

**DETERMINANTS OF NON - COFFEE  
EXPORT COMMODITIES OF  
ETHIOPIA  
(1970/71-2004/05)**

**BY  
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COMMODITIES OF ETHIOPIA**

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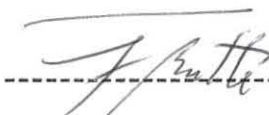
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## ACRONYMS

NCOF1 – Non-Coffee 1  
NCOF2 – Non-Coffee 2  
VECM-Vector Error Correction Model  
SEM – Simultaneous Equation Model  
ADF- Augmented Dicky-Fuller  
EG – Engle –Granger  
OLS – Ordinary Least Square  
FIMLH – Full Information Maximum Likelihood  
TFP – Total Factor Productivity  
SOE – Small Open Economies  
GK – Goldstein and Khan  
ECM – Error Correction Mechanism  
EPRDF – Ethiopian Peoples Revolutionary Democratic Front  
2SLS – Two Stage Least Square  
IV - Instrumental Variables  
ILS – Indirect Least Square  
MoARD – Ministry of Agriculture and Rural Development  
MoTI – Ministry of Trade and Industry  
DSP – Difference Stationary Process  
TSP – Trend Stationary Process  
DNCOF1-Differenced Non-Coffee1  
DNCOF2- Differenced Non-coffee 2  
ECT – Error Correction Term  
LNCOF1-Logarithm of non-coffee 1  
LNCOF2 - Logarithm of non-coffee 2

## ABSTRACT

The purpose of this paper is to analyze the determinant of non-coffee export commodities, subdividing in to two categories, namely NCOF1 (sum of oil seeds, chat, hides and skins, pulses) and NCOF2 (sum of meat and meat products, fruit vegetables, sugar, gold, oil cakes, live animals, petroleum and petroleum products, bees and wax, other). The study employs the standard Augmented Dicky-Fuller and Phillips Perron test to test the stationarity of all variables at levels and first difference and the two stage Engle Granger test to check the existence of cointegration relationship. The model was estimated using error correction procedure.

The main findings of the study show that: first, real effective exchange rate is one of the factors that determine both the long term and short term movement of real non-coffee1 export commodities of Ethiopia.

Secondly, external shock like terms of trade determines the movement of export of non-coffee1.

Thirdly, GDP is one of the important factors which determine the movement for the non-coffee2, implying that as the country's out put due to the influence of the performance of the agricultural sector increases, the country's non-coffee2 export commodities movement will increase.

Fourthly, exchange rate gap is one of the common factors that determine movement for both non-coffee export groups.

# CHAPTER ONE

## Introduction

### 1.1 Background

According to the macro econometric model for Ethiopia constructed by the research committee of National Bank, over the past three decades the current account deficit of the country has steadily widened from 1.2 percent of GDP during the 1970s to 5.8 percent of GDP during 1980s and further rose to 6.9 percent of GDP during the 1990s mainly due to the sluggish performance in exports and a surge in imports. While the export sector seems to improve recently both in terms of quantity and type, the over alarmingly increasing import bill coupled with the development in the world price, the country is unable to improve the balance (The modeling committee, National Bank of Ethiopia, 2003).

According to the report on the Ethiopian Economy Volume V 2005/06 made by the Ethiopian Economic Association, following the recovery that started in 2002, the value of total export has increased consecutively. That is, the value of exports grew by 7.2%, 26.6% and 36.6 % in fiscal years 2002/03, 2003/2004 and 2004/2005, respectively. Similarly based on the export data compiled at National Bank the trend continues with 18% and 20% increase in the total export in fiscal years 2005/2006 and 2006/2007, respectively. As a single commodity, coffee is still dominant in terms of its share in the total value of exports even though it has declined from its pace in early years when it was above the 50 % range.

As was the case for total exports, the value of non-coffee exports significantly improved until 2006/2007. In particular, the value of non-coffee exports grew by about 19.7% in 2006/07 while it grew by 10.3%, 21.8%, 28% and 27% in fiscal years 2002/03, 2003/04, 2004/05 and 2005/06, respectively.

The contribution of the primary non-coffee export (NCOF1) commodities to the total non-coffee export commodities is higher as compared to the remaining non-coffee export

commodities. Particularly they contribute 57.7% in 2006/07 and 55.5%, 62.8%, 64.1%, 63.8% in fiscal years 2002/03, 2003/04, 2004/05, 2005/06 to the total non-coffee export commodities respectively. These primary non-coffee export commodities grew by 8.4% in 2006/07 while it only grew by 4.1%, 35%, 39.1%, 26% in fiscal years 2002/03, 2003/04, 2004/05, 2005/06 respectively.

Unlike the primary non-coffee export commodity, the remaining non-coffee export commodities show some mixed growth pattern. In particular the value of these commodities grew by about 39.8 % in 2006/07 while it only grew by 19.1%,-0.3%, 31.6%, 27.6% in fiscal years 2002/03, 2003/04, 2004/05 and 2005/06 respectively.

Owing to a favorable weather condition, there by a better agricultural out put in the last few years, as well as the policy drive which accords high priority for exports, a significant non-coffee export growth on average by nearly 22.4% annually has been registered over the past six years period and a 22.5 % total export growth was achieved in the specified period.

The movement in the international price of the non-coffee exports was mixed. While the price of some items declined (pulses, and oilseeds, for instance), that of others increased (meat and meat products and gold, as an example). The growth in the value of non-coffee exports in 2006/07 was, therefore, mainly due to an increase in the volume of items exported. It is also strengthened by export proceeds from the non-traditional exports of the country.

Even though export revenue significantly increased (owing to both price and volume effects) during fiscal year 2006/07, it lagged behind the increase in imports bill and consequently the trade balance deteriorated. Similarly the value of export significantly increased with 21% in the fiscal year 2007/8 as compared to the 2006/7. This is mainly because of the increment in volume of primary export commodities and initiatives have been undertaken to facilitate private sector participation in the export trade. In this regard the government awarded major exporters and have given incentives to achieve this objective. It is interesting to note that this pattern has dominated the external sector of Ethiopian economy for some time. That is no matter how exports improve they don't

seem to catch up with imports. And one would suspect that this pattern is likely to continue because as the economy grows, it will need more imports of raw materials, semi finished and capital goods as input of production in excess of its capacity to export goods in the foreseeable future.

Ethiopia is a small open economy that heavily depends on the rest of the world for its exports and imports of goods and services, and capital and financial flows. Hence, the Ethiopian economy is vulnerable to external shocks through the external sector channel. Moreover, a development in the external sector of the economy is also affected by domestic economic environments. Cognizant of such facts, it is believed that obtaining the determinants of non coffee export commodities group by formulating an econometric model can contribute to the analysis of export sector of the country

## **1.2 Statement of the problem and objective of the study**

Previous studies in the export sector of the country and policy options have been emphasizing on coffee product (Mellese, 2004 and Birhanu ,2002). This is mainly because coffee had been the only dominant source of export proceeds (hard currency) for the country. However, it was established that such dependence on a single item for export proceeds makes the country highly susceptible to external price shocks .This was seen to affect the performance of the economy in the past few decades next to oil price shock as an external (exogenous) source of shock. For example, in 1999 the terms of trade deteriorated by 17 percent mainly due to a large fall in the prices of coffee (IMF, 1999 as cited in National Bank modeling Committee, 2003). These problems further intensified in recent years resulting an average decline of 18.3 percent per annum in real export during 2000/01-2001/02 as compared to the 1999/00 export .The relative importance of coffee in total export revenues has declined by 14%,11%,9%,13%,12% and 10% during 2002/3,2003/4,2004/5,2005/6,2006/7and 2007/8 fiscal years below the overall average, 48.16 respectively (National Bank of Ethiopia annual bulletin).This is largely due to the deteriorating terms of trade of coffee in the world market. These developments illustrate the need for further export diversification. The country has to acquire the capacity to compete in the production of new products with higher value added and better demand prospects. In addition, the need to look for a new market place may also contribute to

reducing the geographic concentration of the country's export. Understanding this and given the outward orientation our country is following, currently few new export items beyond our traditional export commodity (coffee) are coming. Some of these non-coffee exports are expected to take over the role of coffee as the main source of foreign currency in the coming few years. Thus, it is now time to make other non-coffee exports points of discussion.

The general objective of this study is, therefore, to analyze the determinant of non-coffee export commodities of Ethiopia via econometric modeling of non-coffee1 (oil seeds, chat, hides and skins, pulses) and non-coffee2 (meat and meat products, fruit vegetables, sugar, gold, oil cakes, live animals, petroleum and petroleum products, bees and wax, other) export commodities..

The rationale for modeling the non-coffee export commodities of the country classifying in to non-coffee 1 and non-coffee 2 lies on the following cases:

- As already explained in the introduction part, the majority share of the non-coffee export commodities is contributed by the primary non-coffee export commodities (NCOF1). The average contribution of these commodities cumulatively in the past six years was 61%, which is almost two third of the total non-coffee export values. These commodities are considered to be primary, as they have been serving as a major currency sources in the past three decades next to coffee. The percentage contribution of this group is 63% during the imperial regime, 55% during the Derg regime, currently it is about 62%. Due to this fact, the analysis of this group can describe the features of all non-coffee export commodities.
- Primary commodity markets have offered an opportunity for much economic debate on a number of key issues. First, declining terms of trade of primary commodities are used to explain the widening gap between developing and developed countries:

Second, they are regarded as a contributing factor to the creation of a structural condition of unequal exchange between a "dominating" industrial center and a "dominated" agrarian periphery. And third, they are thought to be a source of instability, often causing financial vulnerability to foreign exchange equilibria and fragility to international market institution (Diakosavvas and Scandizzo, 1991).

- The remaining non-coffee export commodities were not given as such attention in the past decades. They are not persistent (some of them are not being exported, for example oil cakes). They have nearly one third share in the total non-coffee export earnings.

The questions that tend to be solved by this study is, to identify the real export determinants of non-coffee commodities of the country.

### **1.3 Significance of the study**

The underlying economic principle on export lies on the factors determining it and economic side effects. For example, overvalued birr may seriously undermine the growth of Ethiopian exports in general and non-coffee exports in particular by making foreign currency price of exports high. Overvalued birr may undermine production of import substitutes because of cheap imports.

The reason for quantifying the short run and long run responsiveness of different non-coffee export factors to the non-coffee exports include:

- I. It establishes whether there is a stable long run relationship between the factors and the export. If such a stable long run relationship does not exist, then the factor does not seem to be a reasonable way to improve the country's competitiveness on along-term basis.
- II. The estimate of the short-run dynamic provides information regarding the immediate and medium-run impacts of the factors on the export.

From the policy point of view, the study will shed light on what should be done at the national and regional levels through identifying the determinants of the non-coffee export commodities.

#### **1.4 Limitation of the Study**

Modeling the non-coffee export commodities of the country is considered as one of the best tools in the formulation and implementation of policies as they help in identifying possible policy measures and their expected effects on the national economy. However, the quality of the model's results depends on the quality of data used in calibrating the model. In this regard, though considerable efforts have been made to make use of the best available data and to ensure consistency among different data sources, the study was confronted with data coverage and conversion problems.

With regard to data coverage, some transactions such as smuggling are not captured by the Customs Authority, the primary source of the data.

Concerning conversion problem of data, real values of all values of all variables were obtained by deflating their respective nominal values by GDP deflators owing to lack of locally generated time series data on price indices such as exports. Regarding estimation, since the sample size is not sufficient to employ Johansen multivariate approach, the technique used in this particular modeling is two stages Engel-Granger cointegration approach. And the model faces all the short comings of Engel-Granger approach.

#### **1.5 Organization of the study**

Next to the introductory part some literature reviews will be addressed. In chapter three overview of the export sector performance and market structure of the export with the structure of general and theoretical model will be presented. Chapter four deals with estimation results and interpretations. Conclusions and recommendations of the study are given in chapter five.

# CHAPTER TWO

## Literature Review

### **Empirical Literatures**

Sangita Prasad (2000) developed a single equation model to identifying the determinants of export in Fiji. In this set up it was found that trading partners income and relative prices play a central role. The underlying conceptual framework is an imperfect substitution model, in which the key assumption is that exports are not perfect substitutes for domestic goods in importing countries. A distinguishing feature of the analysis is the incorporation of the effects of agricultural supply-side shocks in the export equation. The results show that in the long run, trading partner's income largely drives movements in Fiji's exports. In the short run, exports are mainly influenced by changes in factors which affect the output capacity of agricultural production, such as weather conditions and industrial disputes, as well as relative prices and changes in foreign demand.

Soludo (1995) , in specifying the external sector of the Nigerian economy, disaggregated export into three goods: - oil, primary commodities (mainly agricultural commodities) and manufactured goods. He specified exports of primary commodities as a function of real GDP (a proxy for domestic supply conditions), real exchange rate and relative prices of this category of exports. OLS estimation procedure revealed that primary commodity prices, real GDP and real exchange rate are significant determinants of primary commodities exports.

On a test of the capacity pressure hypothesis within a simultaneous equation model of export performance of America and Britain, Dunlevy (1980) took a time series regression of export volume on some combination of export price, world market prices, domestic economic activity, world economic activity and a measure of the pressure on domestic capacity. The study has supported the capacity pressure hypothesis, finding that export sales are inversely related to the pressure on domestic capacity. The model presented in his paper consists of simultaneous supply, demand, and market clearing relations. The

demand function relates export volume (quantity) to export unit value (considered endogenous), a unit value of world trade, and to seasonal dummy variables. The supply function relates export volume to export unit value, domestic price, domestic economic capacity, measure of domestic capacity pressure, and seasonal dummy variables. Quarterly data are used to test the model both for the United States and for the United Kingdom. Two stage least squares was employed. The results indicate that changes in the level of capacity pressure, although not the level itself, have had a negative impact on American exports. No support for the capacity pressure effect was detected in the British case. Preliminary regressions indicated the presence of serial correlation among the disturbances of several equations. To deal with this problem the model was re-estimated assuming that the error terms follow a first-order autoregressive pattern. The estimation technique employed is Sargan two-stage procedure. The result shows the supply price elasticities are estimated as 1.09 for the United States and 1.45 for the United Kingdom: both are statistically significant.

Golder (1989) has modeled the Indian export performance in engineering products. His focus of analysis was on the effect of productivity increase on export performance proxied by total factor productivity (TFP). Other explanatory variables included in the model were cumulative output (as a measure of learning), exchange rate, world demand, domestic demand pressure and trend. TFP index was considered to measure technological progress on the overall efficiency of resources while cumulative output measures the learning process such as product design, delivery time, after sales services, marketing and packing. World demand and domestic demand pressure were used to control export performance from the demand and supply side, respectively. A trend variable was taken to capture the influence of some omitted variable.

The export determination model developed by Golder (1989) was different from other studies, which mainly concentrate on export demand function and those, which attempt to estimate the export demand and export supply function in a simultaneous equation framework. He argued that these studies yield biased estimate of the parameters since the supply side was not taken into account in the former case. His work, on the other hand,

incorporated both the demand-side and supply side determinants of export performance in the same regression equation. Using a single equation he estimated the model and found a significant positive effect of exchange rate and world demand pressure. The coefficient of TFP was found out to be positive but insignificant. The coefficient of cumulative output was positive and significant though domestic demand pressure was insignificant with a correct negative sign.

Goldstein and Khan (1978) have introduced two relatively simple models of export demand and export supply equations and then estimated them simultaneously so as to eliminate any bias arising from the two-way relationship of export quantities and export prices. They have constructed two types of models for both export quantity and price determination based on whether the dependent variables (export quantity and price) adjust instantly to the effect of the explanatory variables as: equilibrium and disequilibria models. They have estimated both the equilibrium and disequilibria models for eight countries namely Belgium, France, Germany, Italy Japan, Netherlands, United Kingdom and United states. The estimation method they used was Full information Maximum Likelihood (FIMLH). They have found greater than one price elasticity for six of the eight countries in the disequilibrium model indicating a fairly large response of exports to change in relative price.

Browne (1982) has criticized the Goldstein and Khan (1978) dynamic two-equation model of export supply and demand arguing that the Goldstein and Khan models are inappropriate for the small open economies both on theoretical model and empirical application. The source of their critics is the adjustment mechanism for price and quantity. According to Goldstein and Khan (1978) export quantities are assumed to adjust to discrepancy between world desired demand in the current period and the actual flow of exports in the previous period, while the price of exports is assumed to adjust to conditions of excess supply, implying that export quantities are demand determined and export prices are supply determined.

However, according to Browne (1982), this disequilibria specification is clearly not that of the small open economies (SOE) model in which exporters are price takers. Rather the export quantities adjust towards suppliers' desire value, while export price vary in line with demand conditions: He found that although the fit of the GK (Goldstein & Khan) model is good, the parameter values are implausible. The SOE would suggest a perfect competition on world markets and since it suggests a low value of the non traded sector, it is small relative to the total. Hence a change in export prices will not elicit a large supply response because of the relative unavailability of factors of production from the non traded sector.

According to the estimates obtained by Browne (1982) model, neither variation in exports quantities nor world income has any significant direct effect on export prices. Furthermore the estimates for their model indicate that variations in export quantities are mainly determined by variation in the arguments affecting supply.

Lord (1989) criticized the common modeling literatures on price formation commodity markets since these models lacked theory-consistent econometric models in their dynamic specifications. He contended that commodity market models that have used the reduced form of the system of equations will be unrelated to the separate estimates of parameters in the original structural form of the system of equations. The author claimed that since production often has a great lagged response to price changes than does consumption in commodity markets, it is unclear whether parameter estimates of the supply and demand functions in the system satisfy the dynamic stability conditions of the resulting cobweb model when the price of the commodity is obtained from the reduced form of the model.

The modeling strategy designed by Lord departs from the usual modeling practices by providing separate estimates of the supply and demand components in commodity markets, and by using those parameter estimates to determine the steady state dynamic equilibrium solution for market prices. In his modeling strategy, although a common framework is applied to the characterization of the underlying data generating process in commodity markets, the inherent futures of each commodity markets are retained.

According to his strategy he asserts that commodity markets differ from one another in terms of degrees of competitions that prevail among buyers and sellers, the extent of market fragmentation and whether there are close substitutes. In addition, market conditions give rise to different forms of competitions.

He formulated the dynamic relationships that characterized the adjustment processes of consumers and producers in markets towards their steady state equilibrium solution. He applied the general specification of the model to seven major traded commodities such as coffee, cocoa, maize, soybeans, cotton, sugar, and copper. These products are representatives of the major international traded commodities. He formulated the equilibrium relationship between consumption and demand changes by a co integral process of the time series of these variables. The adjustment process of consumption to income changes was represented by the error correction mechanism (ECM) which corrects disequilibria that arises in the inter-temporal adjustment process between these cointegrated variables. Finally after he estimated the equations using Two Stage Least Square method for the seven commodities mentioned above, he found, on average, that the seven commodities have unitary income elasticity of demand. What he observed from the individual elasticities is that since they varied from commodity to commodity, generalization about elasticity on the basis of an average would be misleading. Lord compared his estimates obtained in equation with other authors. For instance, Akiyama and Dunkan (1892) and Hwa (1985) found 0.45 while Lord (1989) obtained 0.6, which are virtually similar. On the other hand, he got the price elasticity of demand for all the commodities significantly less than one, the average elasticity for commodities being -0.25 and this is compatible with Hwa (1985), although it is some what lower than that estimated by Adams and Behrman (1976).

By the same token, on the production side of the model, Lord (1989) has identified that the lag distributions are closely associated with the gestation period between the planting decision and harvesting of agricultural commodities. For example, the gestation period for coffee is 3-4 years. The supply of these commodities can only be increased in the short run by the expansion of output through yield improvement. In contrast, over 90

percent of the total response of the supply of maize and soybeans occurs within two years of a price change. A trend variable, used to capture various forms of productivity improvements and institutional policies oriented towards influencing producer decision, was found to be significant in all commodities except cotton.

## CHAPTER THREE

### Model specification and explanation of variables

#### **3.1 Overview of Exports Performance and Market Structure of the Export Commodities**

The export sector has played an important role to bring about rapid economic growth in developing countries. However, most of them largely depend for their source of currency earning on a single product or a very narrow range of low value products, mostly agricultural commodities and minerals. Basically these traditional exports face limited demand due to their low-income elasticity.

Likewise, the Ethiopian commodity export sector is basically characterized by the dominant share of agricultural raw commodities in generating the greater proportion of the export earning of the country. These export commodities together have accounted for about 90 percent of the total merchandise export earning. The major export items, in order of their significance in the total commodity export value include coffee, hides and skins, oil seeds, pulses, chat, fruits and vegetables. Export of chat has become among the most important items in the post reform periods.

Since agriculture, in general, is under the vagaries of nature, particularly in the Ethiopian case, the high concentration on non-traditional export goods resulted in an unstable export performance. What is more, the sector is highly susceptible to the erratic nature of prices and unpredictable demand in the international market.

The total amount of export value in 1970/71 was 417.11 million Birr. It has steadily increased to 1,331.76 million Birr in 1978/79. In the year 1991/92, however, fluctuated and reached 318 million Birr. After the reform period i.e. 1991/92, export earnings increased with little fluctuations and recorded 10,458 million Birr in 2006/07.

According to Shiferaw (1995) as cited by Mehiret (2006), in 1942 merchandise export was valued at 66 million Birr. In the 1950s, earnings from merchandise exports increased quite considerably and averaged about 143 million Birr. During the period 1960 to 1974, exports steadily increased with average growth of 8.83 percent per annum rising from 194.6 million Birr in 1960/61 to 556.5 million Birr in 1973/74. Starting from 647.45 million Birr in 1974/75, the export earning increased to 1,338.53 million Birr in 1978/79. In the 1980s export earning declined and reached 279.03 million Birr in 1991/92. (Mehiret 2006)

After the reform period (post 1992), the new government made a new policy to promote the export sector. These include the abolition of tariffs and incentives to exporters. In the post 1992 period, export has increased from 949 million Birr in 1992/93 to 10458 million Birr in 2006/07. The rate of growth of export averaged about 46.19 percent annually. (National Bank of Ethiopia bulletin, 2006/07)

Table 1: Average Annual Percentages Growth of Export

Period	Export Growth
Imperial regime (1970/71 – 1973/74)	13.24
Derg regime (1974/75 – 1990/91)	14.66
EPRDF regime (1991/92 – 2006/07)	46.19
The whole period (1970/71 – 2006/07)	27.52

*Source:* National Bank of Ethiopia

The major factor that contributed to the poor performance of the export sector for the whole period is its dependence on agricultural products and lack of diversification in the exportable commodities. Since agriculture in Ethiopia highly depends on favorable weather condition, the high concentration of exported goods in agriculture resulted in an unstable export performance.

## **The Structure of Exports**

Ethiopia's export sector is characterized by over dependence on few agricultural products, with very limited exports of manufactured and semi-manufactured goods. This structure of concentrating on few agricultural commodities has not significantly changed over time. The achievements of current reform program are below expectations, as it has not lead to a radical shift in the structure of exports. Most of the export items directly originate from the agricultural sector. Besides, Coffee has still remained to be the dominant export commodity, though its share in the value of total exports fluctuates from time to time. It accounted for an average of 48.16 percent of export earnings between 1970/71 and 2006/2007. Hides and skins, Oil seeds, Pulses, chat, fruits and vegetables, live animals and meat and meat products constituted 9.78 percent, 9.53 percent, 3.72 percent, 8.47 percent, 1.47 percent, 1.26 percent and 0.98 percent, respectively. The combined share of coffee along with the above seven items is 83.37 percent (table 2). This indicates that the dominant shares of Ethiopian export sector are agricultural commodities and it confirms that the diversification of the export sector is limited to these agricultural raw commodities.

The absence of diversification and the high dependency on specific commodities make the export sector to be exposed to external shocks. Accordingly, the value of major export items fluctuated from year to year in terms of value due to the volatile and erratic behavior of prices and unpredictable demand in the international market. Similarly, on the supply side, these agricultural items are influenced by a large number of factors that are endogenous to the suppliers' production decisions and behavior.

Although there have been occasionally relative increases, the value of exports has declined from Birr 1,331.76 million Birr in 1978/79 to 318 million Birr in 1991/92 (National Bank Bulletin). The major reason behind Ethiopia's sluggish export growth had been the reduced competitiveness of exportable. This weakness ran across virtually all exports and was largely the result of the appreciation of the country's real effective exchange rate.

In the years before devaluation (1974/75 to 1990/91), the contribution of coffee to the value of total export has declined. Thus, the value of coffee exports has fallen from 87.94 percent in 1978/79 to 49.70 percent in 1990/91. However, on average, coffee contributed more than 60% of total export earnings during the above period. Hides and skins, oil seeds, pulses, chat, Meat and Meat products, Fruits & vegetables and live animals constituted 11.88 percent, 2.65 percent, 3.52 percent and 1.97 percent, 0.62 percent, 0.9 percent and 1.97 percent during the above period respectively (see table 2 below). The main contributing factors for the low performance of the export sector during these periods were mainly decline in profitability and competitiveness of the export sector. It was estimated that in 1984, maize production offered a return of labour at least 50 percent higher than that of coffee production (World Bank, 1987 as cited by National Bank modeling committee, 2003). Ethiopia's exports were also facing competition in the local markets and threatened by illegal exporting (Ibid). In addition, an important factor behind the decline of export profitability and growth was the overvalued exchange rate. According to World Bank estimation taking 1973/74 – 1975/76 as the base year, the real effective appreciation of the Birr was about 50 percent in March 1987. Low level of investment in the economy, inadequate producer incentives together with a shortage of foreign exchange to imports of capital goods, raw materials, spare parts and basic consumer goods were another limiting factors to the export.

During (1991/92 to 2006/07), coffee has contributed on average 45.13 percent to the total export earning. Hides and skins, oil seeds, pulses, chat, Meat and Meat products, Fruits & vegetables and live animals constituted 9.34 percent, 10.82 percent, 3.79 percent and 9.96 percent, 1.00 percent, 1.38 percent and 1.14 percent during the above period respectively (see table 2 below). In 1992/93 after the new government came to power, the first batch of the reform measures were geared on devaluation of the Birr from Birr 2.07/USD to Birr 5/USD followed by subsequent and gradual devaluation. Following the devaluation of the Birr, the government took major steps to determine the exchange rate at the market level. Moreover, after the devaluation of the Birr, export license requirements and state trade monopolies on selected items were eliminated and export price control was replaced with export price verification. All export taxes were removed in 1998, except that of

coffee which was finally removed in 2003 owing to rapid decline in the price of world coffee price.

During the period 1992/93 – 1999/00 total real export grew at annual average of more than 20 percent, including about 30 percent growth in coffee though total export growth start declining in 1999/00 owing to a sharp decline in coffee export growth. Besides, the high dependence of exports on one commodity, coffee, leaves the country highly vulnerable to large terms of trade shocks.

Overall, during 1991/92 to 2006/07, the export sector has showed recovery as manifested by the positive quantity growth rates of the principal export commodities.

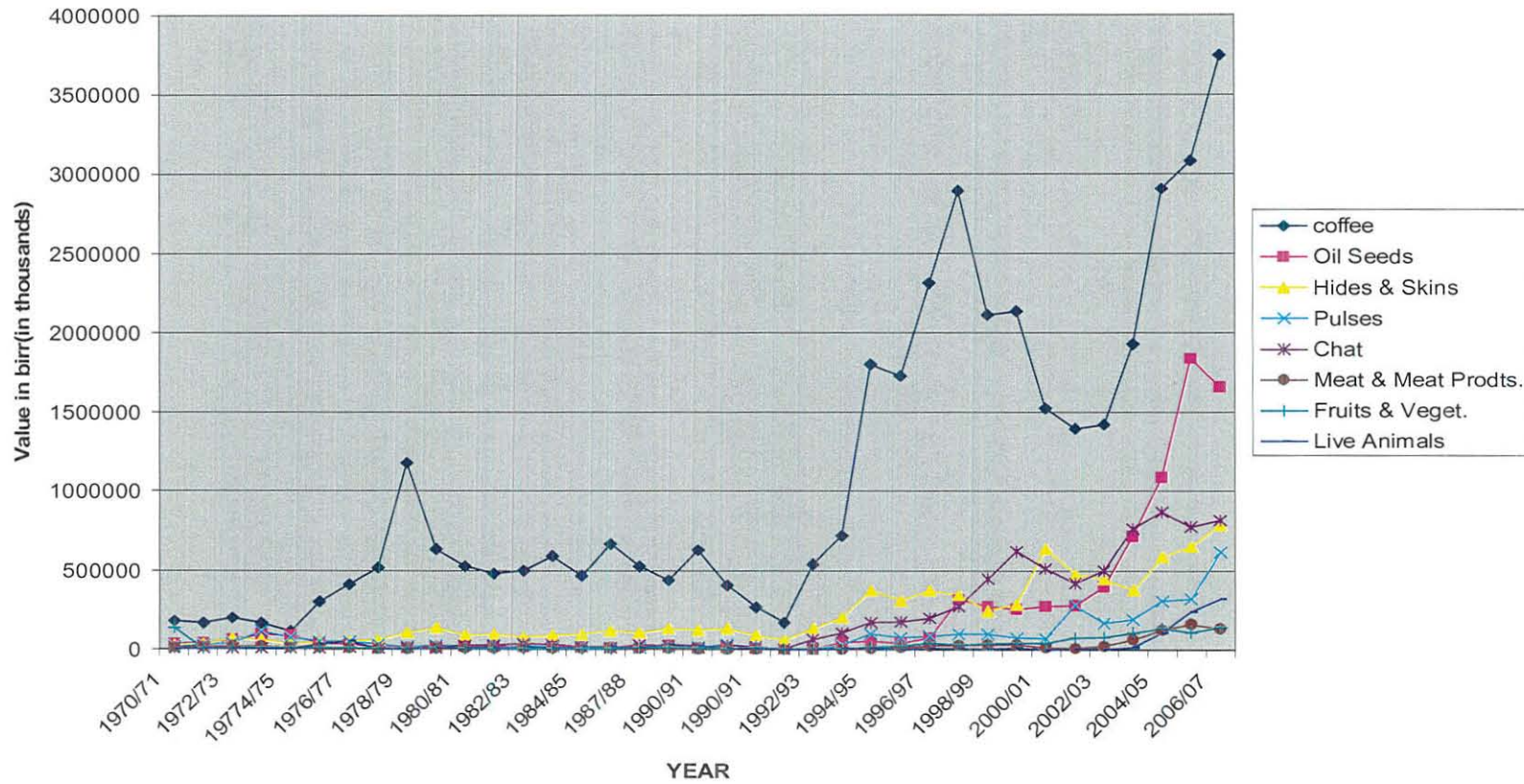
Table 2: Percentage share of Major Export items

No	Commodity	The Imperial regime (1970/71 - 1973/74)	The Derg regime (1974/75- 1990/91)	The EPRDF regime (1991/92 - 2006/07)	The Whole period (1970/71- 2006/07)
1	Coffee	42.05	64.03	45.13	48.16
2	Hides and Skins	10.63	11.88	9.34	9.78
3	Oil seeds	12.86	2.65	10.82	9.53
4	Pulses	12.12	3.52	3.79	3.72
5	Chat	0.84	1.97	9.96	8.47
6	Meat and Meat products	3.38	0.62	1.00	0.98
7	Fruits and Vegetables	9.70	0.9	1.38	1.47
8	Live animals	0.62	1.97	1.14	1.26

Source: National Bank of Ethiopia

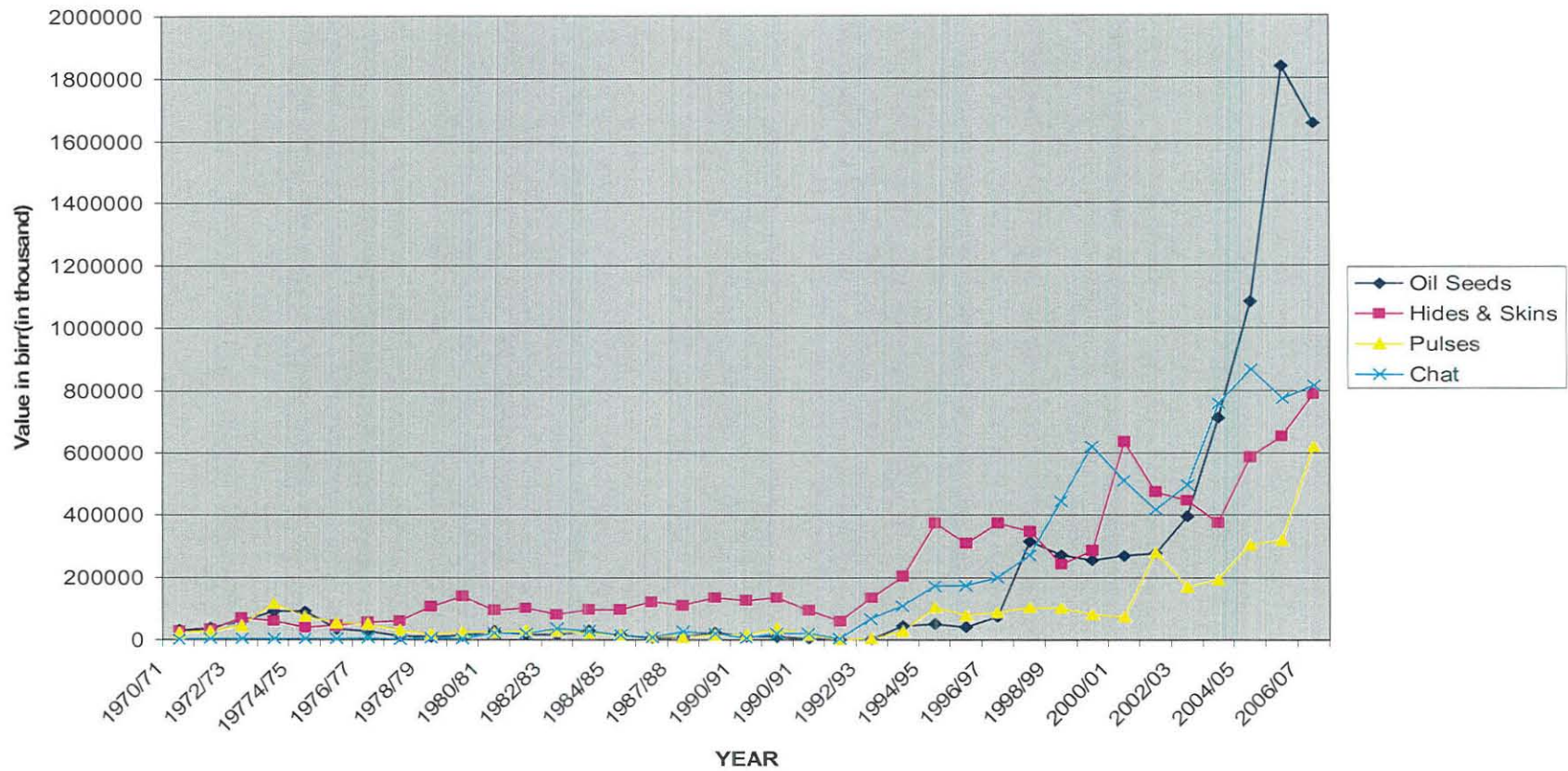
From table 2, we can see that the share of coffee has showed some fluctuating patterns due mainly to its price fluctuation in the international markets, the global production situations in Brazil and economic activity in the trading partners of Ethiopian. The contribution of oil seeds and pulses, however, has declined during the Derg as well as the EPRDF regime. The contribution of chat from total export value has increased sharply to 9.96 percent as compared to its share during the Imperial as well as the Derg regime with amount of 9.12 and 7.99 percent respectively. We can also see graphically the trend of major export items from 1970/71 – 2006/07 in figure 1, export of non-coffee1 (NCOF1) export commodities in figure 2, and export of non- coffee 2 (NCOF2) in figure 3 .

**Figure1.**  
**Value of major export commodities**



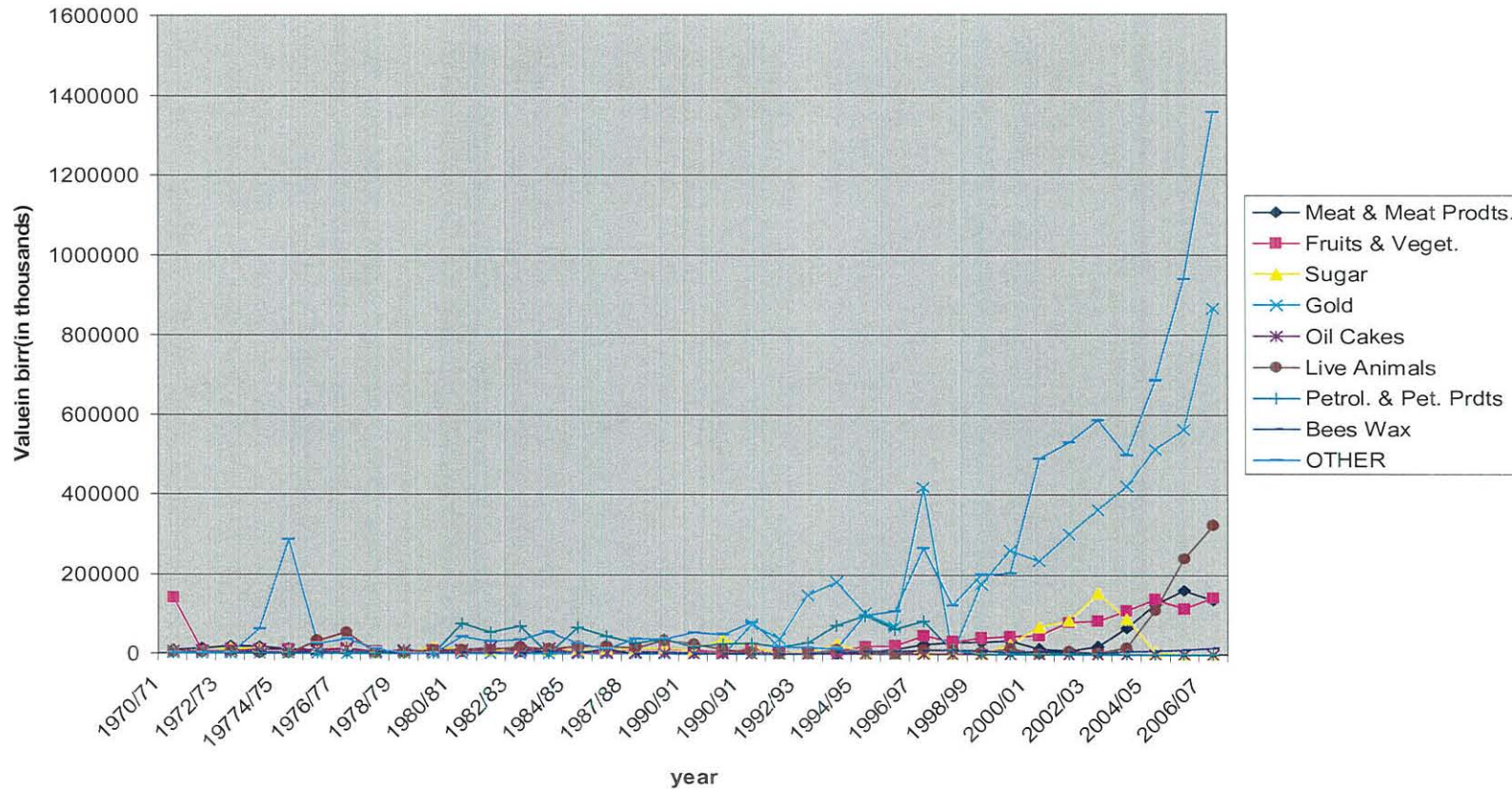
*Source* :- National Bank of Ethiopia data base

**Figure 2**  
**Export of non-coffee export commodities(NCOF1)**



*Source:* - National Bank of Ethiopia data base

**Figure 3**  
**Export of non-coffee export commodities(NCOF2)**



*Source:* - National Bank of Ethiopia data base

## 3.2 Model specification

Interaction and interdependence of economic variables make it necessary that economic models should incorporate a set of equations which describes the behavior of certain variables. This setting of economic models has important implications for estimation and inference. Quite frequently in business and economic modeling, the process or processes under study can best be represented by a series of simultaneous equations. Relations between economic variables involve two way causation and this does not allow us to use a single equation model for the description of the relationship between the endogenous and exogenous (predetermined) variables, i.e. we must use a multiple-equation model. In this regard, the first question that arises is: what are the consequences of applying OLS while there is two-way causation (simultaneity problem).

### 3.2.1 Simultaneous equation model

Given the nature of economic phenomena, it is almost certain that relations between economic variables involve two way causation:

- Due to obvious behavioral reason and
- Due to statistical coincidence (with no obvious behavioral reason)

If we have a two way causation in a function, this implies that the function can not be treated in isolation as a single equation model, but belongs to a wide system of equations which describes the relationships among all the relevant variables. If  $y=f(x)$  and also  $x=f(y)$ , it is not adequate to use a single equation model for the description of the relationship between  $y$  and  $x$ . We must use a multiple equation model, which would include separate equations in which  $Y$  and  $X$  would appear as regressor variables in other equations of the model. A system describing the joint dependence of variables is called a system of simultaneous equations. In simultaneous equation models (SEM), we consider economic models for data that are jointly determined by two or more economic relations.

Simultaneous equation models differ from single equation models because in each simultaneous equation model there are two or more endogenous variables, rather than just one and they consist of a set of equations.

A simultaneous equations model incorporates behavioral equations, endogenous variables (those whose values are determined within the model) and predetermined variables (those whose values are determined outside the model). These variables are divided in to two categories: exogenous (current as well as lagged) and lagged endogenous (Koutsoyiannis).

Consider a simple simultaneous equations model of two structural equations given by:

$$Y_{1t} = \alpha_0 + \alpha_1 Y_{2t} + \varepsilon_{1t} \dots \dots \dots (1)$$

$$Y_{2t} = \beta_0 + \beta_1 Y_{1t} + \varepsilon_{2t} \dots \dots \dots (2)$$

where  $Y_{1t}$  &  $Y_{2t}$  are endogenous variables, and  $\varepsilon_{1t}$  &  $\varepsilon_{2t}$  are the error terms .

In simultaneous equations model, the errors are assumed to be correlated across equations; however the errors of the individual equations are uncorrelated, that is,

$$E(\varepsilon_{1t} \varepsilon_{2t}) \neq 0, \text{ but } E(\varepsilon_{1t} \varepsilon_{1t-s}) = E(\varepsilon_{2t} \varepsilon_{2t-s}) = 0, s > 0$$

The introduction of stochastic dependent variables to the right hand side of equations leads to the violation of the assumption that regressors

are fixed (non stochastic) in repeated trials and are not correlated with the errors.

Symbolically, the assumption that

$$COV(Y_{2t}, \varepsilon_{1t}) = COV(Y_{1t}, \varepsilon_{2t}) = 0 \text{ is violated. To show this:}$$

$$\begin{aligned} Y_{2t} &= \beta_0 + \beta_1 Y_{1t} + \varepsilon_{2t} \\ &= \beta_0 + \beta_1 (\alpha_0 + \alpha_1 Y_{2t} + \varepsilon_{1t}) + \varepsilon_{2t} \\ &= \beta_0 + \beta_1 \alpha_0 + \beta_1 \alpha_1 Y_{2t} + \beta_1 \varepsilon_{1t} + \varepsilon_{2t} \end{aligned}$$

$$\Rightarrow Y_{2t} = \frac{1}{1 - \beta_1 \alpha_1} (\beta_0 + \beta_1 \alpha_0 + \beta_1 \varepsilon_{1t} + \varepsilon_{2t})$$

$$\Rightarrow EY_{2t} = \frac{1}{1 - \beta_1 \alpha_1} (\beta_0 + \beta_1 \alpha_0) \text{ (Since } E\varepsilon_{1t} = E\varepsilon_{2t} = 0)$$

Thus:

$$\begin{aligned} \text{Cov}(Y_{2t}, \varepsilon_{1t}) &= E\{(Y_{2t} - EY_{2t})(\varepsilon_{1t} - E\varepsilon_{1t})\} \\ &= E\left\{\left(\frac{\beta_1 \varepsilon_{1t} + \varepsilon_{2t}}{1 - \beta_1 \alpha_1}\right) \varepsilon_{1t}\right\} \\ &= \frac{\beta_1 E\varepsilon_{1t}^2 + E\varepsilon_{1t}\varepsilon_{2t}}{1 - \beta_1 \alpha_1} = \frac{\beta_1 \sigma_1^2 + \sigma_{12}}{1 - \beta_1 \alpha_1} \neq 0 \end{aligned}$$

where  $\sigma_1^2 = E\varepsilon_{1t}^2$  and  $\sigma_{12} = E\varepsilon_{1t}\varepsilon_{2t}$ . Similarly, it can be shown that  $\text{Cov}(Y_{1t}, \varepsilon_{2t}) \neq 0$

Suppose we treat each of the equations in a simultaneous equations model as a separate single equation model and estimate the parameters by OLS. What are the properties of the estimators?

The least square estimator of  $\alpha_1$ , ignoring the fact that it is part of a simultaneous equations system, is:

$$\begin{aligned} \hat{\alpha}_1 &= \frac{\sum_{t=1}^T (Y_{1t} - \bar{Y}_1)(Y_{2t} - \bar{Y}_2)}{\sum_{t=1}^T (Y_{2t} - \bar{Y}_2)^2} \\ &= \frac{\sum_{t=1}^T (Y_{2t} - \bar{Y}_2)Y_{1t}}{\sum_{t=1}^T (Y_{2t} - \bar{Y}_2)^2} \quad (\text{since } \bar{Y}_1 \sum_{t=1}^T (Y_{2t} - \bar{Y}_2) = 0) \\ &= \frac{\sum (Y_{2t} - \bar{Y}_2)(\alpha_0 + \alpha_1 Y_{2t} + \varepsilon_{1t})}{\sum (Y_{2t} - \bar{Y}_2)^2} \end{aligned}$$

$$\frac{\alpha_0 \sum (Y_{2t} - \bar{Y}_2) + \alpha_1 \sum (Y_{2t} - \bar{Y}_2)^2 + \sum \varepsilon_{1t} (Y_{2t} - \bar{Y}_2)}{\sum (Y_{2t} - \bar{Y}_2)^2}$$

$$= \alpha_1 + \frac{\sum \varepsilon_{1t} (Y_{2t} - \bar{Y}_2)}{\sum (Y_{2t} - \bar{Y}_2)^2}$$

Then,

$$E \hat{\alpha}_1 = \alpha_1 + \frac{\sum (E \varepsilon_{1t} Y_{2t} + \bar{Y}_2 E \varepsilon_{1t})}{\sum (Y_{2t} - \bar{Y}_2)^2}$$

$$= \alpha_1 + \frac{\sum E \varepsilon_{1t} Y_{2t}}{(Y_{2t} - \bar{Y}_2)^2} \neq \alpha_1 \quad (\text{Since } E \varepsilon_{1t} Y_{2t} \neq 0)$$

Thus, the OLS estimator  $\hat{\alpha}_1$  of  $\alpha_1$  is biased. The same holds for the OLS estimator of  $\beta_1$  if we treat equation (2) as a separate single equation model.

The bias comes as a result of the violation of one of the properties of OLS, which states that the least squares procedure yields unbiased estimates provided the error term has zero mean and is uncorrelated with the regressor variables. The simultaneity implies that regressor variables appearing on the right hand side of a given equation will be correlated with the corresponding residual (endogeneity), which makes OLS estimates biased.

Are  $\hat{\alpha}$  and  $\hat{\beta}$  consistent estimators?

Let's check for  $\hat{\alpha}$ .

### Assumptions

- Both  $\varepsilon_{1t}, \varepsilon_{2t}$  are i.i.d with  $E \varepsilon_{1t} = E \varepsilon_{2t} = 0, E \varepsilon_{1t}^2 = \sigma_1^2 < \infty, E \varepsilon_{2t}^2 = \sigma_2^2 < \infty$  and  $E \varepsilon_{1t} \varepsilon_{2t} = \sigma_{12} < \infty$

- $\lim_{T \rightarrow \infty} \frac{1}{T} \sum_{t=1}^T y_{2t}^2 = \sigma_{y_2}^2 < \infty$  where  $y_{2t} = Y_{2t} - \bar{Y}_2$

Under the above assumptions we have:

1.  $E \varepsilon_{1t} y_{2t} = Cov(\varepsilon_{1t}, y_{2t}) = \frac{\beta_1 \sigma_1^2 + \sigma_{12}}{1 - \beta_1 \alpha_1}$  (Constant)
2.  $E(\varepsilon_{1t} y_{2t})^2 = y_{2t}^2 E \varepsilon_{1t}^2 = \sigma_1^2 y_{2t}^2 < \infty$  (Since if we consider equation (1) in isolation, then  $y_{2t}$  is non-stochastic)
3.  $E \varepsilon_{1t} y_{2t} \varepsilon_{1s} y_{2s} = y_{2t} y_{2s} E \varepsilon_{1t} \varepsilon_{1s} = 0$  for  $t \neq s$  (Since  $\varepsilon_{1t}$  is i.i.d)

Thus,  $\varepsilon_{1t} y_{2t}$  is (weakly) stationary. By the law of large numbers,

$$p \lim(\varepsilon_{1t} y_{2t} / T) = E \varepsilon_{1t} y_{2t} = \frac{\beta_1 \sigma_1^2 + \sigma_{12}}{1 - \beta_1 \alpha_1}$$

We have seen earlier that:

$$\hat{\alpha}_1 = \alpha_1 + \frac{\sum \varepsilon_{1t} (Y_{2t} - \bar{Y}_2)}{\sum (Y_{2t} - \bar{Y}_2)^2} = \alpha_1 + \frac{\sum \varepsilon_{1t} y_{2t}}{\sum y_{2t}^2}$$

$$\text{Now, } P \lim \hat{\alpha}_1 = \alpha_1 + \frac{P \lim \left( \frac{\sum \varepsilon_{1t} y_{2t}}{T} \right)}{P \lim \left( \frac{\sum y_{2t}^2}{T} \right)} = \alpha_1 + \frac{\beta_1 \sigma_1^2 + \sigma_{12}}{\sigma_{y_2}^2 (1 - \beta_1 \alpha_1)} \neq \alpha_1$$

Thus,  $\hat{\alpha}_1$  is not consistent. Similarly it can be shown that  $\hat{\beta}_1$  is not consistent.

### Structural form and reduced form of SEM

The structural form of a SEM can be described as:

$$\beta_{11} Y_{1t} + \beta_{12} Y_{2t} + \dots + \beta_{1G} Y_{Gt} + \gamma_{11} X_{1t} + \dots + \gamma_{1k} X_{kt} = u_{1t}$$

.....(3)

$$\beta_{G1} Y_{1t} + \beta_{G2} Y_{2t} + \dots + \beta_{G(G)} Y_{Gt} + \gamma_{G1} X_{1t} + \dots + \gamma_{Gk} X_{kt} = u_{Gt}$$

where,

$Y \rightarrow$  Endogenous,  $X \rightarrow$  Predetermined,  $u \rightarrow$  stochastic disturbances

There are  $G$  endogenous and  $K$  predetermined variables in the system.

In matrix form:

$$\begin{bmatrix} \beta_{11} & \dots & \beta_{1G} \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \beta_{G1} & \dots & \beta_{GG} \end{bmatrix} \begin{bmatrix} Y_{1t} \\ \cdot \\ \cdot \\ Y_{Gt} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \dots & \gamma_{1k} \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \gamma_{G1} & \dots & \gamma_{Gk} \end{bmatrix} \begin{bmatrix} X_{1t} \\ \cdot \\ \cdot \\ X_{kt} \end{bmatrix} = \begin{bmatrix} u_{1t} \\ \cdot \\ \cdot \\ u_{Gt} \end{bmatrix}$$

This can be expressed as

$$\rightarrow BY_t + \Gamma X_t = U_t \quad \text{where } B = \begin{bmatrix} \beta_{11} & \dots & \beta_{1G} \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \beta_{G1} & \dots & \beta_{GG} \end{bmatrix}, \quad \Gamma = \begin{bmatrix} \gamma_{11} & \dots & \gamma_{1k} \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \gamma_{G1} & \dots & \gamma_{Gk} \end{bmatrix}$$

$$\Rightarrow Y_t = -B^{-1}\Gamma X_t + B^{-1}U_t \dots \dots \dots (4), \text{ provided } B \text{ is nonsingular.}$$

The reduced form is obtained by expressing equation (3) as

$$\begin{aligned} Y_{1t} &= \pi_{11}X_{1t} + \dots + \pi_{1k}X_{kt} + v_{1t} \\ \cdot & \quad \cdot \quad \quad \quad \cdot \quad \quad \cdot \\ \cdot & \quad \cdot \quad \quad \quad \cdot \quad \quad \cdot \\ Y_{Gt} &= \pi_{G1}X_{1t} + \dots + \pi_{Gk}X_{kt} + v_{Gt} \end{aligned}$$

In matrix form:

$$\begin{bmatrix} Y_{1t} \\ \cdot \\ \cdot \\ Y_{Gt} \end{bmatrix} = \begin{bmatrix} \pi_{11} & \dots & \pi_{1k} \\ \cdot & & \cdot \\ \cdot & & \cdot \\ \pi_{G1} & \dots & \pi_{Gk} \end{bmatrix} \begin{bmatrix} X_{1t} \\ \cdot \\ \cdot \\ X_{kt} \end{bmatrix} + \begin{bmatrix} V_{1t} \\ \cdot \\ \cdot \\ V_{Gt} \end{bmatrix} \rightarrow Y_t = \Pi X_t + V_t \dots (5)$$

Comparing (4) and (5), the relation ship between the structural and reduced form parameters is:  $\Pi = -B^{-1}\Gamma$  and  $V_t = B^{-1}U_t$

In the reduced form the endogenous variables are explained only by exogenous variables. Since the exogenous variables are not correlated with the error terms in the reduced form, it is possible to apply OLS method of estimation to the reduced form to estimate consistent coefficients of the reduced form equations.

### 3.2.2 Identification problem

By identification we mean whether numerical estimates of the parameters of a structural equation can be obtained from the estimated reduced-form coefficients.

We say a model is identified if it is in a unique statistical form, enabling unique estimates of its parameters to be subsequently made from sample data. If a model is not identified then estimates of parameters of relationships between variables measured in samples may relate to the model in question, or to another model, or to a mixture of models.

An econometric model is frequently expressed in the form of a system of simultaneous equations. The model is said to be complete if it contains at least as many independent equations as endogenous variables. For identification of the entire model, it is necessary for the model to be complete and for each equation in it to be identified.

In econometric theory three possible situations of identifiability are distinguished;

1. equation under- identified
2. equation exactly identified
3. equation over- identified

An equation is under identified if its statistical form is not unique. A system is under identified when one or more of its equations are under identified. If an equation has a unique statistical form we say that it is identified. A system is identified if all its equations are identified. It should be noted that identification problems arise only for those equations which contain coefficients which must be estimated statistically (from sample data). Identification difficulties do not arise for definitional equations, identities or statements of equilibrium conditions, because such relationships do not require measurement.

### **3.2.2.1 Implication of identification of a model**

Identification is closely related to the estimation of the model

1. If an equation (or a model) is under identified it is impossible to estimate all its parameters with any econometric technique.
2. If an equation is identified, its coefficient can in general be statistically estimated. In particular if the equation is exactly identified, the appropriate method to be used for its estimation is the method of indirect least squares (ILS). On the other hand if the equation is over identified, indirect least squares cannot be applied, because it will not yield unique estimates of the structural parameters. There are various other methods which can be used in this case, such as two stage least square (2SLS) and instrumental variables(IV) method

### **3.2.2.2. Formal rules (conditions) for identification**

Identification may be established either by the examination of the specification of the structural model or by the examination of the reduced form of the model.

Traditionally identification has been approached via the reduced form. Actually the term identification was originally used to denote the possibility (or) impossibility of deducting the values of the parameters of the structural relations from a knowledge of the reduced form parameters. However, we think that the reduced form approach is conceptually confusing and computationally more difficult than the structural model approach, because it requires the derivation of the reduced form first and then examination of the values of the determinant formed from some of the reduced form coefficients. The structural form approach is simpler and more useful

### **Establishing identification from structural form of the model**

#### **I. The Order Condition for Identification**

A necessary (but no sufficient) condition for identification, known as the order condition, may be stated in two different but equivalent ways as follows.

In a model of  $G$  simultaneous equations in order for an equation to be identified, it must exclude at least  $M-1$  variables (endogenous as well as predetermined) appearing in the model. If it excludes exactly  $M-1$  variables, the equation is just identified. If it excludes more than  $M-1$  variables, it is over identified.

In a model of  $G$  simultaneous equations, in order for an equation to be identified, the number of predetermined variables excluded from the equation must not be less than the number of endogenous variables included in that equation less 1, that is

$$K-M \geq G-1$$

If  $K-M=G-1$ , the equation is just identified, but if  $K-M>G-1$ , it is over identified.

$G$ = total number of endogenous variables

$K$ =number of total variables in the model (endogenous and predetermined)

$M$ =number of variables, endogenous and exogenous, included in a particular equation

## II. The Rank Condition for Identification

The rank condition states that: in a system of  $G$  equations any particular equation is identified if and only if it is possible to construct at least one non-zero determinant of order  $G-1$  from the coefficients of the variables excluded from that particular equation but contained in the other equations of the model.

### Establishing identification from the reduced form of the model

Similarly there are two conditions for identification based on the reduced form of the model, an order condition and rank condition.

#### 1) The Order Condition for Identification

The order condition is same as that of the identification from the structural model.

## II) The Rank Condition for Identification

Let  $G^*$  stand for the number of endogenous variables contained in a particular equation. The rank condition may be stated as follows:

An equation containing  $G^*$  endogenous variables is identified if and only if it is possible to construct at least one non-zero determinant of order  $G^*-1$  from the reduced form coefficients of the exogenous (predetermined) variables excluded from that particular equation.

### 3.2.2.3 Identification and choice of econometric method

Identification determines basically the choice of the technique by which the model will be statistically estimated.

#### The Reduced Form Method or Indirect Least Squares

The reduced form method is a single-equation method in that it is applied to one equation of a system at a time. It is appropriate when the equations of the structural system contain both predetermined and endogenous variables among the set of explanatory variables, provided that the equations of the system are exactly identified.

The reduced form method, which is also known as indirect least squares method (ILS) may be outlined as follows:

**Step 1.** Obtain the reduced form of the structural model by rewriting the equations in such a way that the endogenous variables are expressed as a function of the predetermined (exogenous or lagged endogenous) variables only.

**Step 2.** Provided that the other usual assumptions about the disturbance term of the reduced-form equations are satisfied, we apply ordinary least squares to each equation of the reduced-form system and we obtain estimates of the reduced form coefficients. These coefficients are conventionally denoted by Greek letter,  $\pi$

Step 3. The final step of the indirect least squares method consists of using the estimates of the reduced form coefficients,  $\pi$ 's, obtained in the previous stage, and solving the system of coefficients' relationships (the system of relationships between the structural coefficients and the reduced form coefficients may be called system of coefficients' relationships) for the structural parameters.

To illustrate the application of indirect least squares, let's assume that the market mechanism of a given commodity is described by the following system of simultaneous equations:

$$\begin{aligned} D &= a_0 + a_1P + a_2Y + u_1 \\ S &= b_0 + b_1P + b_2W + u_2 \\ D &= S \end{aligned}$$

where D=Quantity demanded, S=Quantity supplied, P=price, Y=income, W=index of weather condition

This is the structural model which is mathematically complete in the sense that it contains three equations, in three endogenous variables (D, S, P). The system contains two exogenous variables, income and weather conditions w. The system is exactly identified.

The reduced-form model, in which the endogenous variables are expressed as a function of the exogenous variables only, may be obtained by solving for P and D as:

$$D = \frac{a_0b_1 - a_1b_0}{b_1 - a_1} + \frac{a_2b_1}{b_1 - a_1}Y + -\frac{a_1b_2}{b_1 - a_1}W + v_1, (\text{where } v_1 = \frac{u_1b_1 - u_2a_2}{b_1 - a_1})$$

$$P = \frac{a_0 - b_0}{b_1 - a_1} + \frac{a_2}{b_1 - a_1}Y + -\frac{b_2}{b_1 - a_1}W + v_2, (\text{where } v_2 = \frac{u_2 - u_1}{b_1 - a_1})$$

Using the conventional notation of  $\pi$ 's for the reduced form coefficients, we have

$$D = \pi_{10} + \pi_{11}Y + \pi_{12}W + v_1,$$

$$P = \pi_{20} + \pi_{21}Y + \pi_{22}W + v_2,$$

where:

$$\begin{aligned} \pi_{10} &= \frac{a_0 b_1 - a_1 b_0}{b_1 - a_1} & \pi_{11} &= \frac{a_2 b_1}{b_1 - a_1} & \pi_{12} &= \frac{-a_1 b_2}{b_1 - a_1} \\ \pi_{20} &= \frac{a_0 - b_0}{b_1 - a_1} & \pi_{21} &= \frac{a_2}{b_1 - a_1} & \pi_{22} &= \frac{-b_2}{b_1 - a_1} \end{aligned}$$

Using sample data on D, P, W and Y, we may apply OLS to the reduced-form equations and obtain estimates of the  $\pi$ 's. We next substitute  $\hat{\pi}$ 's into the system of coefficients' relationships and obtain estimates of the structural parameters as:

$$\begin{aligned} \hat{a}_0 &= \hat{\pi}_{20} \left( \frac{\hat{\pi}_{10}}{\hat{\pi}_{20}} - \frac{\hat{\pi}_{12}}{\hat{\pi}_{22}} \right), \quad \hat{a}_1 = \frac{\hat{\pi}_{12}}{\hat{\pi}_{22}}, \quad \hat{a}_2 = \hat{\pi}_{21} \left( \frac{\hat{\pi}_{11}}{\hat{\pi}_{21}} - \frac{\hat{\pi}_{12}}{\hat{\pi}_{22}} \right) \\ \hat{b}_0 &= \hat{\pi}_{20} \left( \frac{\hat{\pi}_{10}}{\hat{\pi}_{20}} - \frac{\hat{\pi}_{11}}{\hat{\pi}_{21}} \right), \quad \hat{b}_1 = \frac{\hat{\pi}_{11}}{\hat{\pi}_{21}}, \quad \hat{b}_2 = \hat{\pi}_{22} \left( \frac{\hat{\pi}_{12}}{\hat{\pi}_{22}} - \frac{\hat{\pi}_{11}}{\hat{\pi}_{21}} \right) \end{aligned}$$

### The Method of Instrumental Variables

The instrumental variables method is a single-equation method, being applied to one equation of the system at a time. It has been developed as a solution to the simultaneous equation bias and is appropriate for over identified models. The instrumental variables method attains the reduction of dependence of the random error term and the explanatory variables by using appropriate exogenous variables (as instruments). The estimates obtained from this method are consistent for large samples, although biased for small samples.

The method of instrumental variables may be outlined as follows:

**Step1.** Choose the appropriate instrumental variables which will replace the endogenous variables appearing as explanatory in the right-hand side of the structural equation.

An instrumental variable is an exogenous variable located some where in the system of simultaneous equations which satisfies the following condition

- a. It must be strongly correlated with the endogenous variable which it will replace in the structural equation.
- b. It must be truly exogenous and hence uncorrelated with the random term of the structural equation.
- c. It must be least correlated with the exogenous variables already appearing in the set of explanatory variables of the particular structural equation.
- d. If more than one instrumental variable is to be used in the same structural equation, they must be least correlated with each other to avoid the difficulties arising from multicollinear explanatory variables.

It should be noted that we must choose as many instrumental variables as there are endogenous variables in the set of explanatory variables of the particular structural equation. If the structural equation contains exogenous variables, these will be used as instrumental for themselves.

**Step 2** Multiply the structural equation throughout by each one of the instrumental variables (as well as by the exogenous variables already present in it since these predetermined variables are their own instruments) and sum the equation over all sample observations.

Let's demonstrate the method of instrumental variables using a model with one explanatory variable,

Application of ordinary least square to the equation  $Y = b_0 + b_1X_1 + u$  will yield biased and inconsistent estimates if  $X_1$  is endogenous to the system (since  $X_1$  will be correlated with  $u$ ).

To avoid this difficulty, it suffices to know that in some other part (equation) of the system to which the above relation belongs, there is an exogenous variable  $Z_1$  which fulfils the above conditions, that is  $Z_1$  is strongly correlated with  $X_1$ , but not with  $u$ . Hence, we may use  $Z_1$  as an instrument for replacing  $X_1$  in our function. Before proceeding to the next

step, it is convenient to express the structural equation in deviation form so as to eliminate the constant intercept  $b_0$ . Thus we have:

$$y' = b_1 x_1 + \xi$$

where  $y = (y - \bar{y})$ ,  $x_1 = (X_1 - \bar{X}_1)$  and  $\xi = (u - \bar{u})$

The next step is to multiply the structural equation through by the instrumental variable, and sum over all sample observations.

$$\sum (Z_1 y) = b_1 \sum (Z_1 x_1) + \sum Z_1 \xi$$

But  $\xi$  and  $Z_1$  are by assumption not correlated, so that their expected value is zero.  $E(\sum \xi Z_1) = 0$ . Hence, we may drop the last term of this equation setting it equal to its zero expected value. We thus obtain

$$\sum (Z_1 y) = b_1^* \sum (Z_1 x_1) \Rightarrow b_1^* = \frac{\sum Z_1 y}{\sum Z_1 x_1}$$

It can be shown that the OLS estimator of  $b_1^*$  is consistent.

### Two Stage Least Square (2SLS)

It is a single equation method, being applied to one equation of the system at a time. It has provided satisfactory result for the estimates of the structural parameters and has been accepted as the most important of the single equation techniques for the estimation of over identified models. Two stage least squares, like other simultaneous equation techniques, aims at the elimination as far as possible of the simultaneous equation bias. We saw that the source of this bias is the existence of endogenous variables in the set of explanatory variables of the function.

Let's demonstrate the 2SLS method using the following notation;

$Y_i$ 's will denote endogenous variables ( $i=1, 2 \dots G$ )

$X_i$ 's will denote exogenous variables ( $i=1, 2 \dots K$ )

$\beta$ 's will present the coefficients of endogenous variables

$\gamma$ 's will present the coefficients of predetermined variables.

Thus the  $i^{\text{th}}$  structural equation is of the general form

$$Y_j = b_{j1}Y_1 + \dots + b_{j(j-1)}Y_{j-1} + \beta_{j(j+1)}Y_{j+1} + \dots + \beta_{jG}Y_G + \gamma_{j1}X_1 + \dots + \gamma_{jK}X_K + \mu_j$$

In the first stage, we apply ordinary least squares to the reduced form equations to obtain estimates of the  $\pi$ 's

$$Y_1 = \pi_{11}X_1 + \dots + \pi_{1K}X_K + v_1$$

$$Y_2 = \pi_{21}X_1 + \dots + \pi_{2K}X_K + v_2$$

$$Y_G = \pi_{G1}X_1 + \dots + \pi_{GK}X_K + v_G$$

Using the reduced form equations, we obtain a set of estimated (computed) values for the endogenous variables  $\hat{Y}_1, \hat{Y}_2, \dots, \hat{Y}_G$ .

In the second stage we substitute the  $\hat{Y}$ 's into the structural equations and obtain the transformed functions:

$$Y_j = b_{j1}\hat{Y}_1 + \dots + b_{j(j-1)}\hat{Y}_{j-1} + \beta_{j(j+1)}\hat{Y}_{j+1} + \dots + \beta_{jG}\hat{Y}_G + \gamma_{j1}X_1 + \dots + \gamma_{jK}X_K + \mu_j$$

Applying OLS to the transformed structural equation, we obtain the 2SLS estimates of the structural parameters. Thus, for the simple structural equation with two explanatory variables:  $Y_1 = b_2Y_2 + \gamma_1X_1 + u$ , the transformed equation is  $Y_1 = b_2\hat{Y}_2 + \gamma_1X_1 + u$  and the normal equations are:

$$\sum Y_1\hat{Y}_2 = b_2^* \sum \hat{Y}_2^2 + \gamma_1^* \sum X_1\hat{Y}_2$$

$$\sum Y_1X_1 = b_2^* \sum X_1\hat{Y}_2 + \gamma_1^* \sum X_1^2$$

The formula for the 2SLS estimates are

$$b_2^* = \frac{\begin{vmatrix} \sum Y_1 \hat{Y}_2 & \sum X_1 \hat{Y}_2 \\ \sum Y_1 X_1 & \sum X_1^2 \end{vmatrix}}{\begin{vmatrix} \sum \hat{Y}_2^2 & \sum X_1 \hat{Y}_2 \\ \sum X_1 \hat{Y}_2 & \sum X_1^2 \end{vmatrix}} = \frac{(\sum Y_1 \hat{Y}_2)(\sum X_1^2) - (\sum Y_1 X_1)(\sum X_1 \hat{Y}_2)}{(\sum \hat{Y}_2^2)(\sum X_1^2) - (\sum X_1 \hat{Y}_2)^2}$$

$$\gamma_1^* = \frac{\begin{vmatrix} \sum Y_2^{*2} & \sum Y_1 \hat{Y}_2 \\ \sum X_1 \hat{Y}_2 & \sum Y_1 X_1 \end{vmatrix}}{\begin{vmatrix} \sum Y_2^{*2} & \sum X_1 \hat{Y}_2 \\ \sum X_1 \hat{Y}_2 & \sum X_1^2 \end{vmatrix}} = \frac{(\sum \hat{Y}_2^2)(\sum Y_1 X_1) - (\sum X_1 \hat{Y}_2)(\sum Y_1 \hat{Y}_2)}{(\sum \hat{Y}_2^2)(\sum X_1^2) - (\sum X_1 \hat{Y}_2)^2}$$

### **3.3 Data Sources and Estimation Technique**

#### **3.3.1. Data Sources**

The data used in this study are obtained from various sources. The main data sources are the National Bank of Ethiopia annual reports and quarterly bulletins, Central Statistical Agency Agricultural Sample Surveys, United Nations publications, Ministry of Agriculture and Rural Development (MoARD) reports and Ministry of Trade and Industry (MoTI) reports.

#### **3.3.2. Estimation technique**

In this modeling technique, the time series characteristics of the variables, that is stationarity and cointegration, in all the equations is considered.

#### **3.3.3. Unit root tests**

Time series econometric study is not complete without performing stationarity test on variables used for the study. The first procedure that should be performed is testing the stationarity of data. When one wants to construct an econometric model (or relationship) between economic variables using time series data, test of stationarity of each time series variable should be undertaken. In empirical studies with time series data, stationarity of the variables under consideration is crucial to avoid problems of spurious regression, which may give very high R<sup>2</sup> value and significant t-ratios even without true relationship among the variables. For the classical regression model to hold, all the variables involved in the regression must be stationary.

Most time series macroeconomic variables are non-stationary in which case the variables may have consistent trend relationship rather than true or behavioral relations (Johansen, 1988).

To avoid the spurious regression problem that may arise from regressing a non-stationary time series on one or more non-stationary time series, we have to apply transformation methods to make them stationary. The transformation method depends on whether the time series are Difference Stationary Process (DSP), which is making a variable stationary by differencing and/or Trend Stationary Process (TSP) that deals with making a variable stationary by de-trending.

Difference Stationary and Trend Stationary techniques are key concepts in time series analysis. These concepts can be illustrated using the following two regression models.

$$Y_t = \beta_1 + \beta_2 t + U_t$$

where  $Y_t$  is the time series under study and  $t$  is the trend variable measured chronologically. The regression represents a TSP if one subtracts the trend, (i.e.  $\beta_1 + \beta_2 t$ ) from the equation i.e.  $\hat{U}_t = Y_t - \hat{\beta}_1 - \hat{\beta}_2 t$  will be stationary.  $\hat{U}_t$  is known as a (linearly) detrended time series. However, if we take the equation  $Y_t = Y_{t-1} + U_t$  (pure random walk without drift), it is non-stationary. But, if we write as  $\Delta Y_t = (Y_t - Y_{t-1}) = U_t$  it becomes stationary. We call such a process difference stationary process.

### **The Augmented Dickey – Fuller (ADF) Test**

To test for unit root of the variables, the Augmented Dickey- Fuller (ADF) test procedure is employed as described by Enders (1995). The ADF test compared to the ordinary Dickey – Fuller unit root test, allows the inclusion of lagged dependent variable terms in order to correct for serially correlated residuals. The following equation is used to test for the presence of unit root in the series:

$$\Delta Z_t = a_0 + a_1 t + \gamma Z_{t-1} + \sum_{i=1}^p \beta_i \Delta Z_{t-i} + \varepsilon_t \quad (6)$$

where  $a_0$ ,  $a_1$ ,  $\gamma$  and  $\beta_i$  are parameters,  $t$  is a time trend and  $\varepsilon_t$  is the error term. The number of augmented lags is denoted by  $p$  and its order can be estimated by minimizing information criteria such as Akaike or Schwarz. The null hypothesis of the ADF in this

specification is that  $\gamma = 0$  (the data needs to be differenced to make it stationary) and the alternative hypothesis is that  $\gamma < 0$  (the data is stationary and does not need to be differenced).

### 3.3.4 Co -integration Test

An  $(n \times 1)$  vector time series  $Y_t$  is said to be co-integrated of order 1 if each of the series taken individually is  $I(1)$ , that is, non stationary with a unit root, while some linear combination of the series  $\mathbf{a}'y_t$  is stationary or  $I(0)$ , (Hamilton James (1994), p-571). When this is the case,  $\mathbf{a}$  is called a co- integrating vector.

Co-integration means that although many developments can cause permanent changes in the individual elements of  $y_t$ , there is some long-run equilibrium relation tying the individual components together, represented by the linear combination  $\mathbf{a}'y_t$ . Clearly, the co-integrating vector  $\mathbf{a}$  is not unique, for if  $\mathbf{a}'y_t$  is stationary, then so is  $\mathbf{b}\mathbf{a}'y_t$  for any nonzero scalar  $\mathbf{b}$ ; if  $\mathbf{a}$  is a co- integrating vector, then so is  $\mathbf{b}\mathbf{a}$ . In speaking of the value of the co integrating vector, an arbitrary normalization must be made, such as that the first element of  $\mathbf{a}$  is unity.

Engle and Granger (1987) provide the following definitions of co integration and noted, “a test for cointegration can be thought of as the pre-test to avoid ‘spurious regression’”.

Time Series variables are said to be co-integrated if their linear combination is found to be stationary. According to Harris (1995), the economic interpretation of co-integration is that if two or more series are linked to form an equilibrium relationship spanning the long run, then even though the series themselves may contain stochastic trends (i.e., be non-stationary) they will nevertheless move closely together over time and the difference between them will be stable (i.e stationary)” .

Making a variable stationary by differencing only gives the short-run dynamics while our interest may be to know also about the long-run parameters. Non-stationary variables can be stationary by differencing but in differencing the variables, there will be loss of

considerable long run information. For this reason the application of cointegration is appropriate.

There are three main approaches to test for co integration. These are the Engle –Granger (1987) two-stage procedure, the Johansen maximum likelihood method (Johansen (1988) and Johansen and Juselius (1990)) procedure.

### **The Engle –Granger (EG) Approach**

Suppose that two variables – say,  $Y_t$  and  $Z_t$  are believed to be integrated of order one and we want to determine whether there exists an equilibrium relationship between the two. Engle and Granger (1987) propose a straightforward test of whether two  $I(1)$  variables are co integrated of order  $CI(1, 1)$  or not.

*Step 1:* Pretest the variables for their order of integration. By definition, co integration necessitates that the variables be integrated of the same order. Thus, the first step in the analysis is to pretest each variable so as to determine its order of integration. If the variables are integrated of different orders, it is possible to conclude that they are not co integrated.

*Step 2:* Estimate the long-run equilibrium relationship. If the results of step 1 indicate that both  $Y_t$  and  $Z_t$  are  $I(1)$ , the next step is to estimate the long-run equilibrium relationship in the form:

$$Y_t = \beta_0 + \beta_1 Z_t + e_t \quad (7)$$

In order to determine if the variables are actually co integrated, denote the residual sequence from this equation by  $\hat{e}_t$ . Thus,  $\hat{e}_t$  is the series of the estimated residuals of the long-run equilibrium relationship. If these deviations from long run equilibrium are found to be stationary, then the  $Y_t$  and  $Z_t$  sequences are co- integrated of order one.

*Step 3:* Estimate the error correction model. If the variables are co integrated (i.e., if the null hypothesis of no co integration is rejected), the residuals from the equilibrium regression can be used to estimate the error correction model.

If  $\{y_t\}$  and  $\{z_t\}$  are  $CI(1, 1)$ , the variables have the following error correction model:

$$\Delta Y_t = \alpha_1 + \alpha_y \hat{e}_{t-1} + \sum_{i=1}^p \alpha_{11}(i) \Delta Y_{t-i} + \sum_{i=1}^p \alpha_{12}(i) \Delta Z_{t-i} + \varepsilon_{yt} \quad (8)$$

$$\Delta Z_t = \alpha_2 + \alpha_z \hat{e}_{t-1} + \sum_{i=1}^p \alpha_{21}(i) \Delta Y_{t-i} + \sum_{i=1}^p \alpha_{22}(i) \Delta Z_{t-i} + \varepsilon_{zt} \quad (9)$$

where,

$\hat{e}_{t-1} = Y_{t-1} - \beta_1 Z_{t-1}$  are the residuals from the estimation of the long-run equilibrium relationship of equation (7)

$\beta_1$  = the parameter of the co integrating vector given by equation (8)

$\varepsilon_{yt}$  &  $\varepsilon_{zt}$  = white-noise disturbances (which may be correlated with each other)

$\alpha_1, \alpha_2, \alpha_y, \alpha_z, \alpha_{11}(i), \alpha_{12}(i), \alpha_{21}(i),$  and  $\alpha_{22}(i)$  are all parameters to be estimated.

### 3.3.5 Vector Error Correction Model (VECM)

A vector error correction model (VECM) is a restricted VAR designed for use with non stationarity series that are known to be co integrated. The VECM has co integration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their co integrating relationships while allowing for short-run adjustment dynamics. The co integration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

If variables are co integrated, then tests involving differenced variables will be misspecified and some important information lost unless a lagged error-correction term is included. Therefore, we estimate the error correction model in which the error correction terms (ECT), derived from long-run co integrating vectors are included as independent explanatory variables in the estimation process to recover all long-run information that was lost in the original estimation process.

Let  $Y_t$  &  $Z_t$  are believed to have a simultaneous relationship and the first relationship is given as:

$$Y_t = \beta_0 + \beta_1 Z_t + e_t$$

Assuming that the above equation is co integrated with its non-stationary variables.

The system can be written as:

$$\Delta \ln(Y_t) = \beta_0 + \lambda e_{t-1} + \sum_{i=1}^k \gamma_i \Delta \ln Y_{t-i} + \sum_{i=1}^j \beta_i \Delta \ln Z_{t-i} + \mu_t$$

where  $e_{t-1}$  is the error correction term;  $\mu_t$  is the disturbance term.

The coefficient of the lagged error correction term  $\lambda$  is the adjustment coefficient that defines the proportion by which long run disequilibrium independent variable is corrected in a given period of time.

The application of EC method produces two types of relationships: short-run dynamics and long-run causal relationships between the dependent variables and the specified set of independent variables. The long-run causal relationship is captured by the coefficients of the lagged value of the error correction term,  $e_{t-1}$ , while the short-run causal effects are implied by the coefficients of the lagged explanatory variables (in first difference). If only the error-correction term (ECT) is statistically significant, this implies that the variable is weakly endogenous with respect to the long-run parameters. Similarly, if only the coefficients of the lagged explanatory variables (in first difference) are statistically significant, this implies that the variable is weakly endogenous with respect to the short-run parameters. Finally, if the lagged explanatory variables and error correction terms are not statistically significant, then the dependent variable is econometrically strongly exogenous.

### 3.4 Theoretical Model Formulation

The export supply and demand models for non-coffee export commodities are modeled following from Goldstein and Khan (1978), Francis X. Browne (1982) and Lord (1989)

#### 3.4.1. Export Demand Equations

$$X_{(NCOF)I}^d = \alpha_0 * [REER_t]^{\alpha_1} * [YW_{(NCOF)I}]^{\alpha_2} * [P^*_{(NCOF)I}]^{\alpha_3} * \exp(\varepsilon_{1t})$$

(10)

Equations (10) can be reformulated in logarithm form as follows.

$$\log X_{(NCOF)t}^d = \alpha_0 + \alpha_1 \log REER_t + \alpha_2 \log YW_{(NCOF)t} + \alpha_3 \log P_{(NCOF)t}^* + \varepsilon_{1t} \quad (11)$$

where:

$X_{(NCOF)t}^d$  represent the real values of non-coffee exports (sum of export values of oil seeds, pulses, chat, hides and skins) deflated by their corresponding prices indices to make them real variables.

REER= The real effective exchange rate index,

$YW_{(NCOF)t}$  = The trade weighted average income of the trading partners.

$P_{(NCOF)t}^*$  = An index of the weighted average international price of non-coffee (Oilseeds, Pulses, Hides and Skins and chat) with 2000/01 as base year (2000/01=100).

### The real effective exchange rate index

Real effective exchange rate is defined as value of the nominal exchange rate (E) corrected by the ratio of the foreign price (P\*) to the domestic price level (P), i.e.,  $e_{PPP} = E(P^*/P)$ .

In this study, real effective exchange rate is defined as the product of nominal exchange rate with the ratio of the wholesale price indices of the country's trade partners to the country's consumer price index. i.e.,

$$REER = EP^*/P$$

where E is the nominal exchange rate, P\* is wholesale price indices (WPIs) of the country's trade partners and P is the country's consumer price index (CPI)

In the practical sections of many real exchange rate literatures, the multilateral real exchange rate that considers the exchange rate of the domestic currency with respect to the trading partners has been advocated as a more reliable proxy for measuring the country's external competitiveness with respect to its trade partners.

With respect to the mathematical formulation of constructing the multilateral real exchange rate, the following formula has been used:

$$REER_t = \sum_{i=1}^k \alpha_i E_{it} P_{it}^* / P_t$$

where,

$REER_t$  = index of real effective exchange rate in period t for the home country.

$E_{it}$  = an index of the nominal exchange rate.

$P_{it}^*$  = the price index of partner i in period t.

$P_t$  = " " " " home country in period t.

$\alpha_i$  = is the weight attached to partner i in the computation of  $REER_t$  (in terms of import, export or total trade) share.

$i = 1, 2, \dots, k$  refers to the k trade partner countries.

### **The trade weighted average income of the trading partners**

It is very difficult to include all trading partners of Ethiopia in the study. Therefore, the study uses a threshold of one percent. That is, those partners having trade weights (export +import to total trade) more than one percent in the selected periods are included in the study as they show relatively strong trade relation with the home country (Ethiopia) .The countries and their corresponding weight are presented in the following table.

COUNTRY	TRADE WEIGHT
Belgium	0.032102
Kenya	0.023851
France	0.041219
Germany	0.170737
Italy	0.129778
Netherlands	0.038856
Sweden	0.025565
United kingdom	0.066651
USA	0.103796
India	0.038175
Japan	0.121751
Korea	0.027727
S/Arabia	0.162835
Switzerland	0.016958

*Source:* National Bank of Ethiopia

### An index of the weighted average international price of non-coffee ( $P^*$ (NCOF1))

This is obtained as:

$$P^*_{(NCOF1)t} = \frac{w_{1t}P_{(oil)t} + w_{2t}P_{(pul)t} + w_{3t}P_{(bnd)t} + w_{4t}P_{(char)t}}{w_{1t} + w_{2t} + w_{3t} + w_{4t}}$$

where,  $w_{it}$  = The importance of the  $i^{th}$  non-coffee export commodity for the country in period  $t$  or share of the  $i^{th}$  non-coffee export commodity in the total non-coffee export commodity in period  $t$  (see Annex-2)

### 3.4.2 Export Supply Equations

$$\log X_{(NCOF1)t} = \phi_0 + \phi_1 \log P^*_{(NCOF1)t} + \phi_2 \log TT_t + \phi_3 ARF_t + \phi_4 \log EGN_t + \phi_5 \log ERGAP_t + \phi_6 \log WLRT_t + \phi_7 RFEA_t + \phi_8 DPRNCOF1_t + \varepsilon_{3t} \dots (12)$$

$X_{(NCOF)t}^S$  = export supply of non-coffee commodity during the time period t (t=1970/71-2004/05)

$ARF_t$  = Average rain fall in period t

The average amount of rain the country obtained annually in period t.

$ERGAP_t$  = Exchange rate gap

Exchange rate gap is defined as the ratio of the difference between Parallel exchange rate and Official exchange rate to official exchange rate at time period t. ((parallel-official)/official exchange rate.)

$RFEA_t$  = Real foreign exchange availability at time period t

In this paper the foreign exchange availability in nominal terms is defined as the yearly sum of export receipts, net service inflows, net private transfers, net official transfers and disbursements less debt service payment during the period considered.

$EGN_t$  = Electric generation at time period t

The amount of electricity generated in KWH during the years considered

$WLRT_t$  = World lending rate at time period t

Considering that the U.S.A., U.K., Germany, Japan and France account for more than 95 percent of the country's correspondent accounts, the world lending rates (WLRT) series is generated as a weighted average rate of these five countries.

$TT_t$  = Terms of trade

Terms of trade can be said to denote the ratio between the values of one commodity bundle in terms of another.

$DPRNCOF1_t$  = Domestic production of primary non-coffee export commodities

The quantity of products (in ton) of the primary non-coffee export commodities produced in the specified period.

### 3.4.3 Supply demand equilibrium

According to Morris Golds and Moshir Khan(1978), the export demand and the export supply equations (by estimating them simultaneously to eliminate any bias arising from the two ways relationship of export quantities and export prices) can be constructed by using two types of model for both export quantities and price (dependent variables) as:

#### I) Equilibrium Model

The model is specified as

$$\log X_{(NCOF)T}^d = \log X_{(NCOF)T}^s \quad \forall t, t= 1970/71-2004/05$$

By equating the demand side that are given in (11) with the supply side given in (12), we can obtain the following relationship;

$$\log P_{(NCOF)T}^* = \kappa_0 + \kappa_1 \log REER_t + \kappa_2 \log YW_{(NCOF)T} + \kappa_3 \log TT_t + \kappa_4 ARF_t + \kappa_5 \log EGN_t + \kappa_6 \log ERGAP_t + \kappa_7 \log WLRT_t + \kappa_8 \log FEA_t + \kappa_9 \log DPRNCOF1_t + \varepsilon_{4t} \dots\dots(13)$$

$$\text{where } \kappa_0 = \frac{\phi_0 - \alpha_0}{\alpha_3 - \phi_1}, \kappa_1 = \frac{\alpha_1}{\phi_1 - \alpha_3}, \kappa_2 = \frac{\alpha_2}{\phi_1 - \alpha_3}, \kappa_i = \frac{\phi_{i-1}}{\alpha_3 - \phi_1}; i=3, \dots, 9$$

$$\log X_{(NCOF)T} = \lambda_0 + \lambda_1 \log REER_t + \lambda_2 \log YW_{(NCOF)T} + \lambda_3 \log TT_t + \lambda_4 ARF_t + \lambda_5 \log EGN_t + \lambda_6 \log ERGAP_t + \lambda_7 \log WLRT_t + \lambda_8 FEA_t + \lambda_9 \log DPRNCOF1O_t + \varepsilon_{5t} \dots\dots\dots(14)$$

$$\text{where } \lambda_0 = \phi_0 + \phi_1 \kappa_0, \lambda_1 = \phi_1 \kappa_1, \lambda_2 = \phi_1 \kappa_2, \lambda_3 = \phi_2 + \phi_1 \kappa_3, \lambda_j = \phi_1 \kappa_j + \phi_{j-1}; j=4, \dots, 9$$

Since the demand and supply of export commodities in the case of developing country like Ethiopia is not equivalent, an adjustment factor must be included in the model. Hence based on the Morris Golds and Moshir Khan (1978), for a small open economy like Ethiopia where exporters are regarded as price takers in the international markets, export quantities are assumed to adjust to the suppliers desired value while export prices vary in line with demand.

## II) Disequilibrium Model

$$\Delta \log X_t = \gamma (\log X_t^s - \log X_{t-1}), \gamma > 0 \dots\dots\dots (15)$$

$$\Delta \log PX_t = \gamma (\log X_t^d - \log X_t) \quad \gamma > 0 \dots\dots\dots(16)$$

where  $X_t$ =export quantity

$PX_t$ =price of commodity exported

Now substituting equation (12) into equation (15) and equation (11) into equation (16) we obtain:

$$\log X_{(NCOF)t} = \rho_0 + \rho_1 \log P^*_{(NCOF)t} + \rho_2 \log TT_t + \rho_3 \log ARF_t + \rho_4 \log EGN_t + \rho_5 \log ERGAP_t + \rho_6 \log WLRT_t + \rho_7 \log FEA_t + \rho_8 \log DPRNCOF1_t + \rho_9 \log X_{(NCOF)t-1} + \varepsilon_{5t} \dots\dots\dots(17)$$

$$\rho_0 = \gamma\phi_0, \rho_i = \gamma\phi_i, \rho_9 = 1 - \gamma, i = 1, \dots, 8$$

$$\log P^*_{(NCOF)t} = \psi_0 + \psi_1 \log REER_t + \psi_2 \log YW_{(NCOF)t} + \psi_3 \log X_{(NCOF)t} + \psi_4 \log P^*_{(NCOF)t-1} + \varepsilon_{6t}$$

$$\psi_0 = \frac{\gamma\alpha_0}{1 - \gamma\alpha_3}, \psi_1 = \frac{\gamma\alpha_1}{1 - \gamma\alpha_3}, \psi_2 = \frac{\gamma\alpha_2}{1 - \gamma\alpha_3}, \psi_3 = \frac{-\gamma}{1 - \gamma\alpha_3}, \psi_4 = \frac{1}{1 - \gamma\alpha_3}$$

### Reduced Form Equations

The reduced form for the disequilibria model is given as

$$\log X_{(NCOF)t} = \rho_0 + \rho_1 \log REER_t + \rho_2 \log YW_{(NCOF)t} + \rho_3 \log TT_t + \rho_4 \log ARF_t + \rho_5 \log EGN_t + \rho_6 \log ERGAP_t + \rho_7 \log WLRT_t + \rho_8 \log FEA_t + \rho_9 \log DPRNCOF1_t + \rho_{10} \log X_{t-1} + \rho_{11} \log P^*_{(NCOF)t-1} + \varepsilon_{7t} \dots\dots\dots(18)$$

$$\log P^*_{(NCOF)t} = \varphi_0 + \varphi_1 \log REER_t + \varphi_2 \log YW_{(NCOF)t} + \varphi_3 \log TT_t + \varphi_4 \log ARF_t + \varphi_5 \log EGN_t + \varphi_6 \log ERGAP_t + \varphi_7 \log WLRT_t + \varphi_8 \log FEA_t + \varphi_9 \log DPRNCOF1_t + \varphi_{10} \log X_{(NCOF)t} + \varphi_{11} \log P^*_{(NCOF)t-1} + \varepsilon_{8t}$$

## Identification from the Reduced Model

### The order and rank conditions

Since our interest is in modeling the supply side, we have to investigate the identifiability of the first reduced equation.

Since the total number of variables in the model (12) less the number variables included in the first supply equation (11) is exactly equal to the total number of endogenous variable included in the supply equation (2) (price and quantity) less one, the order condition is satisfied. The model also satisfies the rank condition.

### 3.4.4 Reduced form Equation for the remaining Non-coffee export commodities (NCOF2)

Since the international prices of manufactured, semi-manufactured and other export items (excluding coffee export) which are the residual from the total export are not available, it has been difficult to model these items by the above simultaneous equation model and as a result we employ the reduced form model.

We estimate by simple OLS and Dynamic OLS estimation techniques alternatively.

$$\log X_{(NCOF2)t} = \varphi_0 + \varphi_1 \log REER_t + \varphi_2 \log TT_t + \varphi_3 \log ARF_t + \varphi_4 \log EGN_t + \varphi_5 \log ERGAP_t + \varphi_6 \log WLRT_t + \varphi_7 \log RFAE_t + \varphi_8 \log TRDL_t + \varphi_9 \log RGDP_t + \varphi_{10} \log RPCON_t + \varepsilon_{12t} \dots \dots (19)$$

*Where*

$\log X_{(NCOF2)t}$  = Other real export value which is obtained by deducting the non-coffee 1 export items mentioned above from total non-coffee export values and deflated by export unit value index to obtain the real values of these exports items.

$RGDP_t$  = Gross domestic product deflated by GDP deflator to make it real.

GDP is the same as saying national income which is equivalent to expenditure on output. In this paper GDP is a measure of the country's output of goods and services produced within a year.

$RPCON_t$  = Real private consumption

is a variable representing consumption by households and other private agents (part of total national consumption excluding government consumption) expressed in real terms.

$TRDL_t$  = The total road network in km that exist in the country at period t

# CHAPTER FOUR

## RESULTS AND INTERPRETATION

### 4.1 Data

In order to meet the desired objective, data are gathered from different sources. Annex 1 provides a description of data sources. All series are available from 1970/71-2004/5.

The degree of integration or stationarity of each data series is determined first before estimating the model. Augmented Dicky –Fuller (ADF) and the Phillips Perron tests were conducted on each of the logarithmic transformed variables, where a unit root null hypothesis is tested against a stationary alternative. ADF shows none of these variables are stationary at level but they all are stationary after first difference .The Phillips Perron test shows that average rain fall and trading partner income are the only variables that are stationary at level where as the remaining variables are all stationary after the first difference (see annex-3).

### 4.2 Estimation

Several methods can be adopted to model cointegrating relationship for export (NCOF1 &NCOF2). In this paper, the cointegrating relationship between real export values & its explanators is tested and estimated using error correction model (ECM) procedure. The Augmented Dickey-Fuller of the two Stage Engle-Granger Cointegration test result for both models we have estimated showed that although the variables ( both the dependent and the explanatory) are I(1), that is, they are not stable individually , their linear relationship is stable implying that they have long run relationship (see Annex 6 &11) .

### 4.3 Diagnostics

Both non-coffee export models (in long run and short run) were tested for normality, serial correlation, heteroscedasticity and stability. Diagnostic tests carried out on the data (reported in Annex-5, 8, 10, 13) using PC GIVE soft ware reveal the models are reasonably

well specified. Diagnostics tests also indicated that the residuals are normally distributed, homoskedastic and serially uncorrelated and the parameters appear to be stable.

## 4.1 Results

### 4.4.1 Real Exports of Non-coffee 1 (NCOF1) Export model

#### 4.4.1.1. Long run model of NCOF1

$$LXNCOF1_t = 10.129 + 0.822LREER + 1.477LTT + 1.523LARF - 0.121EGAP_t + 0.693P * NCOF1_t(-1)$$

(se) (2.553) (0.360) (0.274) (0.26) (0.053) (0.243)

According to the econometric analysis result, it is found that non-coffee1 export have a positive link with real effective exchange rate, terms of trade, average rain fall and lag price of non-coffee1 export while it has a negative relationship with domestic exchange rate gap. Since the remaining variables are found to be insignificant at 5% significance levels, they are excluded from the model.

The positive relationship between real exchange rate and real exports of the non-coffee1 (NCOF1) commodities of Ethiopia implies when the Ethiopian birr depreciates in real term, the price of the commodities of NCOF1 will be lowered when expressed in foreign currency in the international market. The reduction of international price of these items would in turn increase their international demand. However, the net impact of a certain level of decline in international price on total export receipts depends on the rate at which quantity exported increases. Thus, exchange rate depreciation can increase exports value only if the percentage increase in quantity of exports of these commodities exceeds the percentage decrease in their price due to exchange rate depreciation.

The impact of external shocks is proxied by terms of trade. The result confirms that terms of trade is one of the fundamental factors in determining the real non-coffee1 exports of Ethiopia calling for diversifying the export items.

The positive relationship between non-coffee1 export and rainfall depicts that weather condition expectedly affects the production of the country and determines availability of these non-coffee1 export commodities.

Another factor that relates non coffee1 export positively is a one period lag price of these commodities. Though Ethiopia, as a developing country, is a price taker in the international market, it does not mean that the country sells its products for an amount less than the cost incurred during the production period. As the majority of these commodities are agricultural and harvested within a year, farmers try to produce more focusing on these commodities in order to find better income by selling these commodities to exporters.

The other important variable investigated was the exchange rate gap. The result shows that there is an inverse relationship between real exports of non-coffee1 and exchange rate gap. The direction of the link implies that as the exchange rate gap widens, the value of exports of these commodities tend to decline.

Since all variables are transformed in to log forms, we can interpret the coefficients of the explanatory variables as elasticities, that is a 1% real exchange rate depreciation leads to a 0.822 % increase in real exports of non-coffee1. This implies that exchange rate depreciation will encourage exporters to increase their net profit and the commodity's international competitiveness. This stimulates domestic exporters to export more in the international market. Similarly a 1% increase in terms of trade leads to 1.477% increase in real exports of non-coffee1. Like wise a 1% increase in average rain fall leads to 1.523% increase in real exports of non-coffee1 and, a 1% increase in one-year-lagged price of these commodities leads to 0.693% increase in real exports of non-coffee1. As the previous year price of the commodities increase, farmers tend to divert to these commodity groups to get more profits. Hence the export of these commodities will increase. And a 1% increase in exchange rate gap leads to 0.121 % decrease in real export of non- coffee.

#### 4.4.1.2. Short run dynamic for NCOF1 Model

At 5% level of significance the unit root test of the residual of the long run model of the non-coffee1 (see annex 6) indicates that the residual is stationary at level. So using 5% level of significance the short term model for the non-coffee1 export is:

$$DLXNCOF1_t = 1.413DLARF_t + 1.372DREER_t + 1.505DLTT + 0.564LP * NCOF1(-1) - 1.17ECNCOF1_{t-1}$$

(s.e)            (0.217)            (0.349)            (0.3243)            (0.175)            (0.283)

In the short run, the results highlighted the substantial impact of exchange rate, terms of trade and rain fall for non-coffee export items cumulatively. Another factor influencing the real value non-coffee1 exports appears to be the one year lagged price, which is significant with a reasonable coefficient. The factors are consistent with their theoretical expected sign.

The coefficient of the ECNCOF1\_1, 1.17 measures how quickly the equilibrium is adjusted indicating that the short run disequilibria will be back to equilibrium within the same year. 100% of the disequilibrium will be adjusted with a year. The model showed quick adjustment.

#### 4.4.1.3. Identification of NCOF1 model

As mentioned in the methodological part, the rank condition has already been satisfied. And from the long run non-coffee1 model one can see that the largest non-zero determinant,  $\lambda_1=0.822$  (coefficient of REER) is different from zero. This shows both the rank and order condition for identification are satisfied; hence the model is exactly identified. Therefore one can deduct the values of the parameters of the structural relations from the knowledge of the reduced parameters.

## 4.4.2 Real Exports of Non-coffee 2 (NCOF2) Export model

### 4.4.2.1. Long run model of NCOF2

$$\text{LXNCOF2}_t = -3.56 \text{LRPCON} + 4.91 \text{LRGDP} + 1.39 \text{LEGN} - 0.11 \text{ERGAP}_t$$

(se) (1.242) (1.355) (0.604) (0.047)

At 5% level of significance the results of the long run exports of non-coffee2 (NCOF2) indicated that real GDP and electric generation have the expected significant positive impact whereas exchange rate gap and real private consumption have a negative significant effect. The over all performance of the economy as proxied by GDP is one of the variables that significantly affect the real exports in these commodities. This implies that supply side factor is really crucial in determining export proceeds in this country. In addition, it is established that electricity generation is another important variable. The result of regression analysis indicates that the development of the infrastructural activities such as power generation and supply are vital for the performance of the country's export of non-coffee2 commodities (NCOF2). This positive relation is mainly because adequate availability of power supply can boost productivity and efficiency.

The negative and significant impact of the exchange rate gap on real exports of non-coffee2 (NCOF2) indicated a 1% increase in exchange rate gap between the official and the parallel market leads to a 0.11% fall in real exports of this commodities. This may commence as the increased exchange rate gap result in booming of the illicit trade in non coffee2 (NCOF2) market and in turn decreases the export of the commodity in the official channel.

The negative relation between non-coffee2 (NCOF2) export commodities and real private consumption depicts that as domestic consumption increases; the amount available for export will normally decreases.

Similarly, since all variables are transformed into log forms, we can interpret the coefficients of the explanatory variables as elasticities, that is, a 1% increase in real gross domestic product and electric generation leads to a 4.91% and 1.39 % increase in real exports of non-coffee2 (NCOF2), respectively. Like wise a 1% increase in real private

consumption and exchange rate gap leads to a 3.56% and 0.11% decrease in real exports of non-coffee2 (NCOF2).

#### 4.4.2.2. Short Run dynamic for NCOF2 model

At 5% level of significance the unit root test of the residual of the long run model of the non-coffee2 (see annex 11) indicates that the residual is stationary at level.

So using 10 % level of significance the short term model for the non-coffee2 export is:

$$DLXNCOF2_t = 2.95DGDPT_t - 2.28DLRPCONT_t - 1.24ECMNCOF2_{t-1}$$

(se)                      (1.349)                      (1.178)                      (0.2312)

The results of the short run exports of non-coffee2 (NCOF2) indicated that real GDP with the expected positive sign and the real private consumption with the negative sign are the only factors that determine the movement in the country. The remaining variables are insignificant and are discarded from the model.

The coefficient of ECMNCOF2\_1 1.24 divulges that 100% of the short run disequilibrium will come to long run equilibrium with in the given period, which is a year in our case.

# CHAPTER FIVE

## CONCLUSION AND RECOMMENDATION

### 5.1 CONCLUSION

This paper has attempted to provide useful insights into the behavior of non-coffee export growth in Ethiopia. A combination of supply-side and demand side factors was used to construct an empirically tractable non-coffee export model in accordance with traditional theoretical models and the underlying structure of the economy.

The country's non-coffee exports, as in most small economies, are continually subjected to a range of domestic and external factors. Over the past thirty years, the non-coffee exports growth has rarely moved along a smooth growth profile. Nevertheless, it is still possible to identify the key exogenous factors underlying the long run and short term fluctuations in these exports. Both in the short run and long run, while the export of non-coffee1 (primary non-coffee commodities) is dominated by the demand and supply side factors (domestic and external), the export of non-coffee2 (NCOF2) commodities are mainly influenced by the supply side factor due to a cumulative effect that include backward mode of production, high cost of production, high demand for domestic consumption, and low export price elasticities that emanate from low international price for primary agricultural commodities. However the identification of the real reasons needs an independent work. According to the result while real exchange rate, terms of trade, average rainfall, exchange rate gap and previous year's price of non-coffee1 drives the non-coffee 1 export commodities, gross domestic product (GDP), electric generation, private consumption and exchange rate gap determine the movement of the non-coffee2 export commodities.

## **5.2 RECOMENDATION**

As we have seen in the result part, external shocks like terms of trade are one of the factors that determine the non-coffee export commodities. This shock cannot be controlled by policy makers. The best policy prescription in such a situation would be to put in place broad-based macroeconomic conditions, which could dampen the effect of these shocks. Another important factor obtained is real effective exchange rate. Continued stability in exchange rates by diversifying the non-coffee exports in particular and the export market in general would improve economic fundamentals and help bring about sustained growth in the export earning.

Exchange rate gap is one of the domestic factors that affect the sector in both non-coffee export types. The lesson is, thus, policy makers and practitioners (stake holders) should take into account this fact and put a close examination of the development of both the official and parallel exchange market premium.

The country's GDP is also one of the factors that affect the non-coffee<sup>2</sup> export growth. Because of its size, the performance of the agricultural sector heavily influences the performance of the whole economy (GDP). The performance of the economy is a mirror image of the performance of the agricultural sector and the latter on the availability of suitable weather conditions. Therefore, the result forwarded is that all sorts of efforts should be made so as to boost agricultural productivity.

As electric generation is also one of the factors that lead to export growth, government has to work more to intensify the provision of power supply in order to avail a better power to the country.

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## Annex 1. Variable Definitions

Variable	Description	Source	Unit
AVRF	Average Rain Fall	Meteorology Enterprise	10 <sup>3</sup> mm
NCOF1VOL	Volumes of Export Of non-coffee1 (sum of volumes of oilseeds ,hides and skins,chat,pulses)	NBE	10 <sup>3</sup> kg
NCOF2 VOL	Volumes Of Exports Of non- Coffee2 (meat and meat products, fruit vegetables, sugar, gold, oil cakes, live animals, petroleum and petroleum products, bees and wax, other))	NBE	10 <sup>3</sup> kg
ELG	Electricity Generation	NBE	10 <sup>3</sup> Kilo watt Hour
EXGAP	Exchange Rate Gap	NBE	Unit less
P*NCOF1	An index of the weighted average international price of non-coffee ( Oilseeds, Pulses , Hides and Skins and chat	UNCTAD and FAO IFS,NBE	Index
WYNCOF1	Trading partner income non-coffee1 commodities	NBE	10 <sup>6</sup> US Dollar
REER	Real Effective Exchange Rate	NBE	Index
RFEA	Real Foreign Exchange Rate Availability	NBE	10 <sup>6</sup> US Dollar
WLRT	World Lending Interest Rate	IFS	index
GDP	Gross domestic product	NBE	10 <sup>6</sup> birr
PCONP	Private consumption	NBE	10 <sup>6</sup> birr
TRDL	Total road length	Roads authority	10 <sup>3</sup> km
DPRNCOF1	Domestic production of NCOF1	CSA	10 <sup>3</sup> kg

## Annex2 Share (weight) of non-coffee export commodities (1970/71-2006/07)

Period	Oil Seeds	Hides & Skins	Pulses	Chat
1970/71	0.40	0.32	0.26	0.03
1971/72	0.39	0.31	0.26	0.04
1972/73	0.34	0.39	0.25	0.02
1973/74	0.34	0.22	0.43	0.02
1974/75	0.43	0.18	0.36	0.03
1975/76	0.26	0.32	0.39	0.03
1976/77	0.20	0.39	0.36	0.06
1977/78	0.12	0.56	0.29	0.03
1978/79	0.07	0.75	0.13	0.05
1979/80	0.07	0.76	0.14	0.02
1980/81	0.17	0.55	0.14	0.13
1981/82	0.12	0.58	0.18	0.12
1982/83	0.10	0.49	0.18	0.23
1983/84	0.17	0.54	0.12	0.17
1984/85	0.11	0.66	0.12	0.11
1985/86	0.05	0.81	0.09	0.06
1986/87	0.06	0.70	0.05	0.18
1987/88	0.11	0.69	0.08	0.11
1988/89	0.07	0.78	0.10	0.05
1989/90	0.04	0.67	0.18	0.11
1990/91	0.03	0.70	0.12	0.15
1991/92	0.01	0.91	0.01	0.08
1992/93	0.01	0.65	0.02	0.32
1993/94	0.12	0.53	0.07	0.28
1994/95	0.07	0.53	0.15	0.25
1995/96	0.07	0.51	0.13	0.29
1996/97	0.10	0.51	0.12	0.27
1997/98	0.30	0.34	0.10	0.26

Period	Oil Seeds	Hides & Skins	Pulses	Chat
1998/99	0.26	0.23	0.10	0.42
1999/00	0.21	0.23	0.06	0.50
2000/01	0.18	0.43	0.05	0.34
2001/02	0.19	0.33	0.19	0.29
2002/03	0.26	0.30	0.11	0.33
2003/04	0.35	0.18	0.10	0.37
2004/05	0.38	0.21	0.11	0.31
2005/06	0.51	0.18	0.09	0.22
2006/07	0.43	0.20	0.16	0.21

### Annex 3: Unit Root Test Results

Variables	Levels		First difference		Order of Integration at 5% level	
	ADF	PP	ADF	PP	ADF	PP
LARF	-1.92	-3.6	-5.88	-10.56	I(1)	I(0)
LELG	0.1	0.22	-4.02	-5.5	I(1)	I(1)
ERGAP	-2.04	-1.97	-4.66	-5.56	I(1)	I(1)
LTT	-0.28	-0.27	-3.02	-5.85	I(1)	I(1)
LRFEA	-1.18	-1.18	-3.95	-6.01	I(1)	I(1)
LREER	-1.87	-1.42	-4.51	-4.05	I(1)	I(1)
WLRT	-2.74	-1.93	-4.5	-4.11	I(1)	I(1)
LGDP	0.22	0.74	-7.38	-6.17	I(1)	I(1)
LWY	-2.4	-4.23	-2.97	-2.23	I(1)	I(0)
LPCON	-0.04	0.722	-6.9	-6.55	I(1)	I(1)
P*NCOF1(-1)	-2.25	-2.20	-5.75	-6.5	I(1)	I(1)
TRDL	-2.74	-1.93	-4.01	-3.93	I(1)	I(1)
LRXNCOF1	-2.375	-2.492	-3.639	-5.984	I(1)	I(1)
LRXNCOF2	-1.67	-2.024	-4.54	-6.589	I(1)	I(1)

## Annex 4: Estimation Results of Long Run Real Exports of non-coffee I (NCOF1)

Variables	Coefficient	Std.Error	t-value	t-prob
Constant	10.1292	2.553	3.97	0.001
LTT	1.47713	0.2743	5.38	0.000
LREER	0.821528	0.3597	2.28	0.032
Lp*NCOF1_1	0.692589	0.2430	2.85	0.009
LARF	1.52345	0.2603	5.85	0.000
ERGAP	-0.121257	0.05304	-2.29	0.032

R<sup>2</sup>            0.913592 F(10,23) = 24.32 [0.000]\*\*

Log-likelihood    44.0051 DW            2.05

AIC            -1.94148 SC            -1.44765

HQ            -1.77307 FPE            0.146993

## Annex 5. Diagnostic test for NCOF1

### I) Test summary

AR 1-2 test:    F(2,22) = 0.058454 [0.9434]

ARCH 1-1 test:    F(1,22) = 0.033156 [0.8572]

Normality test:    Chi<sup>2</sup>(2) = 1.6659 [0.4348]

hetero test:    F(20,3) = 0.22123 [0.9859]

Not enough observations for hetero-X test

RESET test:    F(1,23) = 4.1865 [0.0523]

**Annex 6: Two Stage Engle-Granger Cointegration Test Result of Exports non-coffee1 (NCOF1) Model(Residual Unit Root Test)**

ADF Test Statistic	-4.180808	1% Critical Value*		-3.6422
		5% Critical Value		-2.9527
		10% Critical Value		-2.6148
*MacKinnon critical values for rejection of hypothesis of a unit root.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(RESID1)				
Method: Least Squares				
Date: 07/01/08 Time: 20:11				
Sample(adjusted): 1972		Sample(adjusted): 1972		
2004		2004		
Included observations:		Included observations:		
33 after adjusting		33 after adjusting		
endpoints		endpoints		
Variable	Coefficient	Std. Error	t-Statistic	Variable
RESID1(-1)	-1.085563	0.259654	-4.180808	RESID1(-1)
D(RESID1(-1))	0.042001		0.180304	0.232944
C	-0.002937		0.012355	-0.237697
R-squared	0.522999	Mean dependent var		-0.001050
Adjusted R-squared	0.491199	S.D. dependent var		0.099453
S.E. of regression	0.070940	Akaike info criterion		-2.367460
Sum squared resid	0.150974	Schwarz criterion		-2.231414

## Annex 7: Estimation Results of short Run Real Exports of non-coffee1 (NCOF1)

Variables	Coefficient	Std.Error	t-value	t-prob
DLTT	1.50512	0.3243	4.64	0.000
DLREER	1.37180	0.3493	3.93	0.001
DLp*NCOF1_1	0.563795	0.1746	3.23	0.004
DLARF	1.41290	0.2166	6.52	0.000
DERGAP	-0.138596	0.04406	-3.15	0.005
ECMNCOF1_1	-1.17122	0.2826	-4.15	0.000

$R^2$             0.882107     $F(11,21) = 14.28 [0.000]**$   
 Log-likelihood    46.6985    DW                2.16  
 AIC                -2.10294    SC                -1.55875  
 HQ                -1.91984    FPE              0.126429

## Annex 8: Diagnostic test for DLXNCOF2

### I) Test summary

AR 1-2 test:     $F(2,19) = 0.52446 [0.6002]$   
 ARCH 1-1 test:  $F(1,19) = 0.10684 [0.7473]$   
 Normality test:  $\chi^2(2) = 0.37844 [0.8276]$   
 hetero test:     $\chi^2(22) = 25.213 [0.2870]$   
 Not enough observations for hetero-X test  
 RESET test:     $F(1,20) = 0.037744 [0.8479]$

## Annex 9: Estimation Results of Long Run Real Exports of non-coffee2 (NCOF2)

Variables	Coefficient	Std.Error	t-value	t-prob
LRPCON	-3.56028	1.242	-2.87	0.008
LRGDP	4.91201	1.355	3.62	0.001
LEGN	1.39273	0.6038	2.31	0.030
ERGAP	-0.108903	0.04748	-2.29	0.031

$R^2$             0.857418     $F(10,24) = 14.43 [0.000]**$   
 log-likelihood    34.5758    DW            2.22  
 AIC                -1.39160    SC            -0.892765  
 HQ                -1.22376    FPE           0.255350

## Annex 10: Diagnostic test for NCOF2

### I) Test summary

AR 1-2 test:     $F(2,22) = 0.41994 [0.6622]$   
 ARCH 1-1 test:  $F(1,22) = 0.00035901 [0.9851]$   
 Normality test:  $\chi^2(2) = 2.8650 [0.2387]$   
 hetero test:     $F(20,3) = 0.26582 [0.9728]$   
 Not enough observations for hetero-X test  
 RESET test:     $F(1,23) = 1.9483 [0.1761]$

## Annex I I: Two Stage Engle-Granger Cointegration Test Result of Exports non-coffee2 (NCOF2) Model

ADF Test Statistic	-4.155737	1% Critical Value*	-3.6422	
		5% Critical Value	-2.9527	
		10% Critical Value	-2.6148	
*MacKinnon critical values for rejection of hypothesis of a unit root.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(RESIDNCOF21)				
Method: Least Squares				
Date: 07/05/08 Time: 14:29				
Sample(adjusted): 1972 2004				
Included observations: 33 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Variable
RESIDNCOF21(-1)	-1.115503	0.268425	-4.155737	RESIDNCOF21(-1)
D(RESIDNCOF21(-1))	-0.037946	0.177816	-0.213402	D(RESIDNCOF21(-1))
C	0.005694	0.016251	0.350400	C
R-squared	0.585847	Mean dependent var	0.002432	
Adjusted R-squared	0.558237	S.D. dependent var	0.140366	
S.E. of regression	0.093295	Akaike info criterion	-1.819602	
Sum squared resid	0.261116	Schwarz criterion	-1.683556	
Log likelihood	33.02343	F-statistic	21.21850	
Durbin-Watson stat	2.051231	Prob(F-statistic)	0.000002	

## Annex 12: Estimation Results of short Run Real Exports of non-coffee 2 (NCOF2)

Variables	Coefficient	Std.Error	t-value	t-prob
DLRPCON	-2.27943	1.178	-1.94	0.066
DLRGDP	2.95478	1.349	2.19	0.039
RESIDNCOF21_1	-1.24025	0.2312	-5.37	0.000

$R^2$             0.83355     $F(11,22) = 10.02 [0.000]**$   
 log-likelihood    42.3194    DW            2.06  
 AIC                -1.78634    SC            -1.23669  
 HQ                -1.60415    FPE           0.174142

## Annex 13 Diagnostic Tests for DNCOF2

### i) Test summary

AR 1-2 test:     $F(2,20) = 0.11124 [0.8953]$   
 ARCH 1-1 test:  $F(1,20) = 0.0013937 [0.9706]$   
 Normality test:  $\chi^2(2) = 2.6017 [0.2723]$   
 hetero test:     $\chi^2(22) = 17.920 [0.7107]$   
 RESET test:     $F(1,21) = 0.044222 [0.8355]$

## DECLARATION

I, the undersigned, declare that this thesis is my original work and it has never been presented in any other university. All sources of materials used for this thesis are duly acknowledged.

### Declared by;

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