root tests. Two unit root tests are applied: the Augmented Dikey-Fuller (ADF) test and Phillips-Perron (PP) test. The results of ADF and PP unit root tests are given in table 5.1 and table 5.2 below[31].

Table 5.1: ADF unit root test results

Variable	Test equation				Order of Integration
	Intercept	Critical values at 5% level of significance	Intercept and Trend	Critical values at 5% level of significance	
LogDCPI	2.450608	-2.922490	0.735580	-3.504330	I(1)
logDFCPI	0.915598	-1.919952	-0.069464	-3.500495	I(1)
logDNFCPI	4.332114	-2.916566	1.488021	-3.495295	I(1)
logFCPI	1.345706	-2.917650	-0.664897	-3.496960	I(1)
logFNFCPI	-1.375973	-2.917650	-1.936112	-3.496960	I(1)
logACPI	1.854814	-2.916566	-0.985724	-3.495295	I(1)
log(M/P)	-1.675818	-2.916566	-1.510774	-3.495295	I(1)
logGDPR	1.776493	-2.917650	-0.767691	-3.496960	I(1)
logEXR	-2.340607	-2.917650	-2.282503	-3.496960	I(1)
logMSUR	-0.595706	-2.917650	-1.754556	-3.496960	I(1)
logFAID	-1.566912	-2.917650	-2.390321	-3.496960	I(1)
logFIMP	-2.278010	-2.916566	-3.311041	-3.495295	I(1)
logWAGES	-1.018008	-2.917650	-1.697923	-3.496960	I(1)
INT	-1.795519	-2.916566	-1.814951	-3.496960	I(1)

[31] All tests in this study are conducted using Eviews 5.

Table 5.2: PP unit root test results

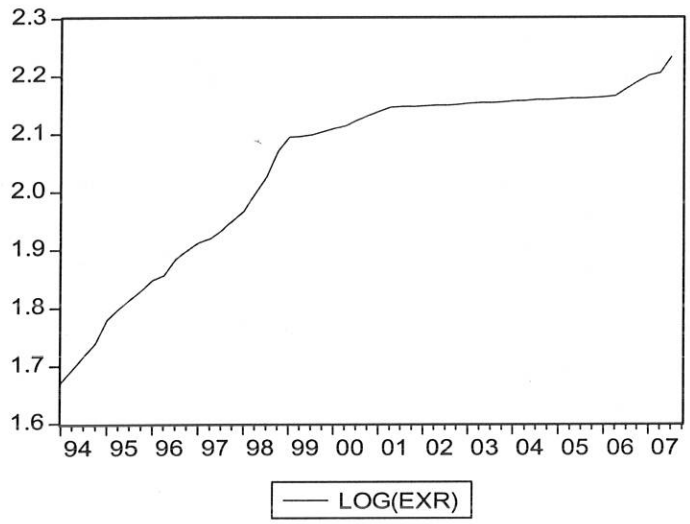
Variable	Test equation				Order of Integration
	Intercept	Critical values at 5% level of significance	Intercept and Trend	Critical values at 5% level of significance	
logDCPI	3.271757	-2.916566	0.733770	-3.495295	I(1)
logDFCPI	1.834041	-2.916566	0.020105	-3.495295	I(1)
logDNFCPI	10.24231	-2.916566	6.256377	-3.495295	I(1)
logFCPI	1.325788	-2.916566	-0.748206	-3.495295	I(1)
logFNFCPI	-1.512071	-2.916566	-1.960599	-3.495295	I(1)
logACPI	3.504180	-2.916566	-0.326146	-3.495295	I(1)
log(M/P)	-1.768465	-2.916566	-1.491220	-3.495295	I(1)
logGDPR	2.420672	-2.916566	-0.576695	-3.495295	I(1)
logEXR	-4.271828	-2.916566	-2.203589	-3.495295	I(0)
logMSUR	-0.314500	-2.916566	-1.475656	-3.495295	I(1)
logFAID	-1.293433	-2.916566	-1.993966	-3.495295	I(1)
logFIMP	-2.020895	-2.916566	-3.125961	-3.495295	I(1)
logWAGES	-1.132758	-2.916566	-1.712560	-3.495295	I(1)
INT	-1.803962	-2.916566	-1.478896	-3.495295	I(1)

The unit root tests conducted revealed all variables have unit root in their level, thus have to be differenced to achieve stationarity[32]. This result is confirmed using both ADF and PP tests. One exception, however, is exchange rate (EXR), which is found to be stationary in level under the PP test, while ADF test indicated that it is non-stationary. One possible explanation for these contradicting results could be strong autocorrelation and structural breaks in the exchange rate series. In such cases ADF test has low power and indicates the presence of unit roots (Harris, 1995). Perron (1989) cited in Harris (1995) notes that the usual ADF unit root test mistakes a permanent shift in a series that is stationary around a deterministic trend during the period under consideration as a persistent innovation to a non-stationary trend and leads to under-rejection of the null of unit roots. The PP test, however, takes accounts of such structural breaks. It is, therefore, a better test in the

[32] The ADF and PP unit root test results of the differenced series are given in Appendix (2).

presence of structural breaks. The existence of a significant break in the exchange rate series can be observed from Figure 5.1 below.

Figure 5.1: The trend of exchange rate



As can be seen in the figure above, there has been a permanent break in the exchange rate series in the first quarter of 1999/00. This could be the reason for the conflicting results of the ADF and PP unit root tests.

Unit root tests revealed that all variables used in this study are I(1). Thus, the determination of cointegrating relationships doesn't suffer from mixed order of integration. The existence of cointegrating vectors in the model will now be tested using Johansen's approach. Unlike the Engle-Granger two step procedure or single equation error correction model, this approach allows the existence of multiple cointegrating relationships.

5.2. Cointegration Analysis

As noted above the determination of the cointegrating relationships in the model is done using the VAR based Johansen's approach. An important limitation of the VAR approach is that it is not suitable for models with large number of variables. This is because the presence of lags of the variables in the system requires estimation of large number of coefficients. The degrees of freedom in estimating the

coefficients will be low and the estimated coefficients, thus, will be inefficient. Moreover, the interpretation of the cointegrating space becomes difficult (Juselius, 1992). Following Juelius (1992), in this study, therefore, the long run relationships will be derived using sectoral VARs. Two sectoral VARs will be estimated for the non-tradable food inflation and non-tradable non-food inflation defined in the previous chapter. Once the cointegrating vectors are identified from the two sectoral VARs, a single equation error correction model consisting of differenced endogenous variables and error correction models derived from the sectoral VARs will be estimated (see also Durevall and Ndungu, 1999).

5.2.1. Food Price Model

The VAR model for food price is defined as:

$$p_{2t}^{f} = \delta_0 + \sum_{j=1}^{k} \delta_{1j} p_{2_{t-j}}^{f} + \sum_{j=1}^{k} \delta_{2j} y_{t-j} + \sum_{j=1}^{k} \delta_{3j} m_{t-j}^{*} + \sum_{j=1}^{k} \delta_{4j} i_{t-j} + \sum_{j=1}^{k} \delta_{5j} \pi_{t-j}^{e} + \sum_{j=1}^{k} \delta_{6j} sup_{t-j} + \sum_{j=1}^{k} \delta_{7j} p_{3_{t-j}} + \sum_{j=1}^{k} \delta_{8j} p_{1_{t-j}} + \varepsilon_{1t} \quad (5.1)$$

where *sup* is the supply of food defined as the sum of marketed surplus, food imports and food aid, all the rest variables are as defined in preceding discussions, m^* is $m - p$, k is the appropriate lag length in the system determined by lag length criteria, mainly Akaike and Schwarz information criteria and ε_t is a white noise error.

Since the variables in the food price model are determined to be I(1), the appropriate modeling strategy is VECM. The VECM is estimated once the number of cointegrating relationships in the VAR model is determined. The resulting VECM can be specified as:

$$\Delta p_{2\,t}^{f} = \sum_{j=1}^{k} \delta_{1j} \Delta p_{2\,t-j}^{f} + \sum_{j=1}^{k} \delta_{2j} \Delta y_{t-j} + \sum_{j=1}^{k} \delta_{3j} \Delta m_{t-j}^{*} + \sum_{j=1}^{k} \delta_{4j} \Delta i_{t-j} + \sum_{j=1}^{k} \delta_{5j} \Delta \pi_{t-j}^{e}$$
$$+ \sum_{j=1}^{k} \delta_{6j} \Delta sup_{t-j} + \sum_{j=1}^{k} \delta_{7j} \Delta\, p_{f_{t-j}}^{f} + \sum_{j=1}^{k} \delta_{8j} \Delta p_{3_{t-j}} + \delta_{9} D_{1t}$$
$$+ \alpha_1 \left(\beta_0 p_{2\,t-1}^{f} - \beta_1 y_{t-1} - \beta_2 m^{*}{}_{t-1} - \beta_3 i_{t-1} - \beta_4 \pi^{e}{}_{t-1} + \beta_5 sup_{t-1} \right.$$
$$\left. + \beta_6 p_{f_{t-1}}^{f} + \beta_7 p_{3_{t-1}} \right) + \varepsilon_{1t} \qquad (5.2)$$

where D_{1t} is vector of deterministic variables: intercept, trend, centered seasonal dummy[33] and structural break dummy, α_1 is the error correction parameter and measures the speed by which inflation adjusts for last period's disequilibria and β_i are coefficients of the long run relationship in the system.

In determining the number of cointegrating relationships the lag length used is 2 as determined using various information criteria[34]. Structural break dummy and centered seasonal dummy are also included in the model in unrestricted manner. The structural break dummy is intended to capture the effect of the shift in many macro variables observed in 2002/03 as discussed in chapter two. The seasonal dummy is included to account for the seasonal nature of public expenditure and agricultural products. The bulk of public expenditure is spent in the fourth quarter of the Ethiopian fiscal year while agricultural products are harvested twice a year, the Meher[35] season being the most important one. Table 5.3 below shows the results from various VAR lag length selection criteria used in determining the lag length of the model.

As can be seen from the table above LR, FPE and HQ criteria indicate that the appropriate lag length is two while AIC and SC indicate it is, rather, four and one

[33] Using centered seasonal dummy variables ensures that their introduction in the model doesn't affect the underlying asymptotic distributions upon which tests depend (see Harris, 1995).
[34] Tests of model reduction using PcGive 10 also suggest the same lag length.
[35] The Meher season comes around the end of the second quarter and the beginning of the third quarter.

respectively. To complement the information criteria above model reduction tests were conducted and the appropriate lag length is identified to be two.

Table 5.3: VAR Lag Order Selection Criteria for food price model[36]

Lag	LR	FPE	AIC	SC	HQ
0	NA	2.31e-16	-16.14163	-15.07090	-15.73389
1	542.5377	1.56e-21	-28.09286	-25.14834*	-26.97157
2	95.25367*	6.81e-22*	-29.10953	-24.29124	-27.27470*
3	47.82692	1.12e-21	-29.06261	-22.37053	-26.51423
4	58.60063	8.07e-22	-30.35820*	-21.79234	-27.09627

*indicates the lag length selected by the criterion.

The Johansen procedure test results for cointegration with two lags in the system indicates that there are two cointegrating relationships. Both trace and maximum eigenvalue tests fail to reject the null of at most two cointegrating equations in the system. The trace and maximum eigenvalue test statistics are given in table 5.4.

Table 5.4: Johansen Cointegration Test for food price model

Hypothesized no of CEs	Eigenvalue	Trace test		Max Eigenvalue test	
		Trace Statistics	Critical level at 5% level of significance	Max-Eigen Statistics	Critical level at 5% level of significance
None*	0.868350	249.5758	159.5297	103.4082	52.36261
At most 1*	0.648277	146.1677	125.6154	53.29042	46.23142
At most 2	0.524307	92.87728	95.7537	37.89214	40.07757

* indicates rejection of the null at 5% level of significance level

This result can be complemented by the fact that the characteristic polynomial of the model has six roots with modulus equal to one. Provided the number of variables in the model is eight, existence of six roots with unit modulus indicates that the adjustment coefficients for six potential cointegration equations are

[36] LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC Akaike information criterion; SC Schwarz information criterion; HQ: Hannan-Quinn information criterion.

statistically zero, leaving only two potential cointegrating relationships (see Harris, 1995). The roots of the model's characteristic polynomial are given in Appendix (3).

The two potentially cointegrating equations of the model are[37]:

$$ECM_{11} = \log(DFCPI) - 0.86494\log(GDPR) - 1.86855\log(EXINF) - 1.49550\log(RNM2) + 2.493575\log(ACPI) - 0.496635\log(FFCPI)$$

$$ECM_{12} = \log(INT) + 6.61721\log(GDPR) + 3.053765\log(EXINF) + 9.594705\log(RNM2) + 20.87717\log(ACPI) + 4.464449\log(FFCPI)$$

Weak stationarity tests are conducted for identifying the cointegrating equations. The tests conducted for the purpose are VEC Granger Causality/Block Exogeneity Wald Test and VEC coefficient restrictions. The former revealed that *INT*, log(*GDPR*), log(*SUP*) and log(*ACPI*) are weakly exogenous in the estimated model. When normalizing ECM_{12} for log(*DFCPI*) and restricting its adjustment coefficient to zero, the restriction was found to be binding, thus, again confirming the weak exogeneity of *INT*. Therefore, the number of cointegration equations in the model reduce to just one as the second equation vanishes.

The results of VEC Granger Causality/Block Exogeneity Wald Test are given in Table 5.5.

Diagnostic tests were conducted to test the adequacy of the model[38]. The model satisfies all diagnostic tests. Autocorrelation tests indicate that there is no problem of autocorrelation. The null of no serial correlation at lag order of 12 cannot be rejected using LM test. Moreover, the residuals of the model are homoskedastic as the null of homoskedastic residuals cannot be rejected using White Heteroskedasticy (no cross terms) test. Jarque-Bera test of residual normality cannot reject the null of multivariate normal residuals implying that the residuals of the model are also normally distributed.

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[37] Note that all insignificant variables in the cointegration equations are excluded.
[38] Diagnostic test results are given in Appendix 4

Table 5.5: VEC Granger Causality/Block Exogeneity Wald Test for food price model

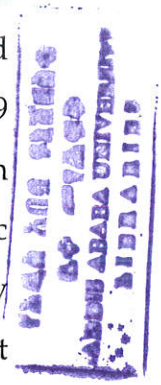
Variable	Chi-sq	Prob.	Conclusion
Log(DFCPI)	26.89306	0.0199	Endogenous
Log(GDPR)	14.56256	0.4087	Weakly Stationary
Log(SUP)	12.48902	0.5671	Weakly Stationary
Log(EXINF)	408.1117	0.0000	Endogenous
Log(RNM2)	28.14208	0.0136	Endogenous
Log(ACPI)	14.86174	0.3877	Weakly Stationary
Log(FFCPI)	37.53205	0.0006	Endogenous
INT	17.16035	0.2477	Weakly Stationary

The estimated cointegration equation also produces a sound impulse response. The impulse responses complement the results obtained in the cointegration equation (see Appendix 5).

As can be seen from the cointegration equation, food inflation is positively related to real income. For a one percent increase in real income (GDP) inflation increases by approximately 0.86 percent. As noted in chapter four, real GDP comes into inflation equation from two sides: first directly as a determinant of food demand and second, as a component of excess money supply. In the first case, as income rises, demand for food rises, for a given supply of food, deriving food price up. In the second case, rise in income results in rise in demand for real money balances and, thus, reduces the excess supply of money, for a given stock of money supply, and drives food price down. The positive relationship between real income and inflation obtained in the cointegration equation indicates the former effect outweighs the later effect.

Expected inflation, real supply of money and world food price all have the expected signs and the coefficients are significant. The significance of expected inflation indicates the importance of inflation inertia in Ethiopian food inflation. The reaction

of agents to one percent expected inflation induces over 1.86 percent of actual inflation. As expected money supply has been a key factor in the current food inflation. For one percent real money growth, food price increases by over 1.49 percent. There is also an international food price pass through effect in Ethiopian food price inflation. A one percent rise in world food prices results in the domestic food prices responding by over 0.49 percent. The supply of food is negatively related to food prices, as should normally be the case. However, its coefficient is not statistically significant, indicating that the supply of food is not an important determinant of the current food price spirals. Administered price index, however, has an unexpected sign. The implication that can be derived from this result is that food price increases are not explained by administered price rises.



To summarize, the most important determinants of the food price inflation process in Ethiopia are inflation expectation, real money supply growth, foreign food price movements and real income growth in a descending order.

5.2.2. Non-food Price Model

The VAR model for the non-food non-tradable sector is specified as

$$p_{2t}^{n} = \delta_9 + \sum_{j=1}^{k} \delta_{10j} p_{2_{t-j}}^{n} + \sum_{j=1}^{k} \delta_{11j} y_{t-j} + \sum_{j=1}^{k} \delta_{12j} m_{t-j}^{*} + \sum_{j=1}^{k} \delta_{13j} i_{t-j} + \sum_{j=1}^{k} \delta_{14j} \pi_{t-j}^{e} + \sum_{j=1}^{k} \delta_{15j} e_{t-j} + \sum_{j=1}^{k} \delta_{16j} p_{f\,t-j}^{n} + \sum_{j=1}^{k} \delta_{17j} p_{3_{t-j}} + \sum_{j=1}^{k} \delta_{18j} w_{t-j} + \varepsilon_{2t} \quad (5.3)$$

All variables in the VAR are already identified to be non-stationary (I(1)). The right approach for modeling non-stationary variables as discussed earlier is VECM. The relevant VECM for the non-food model is defined as

$$\Delta p_{2t}^{n} = \sum_{j=1}^{k} \delta_{10j} \Delta p_{2_{t-j}}^{n} + \sum_{j=1}^{k} \delta_{11j} \Delta y_{t-j} + \sum_{j=1}^{k} \delta_{12j} \Delta m_{t-j}^{*} + \sum_{j=1}^{k} \delta_{13j} \Delta i_{t-j} + \sum_{j=1}^{k} \delta_{14j} \Delta \pi_{t-j}^{e}$$
$$+ \sum_{j=1}^{k} \delta_{15j} \Delta e_{t-j} + \sum_{j=1}^{k} \delta_{16j} \Delta p_{f\,t-j}^{n} + \sum_{j=1}^{k} \delta_{17j} \Delta p_{3_{t-j}} + \sum_{j=1}^{k} \delta_{18j} \Delta w_{t-j}$$
$$+ \delta_{19} D_{2t} + \alpha_2 (\beta_8 p_{2_{t-1}}^{n} - \beta_9 y_{t-1} - \beta_{10} m_{t-1}^{*} - \beta_{11} i_{t-1} - \beta_{12} \pi_{t-1}^{e}$$
$$- \beta_{13} e_{t-1} - \beta_{14} p_{f\,t-1}^{n} - \beta_{15} p_{3_{t-1}} - \beta_{16} w_{t-1}) + \varepsilon_t \qquad (5.4)$$

where Δ is first difference operator, D_{2t} is a vector of exogenous variables (i.e, constant, trend and dummy variables), α_2 is the long run equilibrium adjustment coefficient and βs are coefficients of the long run (cointegrating) equation in the model. All the other variables are as defined in the preceding sections.

Tests for determination of the appropriate lag length in the model indicate that the right lag length is one. In determining the lag length unrestricted structural break dummy and seasonal dummy have been included in the test model. Table 5.6 presents a summary of the different VAR lag length selection criteria used.

Table 5.6: VAR Lag Order Selection Criteria for non-food price model

Lag	LR	FPE	AIC	SC	HQ
0	NA	2.32e-23	-26.57997	-25.55724	-26.18915
1	817.5620*	4.73e-31*	-44.36663	-40.27570*	-42.80336*
2	102.1627	5.54e-31	-44.59558	-37.43646	-41.85987
3	90.26932	5.38e-31	-45.71765*	-35.49034	-41.80949

*indicates the lag length selected by the criterion.

As can be seen from Table 5.6, all test statistics, except AIC, suggest that the appropriate lag length is one. Therefore, in determining the number of cointegrating relationships in this model one lag of the endogenous variables in the system is included.

Johansen cointegration test with one lag indicates the presence of three cointegration relationships in the system. The nulls of no cointegration, at most one

cointegration and at most two cointegration equations are rejected. But the null of at most three cointegrating equations cannot be rejected as shown in Table 5.7 below.

Table 5.7: Johansen Cointegration Test for non-food price model

Hypothesized no of CEs	Eigenvalue	Trace test		Max Eigenvalue test	
		Trace Statistics	Critical level at 5% level of significance	Max-Eigen Statistics	Critical level at 5% level of significance
None*	0.812132	260.1183	179.5098	86.94468	54.96577
At most 1*	0.648583	173.1736	143.6691	54.38071	48.87720
At most 2*	0.543347	118.7929	111.7805	40.75923	42.77219
At most 3	0.408101	78.03369	83.93712	27.26978	36.63019

* indicates rejection of the hypothesis at 5% level of significance.

The problem with the Johansen cointegration test above is that the number of cointegrating relationships implied by trace test and maximum eigenvalue test are different. Trace test indicates the presence of three cointegrating equations while maximum eigenvalue test indicates two. However, because of the high power of trace test over maximum eigenvalue test, the existence of three cointegrating relationships is accepted.

The three potentially cointegrating equations of the non-food model are given below[39].

$$ECM_{21} = \log(DNFCPI) - 0.100941 * INT - 0.960237 * \log(EXINF) - 0.947895 * \log(RNM2)$$

$$ECM_{22} = \log(ACPI) + 1.232541 * \log(FNFCPI) - 1.088594 * \log(EXINF) - 1.089614 * \log(RNM2)$$

$$ECM_{23} = \log(EXR) - 0.742523 * \log(FNFCPI) + 0.450888 * log(EXINF) + 0.370791 * \log(GDPR) + 0.917167 * \log(RNM2) - 1.888804 * \log(WAGES)$$

[39] Note that all insignificant variables in the cointegration equations are excluded.

Weak exogeneity test using Granger Causality/Block Exogeneity Wald Test for identification of the cointegration relationships indicated that all variables except log(*DNFCPI*) and log(*EXINF*) are weakly exogenous.

Table 5.8: VEC Granger Causality/Block Exogeneity Wald Test for non-food price model

Variable	Chi-sq	Prob.	Conclusion
Log(DNFCPI)	24.84257	0.0351	Endogenous
Log(ACPI)	2.018485	0.9804	Weakly Exogenous
Log(EXR)	7.375004	0.4968	Weakly Exogenous
(INT)	5.094135	0.7475	Weakly Exogenous
Log(FNFCPI)	6.891927	0.5483	Weakly Exogenous
Log(EXINF)	39.41053	0.0000	Endogenous
Log(GDPR)	5.435048	0.7102	Weakly Exogenous
Log(RNM2)	11.20570	0.1903	Weakly Exogenous
Log(WAGES)	8.032072	0.4303	Weakly Exogenous

From table 5.8 it can be learnt that the last two potential cointegrating equations (ECM_{22} and ECM_{23}) are long run equations of weakly exogenous variables and, thus, should not enter the short run model as error correction terms. Zero restrictions on the long run adjustment coefficients of ECM_{22} and ECM_{23} after normalizing for log(*DNFCPI*) are found to be binding, confirming that there is only one unique cointegrating relationship in the non-food price model.

Diagnostic tests[40] for adequacy of the model indicate that the model satisfies all tests. There is no problem of autocorrelation in the model as the null of no serial correlation cannot be rejected at lag order 12 using LM test. Similarly, the null of homoskedastic residuals cannot be rejected using White Heteroskedasticity Test (no cross terms) implying that the residuals of the model are homoskedastic. VEC

[40] Test results are reported in Appendix 6.

Normality Tests also indicate that residuals are normally distributed since the null of multivariate normal residuals cannot be rejected using Jarque-Bera test.

The impulse responses of the model are consistent with the results obtained in the cointegrating relationship (see Appendix 7).

The signs of all variables in the cointegrating equation, except log(*WAGES*), are as expected. Despite having the expected sign, log(*FNFCPI*) and log(*GDPR*) are both insignificant. What these results indicate is that wage mark-ups are not important in the current non-food inflation as there is no real wage indexation in the Ethiopian labor market. There is no considerable international price pass through in the case of non-food non-tradable prices. The result is consistent with the fact that this category includes items that are not traded. Real income (GDP) is found to be positively related to non-food price, but the coefficient is found to be insignificant.

The most important determinants of non-food inflation are inflation expectation, real money growth and interest rate, in order of their importance. Monetary growth leads to increase in demand and, for a given supply of non-food items, leads to rise in non-food price. The result indicates that for a one percent increase in real money supply non-food prices rise by 0.94 percent. Inflation expectation, on the other hand, feeds into the price system as agents expect price increases to persist and act accordingly to mitigate its effects. Provided the price rises have been persistent of late, this wouldn't be a surprising outcome. For a one percent increase in price agents expect, their actions lead to a 0.96 percent non-food inflation. Compared to food prices, the effect of inflation expectations is lower for non-food prices. The effect of interest rate movements on non-food inflation may come from two directions. First a rise in interest rate lowers demand for real money balances and raises the excess money supply in the economy, for a given stock of real money. This in turn exerts an upward pressure in price as discussed above. Second, a rise in interest rate means a rise of cost of production for domestic producers. This may translate into increased prices via mark-up pricing. The effect of interest rate

movements on non-food prices, however, is relatively low. A one percent increase in interest rate induces a 0.1 percent increase in non-food price.

As noted in chapter four, tradable prices and administered prices are assumed to be exogenous. This implies that endogenous price adjustments take place only in the domestic food and non-food sub sector. Now that the cointegration relationships in the two sub sectors are identified, the estimated cointegration equations will enter the short run general price model as error correction terms (ECM_1 and ECM_2).

5.3. Single Equation Error Correction Model

The error correction model (ECM) includes the present and lagged values of tradable price, administered price, real GDP, real money supply, interest rate, expected inflation, food supply, exchange rate, foreign non-food CPI, wages and exogenous variables (constant, dummies, and trend). The general price error correction model is specified as:

$$\begin{aligned}\Delta p_t = \gamma_0 &+ \sum_{j=1}^{m} \gamma_{1j} \Delta p_{t-j} + \sum_{j=0}^{m} \gamma_{1j} \Delta y_{t-j} + \sum_{j=0}^{m} \gamma_{2j} \Delta m^*_{t-j} + \sum_{j=0}^{m} \gamma_{3j} \Delta i_{t-j} + \sum_{j=0}^{m} \delta_{14j} \Delta \pi^e_{t-j} \\ &+ \sum_{j=0}^{m} \gamma_{5j} \Delta e_{t-j} + \sum_{j=0}^{m} \gamma_{6j} \Delta p^n_{f\,t-j} + \sum_{j=0}^{m} \gamma_{7j} \Delta p_{3_{t-j}} + \sum_{j=0}^{m} \gamma_{8j} \Delta p_{1_{t-j}} \\ &+ \sum_{j=0}^{m} \gamma_{9j} \Delta w_{t-j} + \sum_{j=0}^{m} \gamma_{10j} \Delta sup_{t-j} + \gamma_{11} D_t + \varphi_1 ECM_1 + \varphi_2 ECM_2 + \varepsilon_t \end{aligned} \tag{5.5}$$

The above equation being the appropriate approach to specifying a single equation error correction model, due to strong multicollinearity problem the lagged domestic CPI are all dropped from the model.

The estimated error correction model passes all diagnostic tests. Breusch-Godfrey Serial Correlation LM test indicates that the residuals of the estimated error correction model do not suffer from autocorrelation. This can also be confirmed by looking at the model's autocorrelation function given in Appendix 9(a). The errors

are also normally distributed as Jarque-Bera test of normality fails to reject the null of normally distributed residuals. The same conclusion can be derived using Histogram-Normality test shown in Appendix 9(b). The forecasting power of the error correction model is also good as can be seen in Appendix 9(c). The plot of the actual LDCPI series against the forecasted series with 95% confidence intervals for the forecasts shows that the forecast errors (variances) are low. Throughout the forecasting period the actual LDCPI series falls within the forecast intervals. This indicates that the model has a strong forecasting power. Tests for the fit of the model (shown in Appendix 9(d)) also indicate that the model has a good fit.

Due to limited number of observations, the maximum lag length that can be used in the error correction model is three. In estimating the error correction model general to specific approach is adopted. Starting with three lags for all variables, the Current and lagged observations on variables are excluded from the final parsimonious model based on tests of coefficient significance. The parsimonious error correction model is given in table 5.9[41].

The results in table 5.9 appear to suggest that both demand and supply factors play role in short run price dynamics. The short run the determinants of inflation in Ethiopia are found to be real income, interest rate, inflation expectations, exchange rate, international prices, administered prices, wages and food supply. There is also evidence of inflation deriving from cost mark-up pricing. Growth in real income, interest rate and wages fuel the demand and lead to rising prices for a given level of output while food supply growth serves to cool down the price pressures. The exogenous international prices and administered prices are also found significant. Interest rate and wages play into the inflation process from two directions. First, by increasing aggregate demand as discussed above, and second by raising the production costs may be reflected via mark-up pricing. Exchange rate also has a cost raising effect and play into domestic prices as a cost component.

[41] The complete estimation result is given in Appendix 8.

Table 5.9: Parsimonious Error Correction Model

Dependent Variable: log(DCPI)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDPR(-3))	0.782691	0.127882	6.120416	0.0001
D(INT(-1))	0.036853	0.004948	7.447402	0.0000
D(INT(-3))	0.015139	0.004412	3.431457	0.0056
D(LEXINF(-2))	0.416174	0.052697	7.897468	0.0000
D(LEXR)	1.943555	0.185600	10.47173	0.0000
D(LFNFCPI)	1.088027	0.229159	4.747902	0.0006
D(LFNFCPI(-1))	0.482059	0.151851	3.174556	0.0088
D(LACPI(-1))	0.271630	0.052984	5.126628	0.0003
D(LFCPI(-3))	1.677412	0.328718	5.102889	0.0003
D(LWAGES)	5.166812	0.564142	9.158710	0.0000
D(LWAGES(-2))	1.730533	0.417255	4.147425	0.0016
D(LSUP)	-0.029904	0.008728	-3.426104	0.0057
ECM1(-1)	-0.020852	0.002841	-7.339772	0.0000
ECM2(-1)	0.297984	0.052213	5.707136	0.0001

Money supply, however, doesn't have a strong direct positive effect on short run inflation. It affects inflation indirectly through the error correction terms. This result is consistent with the view that in the absence of a well developed financial sector monetary transmission might take longer than would be with well developed financial sector. As noted in chapter two there is no well developed financial market in Ethiopia. Thus, the effect of monetary expansion may not be reflected in prices very fast. This result is also supported by the negative correlation between current and lagged real money supply growth and inflation shown in Appendix 10.

The most important determinants of short run inflation in Ethiopia are wages, exchange rate and international prices. All appear to affect the domestic prices

through cost mark-ups. The relatively fast and quite significant transmission of these cost raising factors into domestic prices indicates that there is a considerable market (monopoly) power in the hands of producers/traders. The results of the short run model seem to suggest that for a given rise in wages and international prices and exchange rate depreciation domestic prices rise more than proportionately. Wages increases translate into inflationary pressure fast as the current level of income is very low and for a given increase in income the marginal propensity to consume food is likely to rise[42]. International price increases and exchange rate depreciation induce inflation through two likely routes. First, such conditions may discourage domestic production by raising cost of production creating supply shortages, which would eventually lead to soaring prices. Second, the effect of the rise in international prices and exchange rate depreciation may be directly transferred into prices by producers/traders. The estimation results suggest the second effect prevails in Ethiopian case.

The coefficients of the error correction terms are interpreted as speed of adjustment to long run equilibrium or the disequilibrium periodically transmitted to inflation from food prices and non-food prices. The coefficient of the error correction term of the price model is negative and less than one. This result ensures that food price convergences to its long run equilibrium. The coefficient of the error correction term of the non-price model, on the other hand, is less than unity but positive. The positive adjustment coefficient implies that any disequilibrium in non-food price continuously grows making convergence difficult. The speed of adjustment of the food price to its own long run equilibrium, however, is slow as shown by the small adjustment coefficient. Every quarter only just over 2 percent of the disequilibrium in food prices is adjusted.

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[42] This is the Engel Law discussed in chapter four.

6. Conclusion and Policy Implications

6.1. Conclusion

The short run and long run model estimations conducted in this study indicated that the determinants of inflation in Ethiopia vary across sectors (food and non food) as well as over time horizons. The most important determinants of inflation in the long run are mainly domestic monetary developments while cost-push factors are the force behind short run inflation.

In the long run, domestic food prices are influenced mostly by income growth, inflation expectations, money supply growth and increase in international food prices. It is found that the positive effect of income growth through increased demand for food more than offsets the negative effect through money demand growth. Inflation expectations are also fueling the inflationary process. The strong inflation expectation effects observed in the long run food price model suggest that a price-price spiral may be imminent. As noted in chapter two, the government's use of domestic sources of finance, mainly money creation, is significant. Provided, most of household income goes to food expenditure, as money creation results in increase in money stock in the economy, the demand for food is bound to rise. With supply of food failing to catch up the growing demand, food prices responded to the disequilibrium in food market. This argument is supported by the insignificance of food supply in the long run food price model. The implication is either the supply of food has not grown by a significant amount or food demand is growing at a rate much higher than supply growth rendering the supply growth insignificant in the domestic food price dynamics.

The most important determinants of long run non-food inflation are found to be inflation expectations, money supply growth and interest rate. Like food prices, agents' expectation of persistent inflation appears to have fueled the non-food price dynamics. Money supply growth has also played into the non-food price inflation

as both private and public demand increases following the monetary expansion. Like the case with real income in the food price model, interest rates impact non-food prices through two routes: demand for real money balances and cost of production, both of which inducing upward pressure on non-food prices. Wages, however, are found to have no significant role in the long run non-food price inflation process suggesting that there have been no persistent (continuous) and significant wage cost-mark ups. This is a reasonable result given that there is no system of real wage indexation in the country.

In the short run, both demand and supply appear important in the current inflationary process, with supply factors having the edge over demand factors. Especially, wages, international food and non-food prices, exchange rate and food supply are found to be the most important forces behind short run price movements. The effect of wages may derive from the fast increase in demand following wages increases and the transfer of the increase in wage bills into prices by producers/traders due to monopoly power. Despite its strong effect in the long run, money supply is insignificant in the short run. This may have resulted from slow monetary transmission due to underdeveloped financial sector in Ethiopia.

The estimated short run model revealed that food price converges to its long run equilibrium value. The speed of adjustment, however, is slow implying that it takes very long for food price to move back to its equilibrium once it drifts away from its long run equilibrium value.

6.2. Policy Implications

This study has tried to identify the forces behind Ethiopian inflationary process both in the short run and the long run. The results indicated that the determinants of inflation differ between sectors and the time horizon under consideration. The policy implications that can be derived from this empirical study are:

- The policy interventions aimed at tackling the current inflationary processes need to take into account the priorities of the government as the effect of policy instruments highly depends on whether it is meant to temporarily deal with the inflationary problem or permanently reverse the inflation cycle. This is essential in that choice of policy instruments may bring forward the need to trade of economic growth for macroeconomic stability. The fact that the determinants of inflation in the short run somewhat differ from those in the long run supports the above argument.
- Money supply growth has been one of the prime sources of long run inflation. Therefore, in order to be able to curb the upward trend in prices, it is essential to adopt conservative monetary expansion. This may, however, restrict the government on fiscal front and engender problem of slower growth as observed in pre 2003 period when the government followed conservative fiscal and monetary policies. Finding the appropriate balance would be the role of policy makers.
- Another important variable in the long run inflation process is inflation expectation. At the moment, strong inflation expectations appear to be serving as effective inflation inertia and fueling continuous price-price spirals. Such may render efforts to control inflation hapless. This calls for government intervention in order to change the public opinion about inflation. The success of such efforts, however, raises the issue of credibility on the part of the government. It is important, therefore, for the government to announce monetary policy targets (mainly money supply and inflation

targets) and adhere to it for a considerable time period. There is, however, no consensus on which one is more effective. The current trend is a move towards exchange rate targeting. This doesn't seem to work in Ethiopian case as exchange rate has remained reasonably stable despite the macroeconomic instabilities.

- The current inflation trend is mainly derived by food inflation. Real income growth is found to be an important determinant of food prices. Since the level of income in Ethiopia is very low, most of a given increase in income is likely to be spent on food items. Therefore, in order to cool down the food price inflation it is essential that the government looks at ways of cooling down the economic growth, such as fiscal and monetary contractions.
- All the above forms of intervention will only be effective in the long run. The inflation process in the country is proving to be unbearable, especially for the urban working class since there is no real wage indexation system in the country. Therefore, it is also important to sanction policy interventions to temporarily contain inflation.
- On the basis of temporary welfare perspective, real wage indexation may serve the purpose. The danger of real wage indexation in the presence of persistent inflation, however, is that it may lead to continuous wage-price spiral. Therefore, other alternatives which may help contain short run inflation are reducing interest rate, exchange rate appreciation and downward revision of administered prices. It should be noted, however, reduction of administered prices may force the government into extra spending. Thus, caution should be taken in exercising it so as not to create additional pressure on price.

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Appendix 1(a): Government Revenue, Expenditure and Financing

Year	Revenue (% GDP)	Grants (% GDP)	Expenditure (% GDP)		Growth rates			Deficit excluding grants (% GDP)	Deficit including grants (% GDP)	Financing (% Deficit including grants)		
			Current	Capital	Revenue	Grants	Expenditure			Domestic		External
										Bank	Non-bank	
1997/98	14.6	2.3	12.8	7.5	8.3	26.8	33.7	5.8	3.5	29.4	70.6	39.9
1998/99	14.9	2.7	17.9	7.9	8.3	6.8	13.4	10.8	8.1	18.6	81.4	36.7
1999/00	14.3	2.6	20.6	5.2	14.0	99.9	11.2	11.5	8.9	92.3	7.7	14.6
2000/01	15.9	5.1	18.3	8.2	6.3	-9.4	-1.4	12.2	7.1	-4.0	104.0	84.6
2001/02	17.3	4.7	17.5	10.8	-3.1	45.8	8.8	13.6	8.9	-7.1	107.1	93.3
2002/03	15.2	6.2	18.4	8.6	24.8	-12.1	0.0	12.7	6.5	34.4	65.6	80.5
2003/04	16.1	4.6	13.8	9.5	12.0	14.1	20.9	7.6	3.0	83.2	16.8	92.6
2004/05	14.6	4.3	12.4	10.7	25.3	-18.3	18.3	8.7	4.4	67.9	32.1	51.3
2005/06	14.8	2.8	11.6	10.7	9.1	103.2	21.3	7.4	4.6	47.4	52.6	24.9
2006/07	12.5	4.4	10.0	10.8	8.3	26.8	33.7	8.3	3.9	63.8	36.2	28.6

Source: MOFED (2007/08)

Appendix 1(b): Monetary developments

Year	M1 growth rate (%)	M2[1] growth rate (%)	M1/GDP[2]	M2/GDP	Inflation rate	Nominal GDP growth	Growth rates (%)			
							COB[3]	Demand deposits	Savings deposits	Time deposits
1997/98	10.1	12.3	18.5	31.1	2.9	-3.9	-8.9	30.3	14.0	27.1
1998/99	3.1	4.4	18.1	30.9	4.7	5.9	10.2	-2.2	10.6	-20.1
1999/00	14.7	14.3	19.6	33.3	6.2	13.4	13.8	15.4	16.2	-6.4
2000/01	5.3	12.0	19.0	34.4	-5.2	2.1	0.0	9.8	17.4	23.8
2001/02	10.5	11.6	20.7	37.8	-7.2	-2.2	9.8	10.9	12.9	10.9
2002/03	8.3	10.5	22.9	42.7	15.1	10.3	17.3	1.7	13.2	4.1
2003/04	15.9	16.0	23.4	43.6	8.6	18.0	16.6	15.4	14.9	7.0
2004/05	11.7	17.4	23.4	45.8	6.8	22.9	12.9	10.6	20.5	32.1
2005/06	11.8	15.9	23.6	47.9	12.2	23.7	14.0	9.9	18.3	29.1
2006/07	24.4	22.9	26.4	53.0	17.7	29.8	20.0	28.4	15.8	59.6

1 Includes credit by microfinance institutions for the 2000/01-2006/07 period

2 Considered real GDP

3 Currency outside banks

Source: Own computation based on NBE (2006/07)

Appendix 2: Unit Root tests of first differences

2(a) - ADF unit root test for first difference

Variable	Test equation				Order of Integration
	Intercept	Critical values at 5% level of significance	Intercept and Trend	Critical values at 5% level of significance	
ΔLogDCPI	-2.109247	-2.919952	-3.215218	-3.504330	I(1)
ΔlogDFCPI	-2.170821	-2.919952	-2.685010	-3.500495	I(1)
ΔlogDNFCPI	0.115740	-2.923780	-7.389882	-3.496960	I(0)
ΔlogFCPI	-5.103166	-2.917650	-5.412412	-3.496960	I(0)
ΔlogFNFCPI	-6.600190	-2.917650	-6.644473	-3.496960	I(0)
ΔlogACPI	-4.927538	-2.917650	-5.930045	-3.498692	I(0)
Δlog(M/P)	-8.592083	-2.917650	-8.860855	-3.496960	I(0)
ΔlogGDPR	-3.812395	-2.917650	-4.616318	-3.496960	I(0)
ΔlogMSUR	-3.576603	-2.917650	-3.656907	-3.496960	I(0)
ΔlogFAID	-4.123906	-2.917650	-4.143783	-3.496960	I(0)
ΔlogFIMP	-8.121586	-2.917650	-6.609343	-3.502373	I(0)
ΔlogWAGES	-4.880519	-2.917650	-4.941454	-3.496960	I(0)
ΔINT	-6.496420	-2.917650	-6.508666	-3.496960	I(0)

2(b) - PP unit root test for first difference

Variable	Test equation				Order of Integration
	Intercept	Critical values at 5% level of significance	Intercept and Trend	Critical values at 5% level of significance	
ΔLogDCPI	-4.722408	-2.917650	-5.674747	-3.496960	I(0)
ΔlogDFCPI	-5.082298	-2.917650	-5.600360	-3.496960	I(0)
ΔlogDNFCPI	-5.435323	-2.917650	-7.405917	-3.496960	I(0)
ΔlogFCPI	5.119122	-2.917650	-5.434125	-3.496960	I(0)
ΔlogFNFCPI	-6.597529	-2.917650	-6.643316	-3.496960	I(0)
ΔlogACPI	-4.392381	-2.917650	-4.658153	-3.496960	I(0)
Δlog(M/P)	-8.496895	-2.917650	-8.758377	-3.496960	I(0)
ΔlogGDPR	-3.804468	-2.917650	-4.624365	-3.496960	I(0)
ΔlogMSUR	-3.519586	-2.917650	-3.615545	-3.496960	I(0)
ΔlogFAID	-4.239124	-2.917650	-4.258710	-3.496960	I(0)
ΔlogFIMP	-12.03101	-2.917650	-16.24936	-3.496960	I(0)
ΔlogWAGES	-4.882572	-2.917650	-4.954781	-3.496960	I(0)
ΔINT	-6476171	-2.917650	-6.577228	-3.496960	I(0)

Appendix 3: Roots of Characteristic Polynomial of food price model

Endogenous variables: LOG(DFCPI) INT LOG(GDPR) LOG(SUP) LOG(EXINF) LOG(RNM2) LOG(ACPI) LOG(FFCPI)
Exogenous variables: STBD STBD2 D_Q
Lag specification: 1 2

Root	Modulus
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
-0.295329 + 0.879247i	0.927520
-0.295329 - 0.879247i	0.927520
0.604983 + 0.558445i	0.823325
0.604983 - 0.558445i	0.823325
0.335824 + 0.712747i	0.787900
0.335824 - 0.712747i	0.787900
-0.692362 - 0.097040i	0.699129
-0.692362 + 0.097040i	0.699129
0.621871 - 0.237894i	0.665821
0.621871 + 0.237894i	0.665821
-0.496565 - 0.353573i	0.609583
-0.496565 + 0.353573i	0.609583
0.121619 + 0.487683i	0.502619
0.121619 - 0.487683i	0.502619
0.125908 + 0.262694i	0.291309
0.125908 - 0.262694i	0.291309
-0.030251 + 0.235452i	0.237388
-0.030251 - 0.235452i	0.237388

VEC specification imposes 6 unit root(s).

Appendix 4: Diagnostic Tests for food price model

4(a) – LM Test

VEC Residual Serial Correlation LM Tests
H0: no serial correlation at lag order h
Sample: 1994Q1 2007Q3
Included observations: 51

Lags	LM-Stat	Prob
1	72.22151	0.2248
2	81.09590	0.0732
3	54.50721	0.7953
4	66.20766	0.4006
5	63.04639	0.5102
6	102.3744	0.0016
7	72.10429	0.2277
8	62.86019	0.5169
9	78.19007	0.1094
10	56.60589	0.7327
11	65.80303	0.4142
12	67.42105	0.3610

Probs from chi-square with 64 df.

4(b) – Heteroskedasticity Test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Sample: 1994Q1 2007Q3
Included observations: 51

Joint test:

Chi-sq	Df	Prob.
1401.097	1404	0.5168

Individual components:

Dependent	R-squared	F(39,11)	Prob.	Chi-sq(39)	Prob.
res1*res1	0.677603	0.592805	0.8870	34.55774	0.6726
res2*res2	0.924198	3.438834	0.0160	47.13409	0.1741
res3*res3	0.640219	0.501902	0.9437	32.65117	0.7535
res4*res4	0.732928	0.774034	0.7347	37.37931	0.5439
res5*res5	0.506559	0.289550	0.9980	25.83453	0.9478
res6*res6	0.806333	1.174322	0.4078	41.12299	0.3778
res7*res7	0.905097	2.689942	0.0405	46.15994	0.2004
res8*res8	0.747481	0.834900	0.6795	38.12154	0.5098
res2*res1	0.826842	1.346812	0.3080	42.16892	0.3356
res3*res1	0.638257	0.497648	0.9458	32.55108	0.7575
res3*res2	0.859087	1.719549	0.1681	43.81344	0.2746
res4*res1	0.850826	1.608702	0.2009	43.39212	0.2896
res4*res2	0.862150	1.764018	0.1566	43.96963	0.2692
res4*res3	0.803292	1.151808	0.4228	40.96790	0.3842
res5*res1	0.481053	0.261455	0.9991	24.53368	0.9658
res5*res2	0.754122	0.865069	0.6522	38.46024	0.4943
res5*res3	0.736287	0.787487	0.7225	37.55063	0.5360
res5*res4	0.795874	1.099702	0.4594	40.58959	0.4002
res6*res1	0.707629	0.682651	0.8157	36.08907	0.6034
res6*res2	0.794856	1.092842	0.4644	40.53765	0.4024
res6*res3	0.908778	2.809865	0.0346	46.34767	0.1951
res6*res4	0.641291	0.504244	0.9424	32.70583	0.7513
res6*res5	0.807023	1.179531	0.4044	41.15819	0.3763
res7*res1	0.681346	0.603082	0.8795	34.74865	0.6641
res7*res2	0.866379	1.828782	0.1414	44.18534	0.2618
res7*res3	0.855182	1.665573	0.1833	43.61428	0.2816
res7*res4	0.796598	1.104616	0.4558	40.62649	0.3986
res7*res5	0.533920	0.323105	0.9955	27.22990	0.9221
res7*res6	0.905044	2.688293	0.0406	46.15726	0.2004
res8*res1	0.643567	0.509264	0.9398	32.82190	0.7466
res8*res2	0.881140	2.090927	0.0945	44.93816	0.2371
res8*res3	0.717101	0.714954	0.7877	36.57217	0.5812

res8*res4	0.855266	1.666704	0.1829	43.61856	0.2815
res8*res5	0.590374	0.406506	0.9809	30.10906	0.8457
res8*res6	0.899204	2.516196	0.0512	45.85942	0.2090
res8*res7	0.819166	1.277676	0.3449	41.77748	0.3511

4(c) - Normality Test

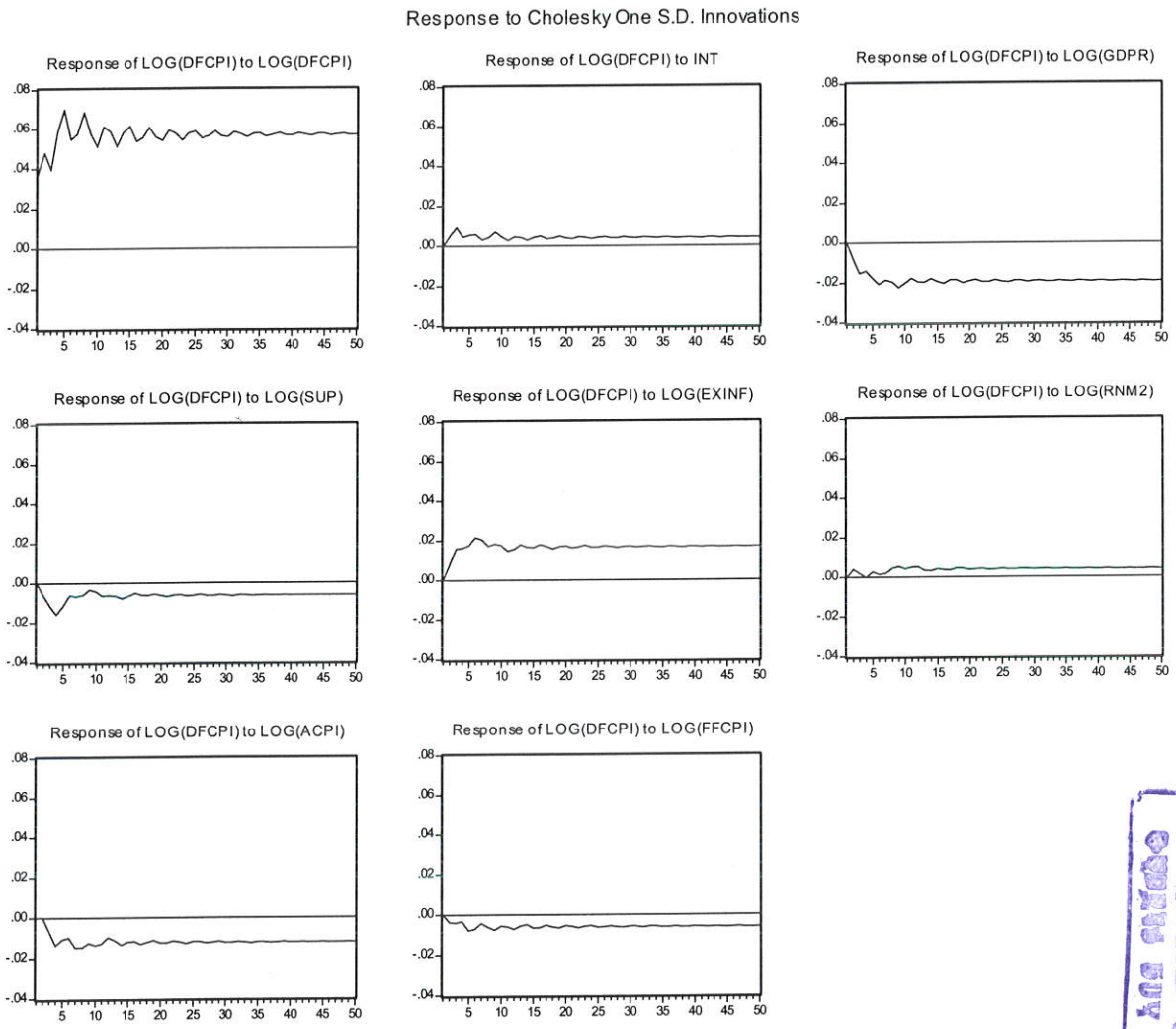
VEC Residual Normality Tests
Orthogonalization: Residual Covariance (Urzua)
H0: residuals are multivariate normal
Included observations: 51

Component	Skewness	Chi-sq	Df	Prob.
1	-0.142348	0.193532	1	0.6600
2	-0.080844	0.062423	1	0.8027
3	0.289551	0.800757	1	0.3709
4	0.173417	0.287232	1	0.5920
5	0.254811	0.620137	1	0.4310
6	0.054489	0.028358	1	0.8663
7	-0.038511	0.014165	1	0.9053
8	0.025378	0.006151	1	0.9375
Joint		2.012756	8	0.9806

Component	Kurtosis	Chi-sq	Df	Prob.
1	0.951647	10.61253	1	0.0011
2	1.597839	4.703013	1	0.0301
3	1.673421	4.166751	1	0.0412
4	1.347806	6.708260	1	0.0096
5	0.940854	10.73138	1	0.0011
6	1.107670	8.968456	1	0.0027
7	0.833828	11.94569	1	0.0005
8	0.895703	11.23573	1	0.0008
Joint		69.07181	8	0.0000

Component	Jarque-Bera	df	Prob.
1	10.80607	2	0.0045
2	4.765437	2	0.0923
3	4.967508	2	0.0834
4	6.995492	2	0.0303
5	11.35152	2	0.0034
6	8.996814	2	0.0111
7	11.95985	2	0.0025
8	11.24188	2	0.0036
Joint	280.9995	450	1.0000

Appendix 5: Impulse Response for food price model



Appendix 6: Diagnostic tests for non-food price model

6(a) – LM Test

VEC Residual Serial Correlation LM Tests
H0: no serial correlation at lag order h
Date: 06/21/08 Time: 03:26
Sample: 1994Q1 2007Q3
Included observations: 52

Lags	LM-Stat	Prob
1	84.04943	0.3863
2	50.34912	0.9970
3	75.26002	0.6589
4	75.78096	0.6430
5	94.45766	0.1456
6	73.08175	0.7227
7	107.1485	0.0275
8	68.27820	0.8423
9	86.12772	0.3275
10	82.67257	0.4275
11	72.10655	0.7496
12	106.8272	0.0289

Probs from chi-square with 81 df.

6(b) – Heteroskedasticity Test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Sample: 1994Q1 2007Q3
Included observations: 52

Joint test:

Chi-sq	df	Prob.
1257.716	1215	0.1921

Individual components:

Dependent	R-squared	F(27,24)	Prob.	Chi-sq(27)	Prob.
res1*res1	0.450961	0.730100	0.7863	23.44995	0.6606
res2*res2	0.489311	0.851680	0.6587	25.44419	0.5496
res3*res3	0.357424	0.494431	0.9608	18.58603	0.8846
res4*res4	0.841174	4.707733	0.0001	43.74105	0.0220
res5*res5	0.672892	1.828525	0.0696	34.99037	0.1391
res6*res6	0.694024	2.016201	0.0433	36.08923	0.1134
res7*res7	0.514329	0.941340	0.5631	26.74511	0.4776
res8*res8	0.554548	1.106589	0.4034	28.83652	0.3689
res9*res9	0.670318	1.807308	0.0734	34.85651	0.1425
res2*res1	0.435126	0.684717	0.8299	22.62656	0.7049
res3*res1	0.381083	0.547313	0.9345	19.81634	0.8384
res3*res2	0.407348	0.610960	0.8920	21.18209	0.7777
res4*res1	0.713771	2.216633	0.0262	37.11612	0.0929
res4*res2	0.530156	1.002990	0.5001	27.56809	0.4335
res4*res3	0.705849	2.132987	0.0323	36.70413	0.1007
res5*res1	0.578631	1.220637	0.3126	30.08881	0.3102
res5*res2	0.583153	1.243523	0.2965	30.32397	0.2998
res5*res3	0.465352	0.773681	0.7418	24.19832	0.6193
res5*res4	0.648074	1.636895	0.1131	33.69985	0.1749
res6*res1	0.506538	0.912443	0.5935	26.33998	0.4998
res6*res2	0.484565	0.835652	0.6760	25.19738	0.5634
res6*res3	0.441276	0.702037	0.8137	22.94634	0.6879
res6*res4	0.685865	1.940755	0.0524	35.66500	0.1228
res6*res5	0.771041	2.993415	0.0042	40.09413	0.0502
res7*res1	0.505025	0.906937	0.5994	26.26130	0.5041
res7*res2	0.523516	0.976628	0.5267	27.22284	0.4518
res7*res3	0.397957	0.587565	0.9089	20.69376	0.8004
res7*res4	0.711989	2.197416	0.0275	37.02344	0.0946
res7*res5	0.570550	1.180944	0.3422	29.66862	0.3292
res7*res6	0.612182	1.403139	0.2025	31.83348	0.2383
res8*res1	0.537090	1.031332	0.4724	27.92869	0.4147

res8*res2	0.498726	0.884372	0.6235	25.93377	0.5223
res8*res3	0.552238	1.096294	0.4124	28.71639	0.3748
res8*res4	0.545649	1.067502	0.4384	28.37373	0.3919
res8*res5	0.405876	0.607246	0.8948	21.10557	0.7813
res8*res6	0.681032	1.897876	0.0584	35.41366	0.1287
res8*res7	0.531155	1.007022	0.4962	27.62005	0.4308
res9*res1	0.500018	0.888953	0.6186	26.00094	0.5185
res9*res2	0.645560	1.618982	0.1183	33.56913	0.1789
res9*res3	0.473509	0.799437	0.7147	24.62245	0.5956
res9*res4	0.694477	2.020515	0.0428	36.11282	0.1129
res9*res5	0.659823	1.724128	0.0907	34.31078	0.1572
res9*res6	0.637694	1.564533	0.1357	33.16010	0.1918
res9*res7	0.572497	1.190369	0.3350	29.76985	0.3246
res9*res8	0.435878	0.686816	0.8280	22.66568	0.7028

6(c) – Normality Test

Orthogonalization: Residual Covariance (Urzua)
H0: residuals are multivariate normal
Included observations: 52

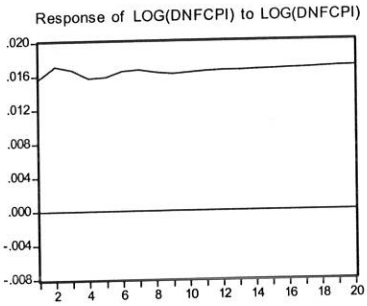
Component	Skewness	Chi-sq	df	Prob.
1	0.155884	0.236113	1	0.6270
2	0.446092	1.933595	1	0.1644
3	0.725900	5.120010	1	0.0237
4	-0.535609	2.787489	1	0.0950
5	-0.258527	0.649427	1	0.4203
6	0.197929	0.380659	1	0.5373
7	0.075210	0.054962	1	0.8146
8	-0.012477	0.001513	1	0.9690
9	0.363484	1.283770	1	0.2572
Joint		12.44754	9	0.1892

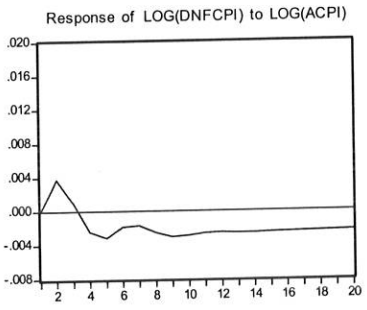
Component	Kurtosis	Chi-sq	df	Prob.
1	2.064805	1.945984	1	0.1630
2	1.700253	4.054830	1	0.0440
3	2.825461	0.010834	1	0.9171
4	4.355454	6.212295	1	0.0127
5	1.508055	5.474846	1	0.0193
6	1.518245	5.394218	1	0.0202
7	2.180184	1.438026	1	0.2305
8	2.075913	1.893743	1	0.1688
9	1.815964	3.302543	1	0.0692
Joint		29.72732	9	0.0005

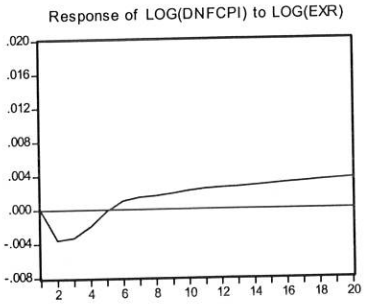
Component	Jarque-Bera	df	Prob.
1	2.182097	2	0.3359
2	5.988425	2	0.0501
3	5.130844	2	0.0769
4	8.999785	2	0.0111
5	6.124273	2	0.0468
6	5.774877	2	0.0557
7	1.492988	2	0.4740
8	1.895255	2	0.3877
9	4.586313	2	0.1009
Joint	387.3703	660	1.0000

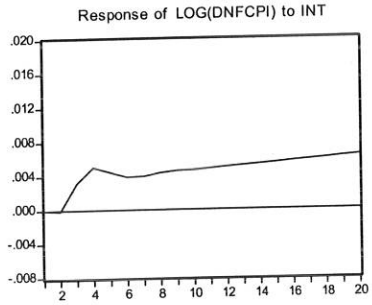
Appendix 7: Impulse Response for non-food model

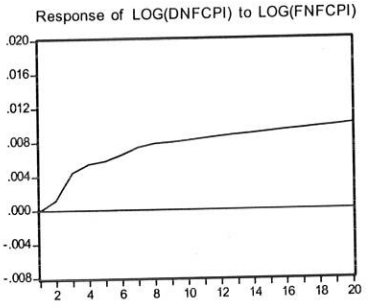
Response to Cholesky One S.D. Innovations

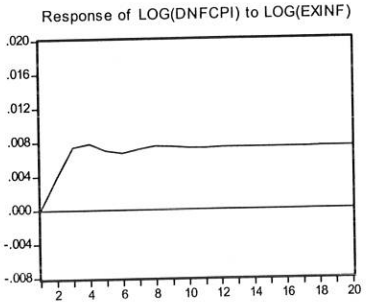


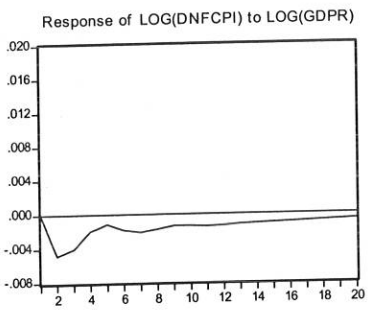


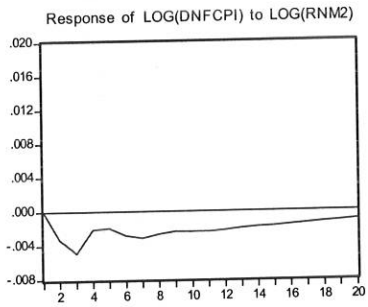


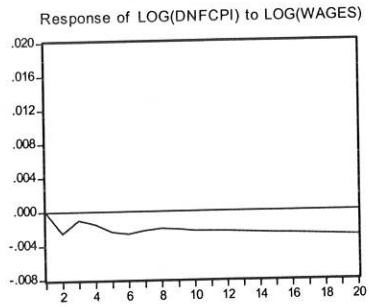












Appendix 8: Estimation results of Error Correction Model

Dependent Variable: D(LDCPI)

Method: Least Squares

Sample (adjusted): 1995Q2 2007Q3

Included observations: 50 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDPR)	-1.690798	0.293950	-5.751997	0.0001
D(LGDPR(-1))	-0.452472	0.117548	-3.849246	0.0027
D(LGDPR(-2))	-0.532919	0.153882	-3.463158	0.0053
D(LGDPR(-3))	0.782691	0.127882	6.120416	0.0001
D(LRNM2)	-0.304056	0.043769	-6.946883	0.0000
D(LRNM2(-1))	-0.188901	0.034432	-5.486277	0.0002
D(LRNM2(-2))	-0.269187	0.040149	-6.704693	0.0000
D(LRNM2(-3))	-0.071726	0.045239	-1.585503	0.1412
D(INT(-1))	0.036853	0.004948	7.447402	0.0000
D(INT(-2))	0.009665	0.004899	1.972809	0.0742
D(INT(-3))	0.015139	0.004412	3.431457	0.0056
D(LEXINF)	-0.250408	0.075405	-3.320851	0.0068
D(LEXINF(-1))	-0.265256	0.072034	-3.682380	0.0036
D(LEXINF(-2))	0.416174	0.052697	7.897468	0.0000
D(LEXINF(-3))	0.108818	0.074053	1.469464	0.1697
D(LEXR)	1.943555	0.185600	10.47173	0.0000
D(LEXR(-1))	0.278705	0.380055	0.733326	0.4787
D(LEXR(-2))	-0.754760	0.286316	-2.636106	0.0232
D(LFNFCPI)	1.088027	0.229159	4.747902	0.0006
D(LFNFCPI(-1))	0.482059	0.151851	3.174556	0.0088
D(LFNFCPI(-2))	0.496628	0.258428	1.921729	0.0809
D(LACPI(-1))	0.271630	0.052984	5.126628	0.0003
D(LACPI(-2))	-0.365067	0.064909	-5.624306	0.0002
D(LACPI(-3))	-0.091663	0.045596	-2.010310	0.0696
D(LFCPI)	1.130123	0.526731	2.145541	0.0551
D(LFCPI(-2))	-1.607145	0.473715	-3.392645	0.0060
D(LFCPI(-3))	1.677412	0.328718	5.102889	0.0003
D(LWAGES)	5.166812	0.564142	9.158710	0.0000

D(LWAGES(-2))	1.730533	0.417255	4.147425	0.0016
D(LWAGES(-3))	-0.353023	0.400120	-0.882294	0.3965
D(LSUP)	-0.029904	0.008728	-3.426104	0.0057
D(LSUP(-1))	-0.029332	0.006847	-4.283911	0.0013
D(LSUP(-2))	-0.009498	0.009310	-1.020136	0.3296
D(LSUP(-3))	-0.029069	0.007857	-3.699658	0.0035
STBD	0.067351	0.008701	7.740890	0.0000
STBD2	-0.012716	0.005403	-2.353406	0.0383
D_Q	0.029368	0.004178	7.029196	0.0000
ECM1(-1)	-0.020852	0.002841	-7.339772	0.0000
ECM2(-1)	0.297984	0.052213	5.707136	0.0001

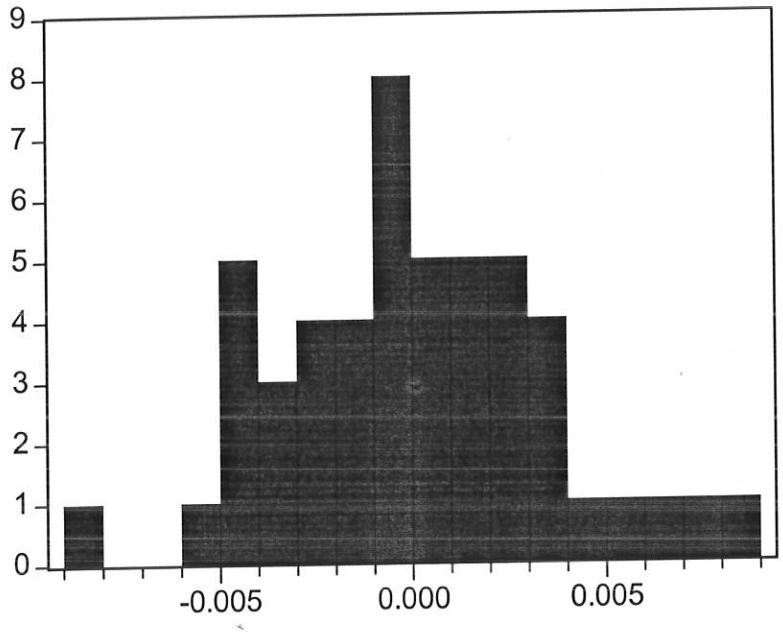
R-squared	0.995609	Mean dependent var	0.015359
Adjusted R-squared	0.980438	S.D. dependent var	0.034667
S.E. of regression	0.004849	Akaike info criterion	-7.774375
Sum squared resid	0.000259	Schwarz criterion	-6.282997
Log likelihood	233.3594	Durbin-Watson stat	1.747157

Appendix 9: Diagnostic tests for error correction model

9(a)-Autocorrelation function

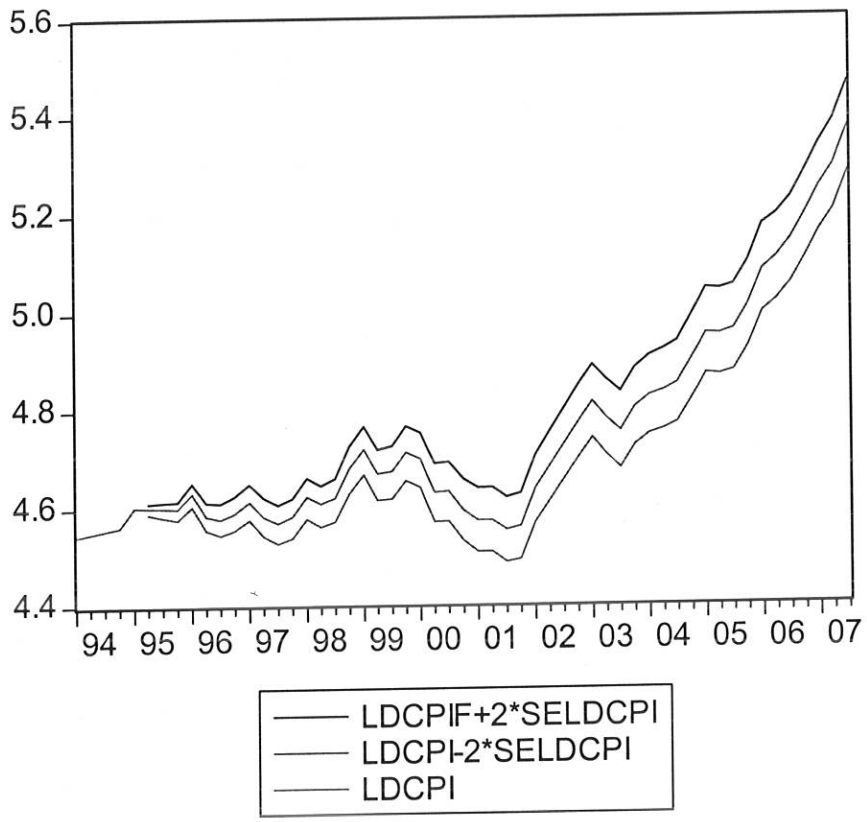
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.*| . |	.*| . |	1	-0.097	-0.097	0.4978	0.480
. |** |	. |** |	2	0.231	0.223	3.3807	0.184
.*| . |	. | . |	3	-0.063	-0.026	3.6019	0.308
. | . |	.*| . |	4	-0.005	-0.067	3.6034	0.462
. | . |	. |*. |	5	0.064	0.085	3.8409	0.573
.*| . |	.*| . |	6	-0.101	-0.082	4.4405	0.617
. | . |	. | . |	7	0.024	-0.028	4.4767	0.724
. | . |	. | . |	8	-0.052	-0.002	4.6450	0.795
. | . |	. | . |	9	-0.037	-0.052	4.7331	0.857
. |** |	. |** |	10	0.223	0.239	7.9565	0.633
. | . |	. |*. |	11	0.036	0.107	8.0437	0.709
. |*. |	. | . |	12	0.151	0.043	9.6067	0.650
. |*. |	. |*. |	13	0.071	0.101	9.9572	0.697
.*| . |	.*| . |	14	-0.132	-0.181	11.220	0.669
. | . |	.*| . |	15	0.011	-0.090	11.229	0.736
.*| . |	. | . |	16	-0.096	0.012	11.935	0.748
.*| . |	**| . |	17	-0.129	-0.194	13.254	0.719
. | . |	. | . |	18	-0.034	-0.002	13.346	0.771
.*| . |	. | . |	19	-0.086	0.051	13.963	0.786
. |*. |	. | . |	20	0.080	-0.000	14.521	0.803
. | . |	. | . |	21	-0.027	0.019	14.585	0.843
. |*. |	. | . |	22	0.083	0.010	15.225	0.852
. | . |	.*| . |	23	0.021	-0.073	15.268	0.885
. | . |	. | . |	24	-0.022	0.010	15.319	0.911

9(b)-Histogram-Normality Test

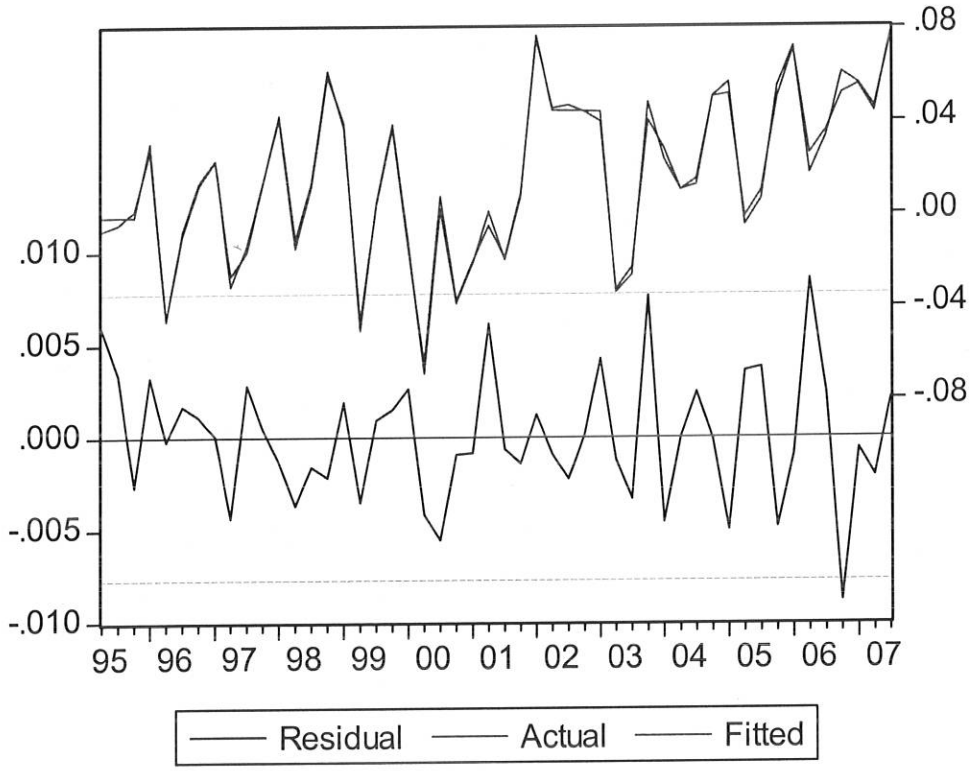


Series: Residuals	
Sample 1995Q2 2007Q3	
Observations 50	
Mean	6.97e-06
Median	-0.000152
Maximum	0.008539
Minimum	-0.008835
Std. Dev.	0.003497
Skewness	0.144300
Kurtosis	3.119987
Jarque-Bera	0.203513
Probability	0.903249

9(c) - Forecasting power test



8(d) - Fit of the Error Correction Model



Appendix 10: Correlation between inflation and growth rate of real money supply

	D(LDCPI)	D(LRNM2)	D(LRNM2(-1))	D(LRNM2(-2))	D(LRNM2(-3))	D(LRNM2(-4))
D(LDCPI)	1.000000	-0.459732	-0.092376	-0.189090	-0.264836	-0.158698
D(LRNM2)	-0.459732	1.000000	-0.125108	0.153591	0.052501	-0.027934
D(LRNM2(-1))	-0.092376	-0.125108	1.000000	-0.130447	0.142976	0.051442
D(LRNM2(-2))	-0.189090	0.153591	-0.130447	1.000000	-0.142294	0.142282
D(LRNM2(-3))	-0.264836	0.052501	0.142976	-0.142294	1.000000	-0.148135
D(LRNM2(-4))	-0.158698	-0.027934	0.051442	0.142282	-0.148135	1.000000

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university, and that all sources of materials used for the thesis have been duly acknowledged.

Declared by:

Name: Memayelu Coeda

Signature: _____

Date: _____

Confirmed by advisor:

Name: _____

Signature: _____

Date: _____