A MODEL FOR THE ANALYSIS OF THE EFFECTS OF COFFEE EXPORT EARNINGS INSTABILITY ON SELECTED MACRO-ECONOMIC VARIABLES: THE CASE OF ETHIOPIA

by
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Measurements, List of Tables, Figures

Measurements:

1 hectare = 10,000 m^2
1 ton = 10 quintals
1 quintal = 100 kg
1 bag = 60 kg
1 Ethiopian Birr = US$ 0.4830917

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Introduction

(i) Objective of the Study

Coffee is an agricultural product that is second to petroleum as a source of foreign exchange for many developing countries. Since it is the most important single export-commodity for many of these countries, it provides the necessary foreign exchange for their development effort. Furthermore, its contribution to government revenue, employment and GDP is of immense importance. It is also used as a consumer good in many producing countries.

In the Ethiopian context, coffee contributes about 9 percent to GNP (1975/76) in current prices and 19 percent to agriculture. Average annual export revenue from coffee constitutes 60-65 percent of total foreign exchange earnings. Coffee also contributes about 10 percent to direct government revenues through taxes. With regard to employment, according to the Ministry of Coffee and Tea Development (hereafter, MCTD), it is estimated that about 25 percent of the population are engaged in the production, processing and marketing of coffee (Coffee Processing Project Preparation Report, p. 4).

However, international prices of coffee fluctuate widely from week to week, month to month, and from year to year. It follows that fluctuating prices lead to unstable export earnings and hence instability in the income of the country, thereby in the domestic economic variables. It should, however, be kept in mind that the extent of the instability depends on how much the country relies on foreign trade. It has been calculated that the Ethiopian coffee export price and export revenue from coffee fluctuated by 26 percent and 24 percent a year respectively during the period 1963/4 - 1980/81. Similarly, quantity of coffee exports fluctuated by 15.5 percent a year during the same period.

There is a controversy whether or not export instability has adverse effects on the domestic economic variables of LDCs dependent on primary commodity exports. To substantiate the argument empirically, we deal with the Ethiopian coffee case. Therefore, in our study, the questions that we are going to ask would be: To what extent does instability of coffee export earnings affect the key economic variables of Ethiopia? and, which policies should be adopted in order to alleviate the problem by means of a simplified econometric model specifically built for Ethiopia? Hence, we choose to study the problem on the one hand, because no previous attempt has been made to study the multiplier effect of coffee export earnings on these economic variables, on the other hand that coffee is, as has been mentioned before, the most important foreign exchange earner of the country, whose world price is very unstable. Hence, it is hoped that this study will provide some empirical and quantitative evidence toward this end.

(ii) Methodology and Structure of the Paper

Our sample period refers to 1963/64 to 1980/81 (1956 to 1973 Ethiopian Fiscal Year (EFY)) and the major sources of data for the macro-variables were the Annual Reports of the Central Statistical Office of Socialist Ethiopia. The data for the coffee micro-sector were obtained from Coffee Statistics Handbook (1980/81), MCTD, Ethiopia. However, data for coffee-production and acreage were compiled from 'Data Book on Land-Use and Agriculture' (1982), Ministry of Agriculture, Ethiopia. All data expressed in Coffee Year and in Gregorian Calendar had to be transformed into the Ethiopian Fiscal Calendar equivalents.

In building a model, the quality, quantity and form of data is quite determinant. Although we were very much constrained by these limitations, an unreserved effort was made to check the consistency and reliability of the available data.

In constructing our model the Ordinary Least Squares (OLS) statistical method has been applied to estimate all the necessary coefficients, using the VAX 11/750 computer, and the model is solved simultaneously. Thus, using impact multipliers, a simulation analysis has been undertaken to see the effect of one of the most important exogenous variables, the New York international coffee price.

The work of this paper is organised in five main Chapters. In Chapter I, we briefly assess the economic development of the country during the period under study. In this Chapter, a general background of the country is given, followed by a short examination of the role of coffee in the economy. Furthermore, growth-rate analysis for key macro-economic variables is undertaken, and these coefficients have been calculated by using exponential trend equations; and since Ethiopia underwent a structural change in 1974, our analysis is broken into two sub-periods: Before and after 1973/74.

In Chapter II we present the causes, theoretical argument against export instability, some empirical studies of the issue, and the World coffee-market situation. Chapter III attempts to construct an aggregated econometric model which enables us to expose the problem in the rest of the Chapters. In this part of the analysis both equations of the coffee micro-sector and key economic variables are specified.

Chapter IV presents the 'performance' of the model and simulation analysis. A sensitivity-analysis is also undertaken to examine the impact of international coffee price fluctuations. To this end, we have assumed one-period and permanent changes in the variable. In Chapter V, that is, by way of conclusion, policy-recommendations are formulated.

Finally, we would like to inform the reader that this model-building exercise has mainly been done out of academic interest of the author, and as it is one of the first attempts to model such important aspects of the Ethiopian economy, the lack of appropriate information and statistical data, time constraints, thus it may not necessarily reflect the recent economic situation of Ethiopia, instead it should be considered as a first step towards model-building.

Chapter I

1. The Economy of Ethiopia

1.1 General

Ethiopia, with a total land-area of about 122.2 million hectares, and a 1980 population of 30.25 million, is located on the Horn of Africa between three and eighteen degrees North Latitude, and thirty-eight and forty-eight degrees Longitude, just North of the Equator. The central part of the country is mostly high plateau, 1500 to 3000 metres above sea-level. This plateau is intersected by gorges and broad valleys and surrounded by extensive lowlands, most of which are inhabited by nomadic pastoralists. However, the topography has been difficult for internal transportation and economic development.

Ethiopia stretches to Somalia in the East and Southeast, to Kenya in the South, to the Sudan in the West, and to the Red Sea in the North. The country is divided into 15 administrative regions (including the capital, Addis Ababa). These regions are subdivided into 102 Awrajas (provinces) which are further subdivided into 586 Woredas (districts). To reduce interregional as well as intraregional disparities, the administrative regions have recently been grouped into seven planning-zones so as to effectively implement future development plans.

Ethiopia underwent a structural change in 1974 which has brought major institutional changes in the economy. According to the World Bank document (1984, p. 1):

> "Such rapid changes enabled the country to achieve considerable social progress and a better egalitarian distribution of incomes."

Rural land had been nationalised, and was distributed among peasants; peasants have been organised in peasant-associations and cooperatives.

Public ownership also covers major means of production, banking and insurance, utilities etc.

The country's economy is dominated by agriculture. The majority of the population, over 85 percent, live in rural areas and obtain their livelihood from agriculture. The country has a vast potential of agricultural land with favourable climate, soils and vegetations, which are conducive to the production of a number of crops for domestic consumption and export. In the Ten Year Perspective Plan (1983/4-1992/93, p. 1), it has been estimated that 67 percent of the total area is agricultural land (of which 12.9 percent is under cultivation - 11.4 percent seasonal crops and 1.5 percent permanent crops - and 54.2 percent is permanent pasture, 3.9 percent forests, 0.8 percent swamps, 0.6 percent lakes and 27.8 percent others (for details, see table 1.1 below)).

Table 1.1 Land-use in Ethiopia

Type of land		Area mln. ha.	percent
1.	Agricultural land	81.9	67.0
1.1	Cultivated	15.7	12.9
1.1.1	Seasonal crops	13.9	11.4
1.1.2	Permanent crops	1.8	1.5
1.2	Pasture	66.2	54.2
2.	Forests	4.8	3.9
3.	Swamps	0.9	0.8
4.	Lakes	0.7	0.6
5.	Others	33.9	27.8
	TOTAL	122.2	100.0

Source: National Revolutionary Development Campaign; and Central Planning Supreme Council (NRDC & CPSC)

The industrial sector of the economy is relatively small, though it has been growing steadily over time. Ethiopia's other natural resources include gold, platinum, copper, potash and petroleum - some of which are not yet fully exploited.

1.2 Coffee production and its role in the economy

Coffee is a permanent crop with three major species known for consumption: Arabica, Robusta and Excelsa. The former is believed to have originated in Ethiopia and the tree requires four years, on average, to bear crops after the time of planting. Today it is widely grown in most important producing countries of the world and its demand is relatively high as compared with other coffee varieties, since the taste and flavour of Arabica coffee is the most superior one.

Coffee-growing in Ethiopia is scattered and fragmented. Although coffee is grown in many parts of the country, the majority of the production is concentrated in six administrative regions: Kaffa, Sidamo, Wollega, Illubabor, Southern Shoa and Gamo Gofa. Nevertheless, the total area under coffee is estimated to be 450,000 hectares, which is 2.87 percent and 30 percent of the total cultivated land and of the area covered by permanent crops respectively. The annual production is also estimated at 200,000 tons of clean coffee. The main producers of coffee in the Ethiopian context are smallholders with a share of 98 percent of the total production. Moreover, efforts have been made to expand coffee State farms since 1974. At present the share of these farms out of the total production is estimated at about two percent.

In Ethiopia, the Ministry of Coffee and Tea Development is the main institution responsible for improving coffee-production, harvesting and processing, as well as regulatory functions such as implementation of international coffee agreements, internal and external coffee-trading and , more recently, tea development (World Bank Appraisal Report, 1983, p. 5). The country's coffee-production is primarily constrained by the use of backward technology by smallholders. Furthermore, the spread of diseases and pests have affected both the quality and the quantity of coffee produced. For example, Coffee-Berry Disease (CBD), which was first detected in Kenya in 1922, spread to Ethiopia in 1971. Recent MCTD estimates indicate that about 20 percent of the total production has been lost due to CBD. Other factors affecting Ethiopian coffee-production include lower producer-prices of coffee (which are determined by the export-prices), drought, lack of investment, serious shortage of labour relative to land (in Kaffa and Illubabor

Administrative Regions in particular), etc. To alleviate the major internal problems, however, a genuine attempt is being made by the MCTD in providing improved extension services, harvesting and processing-methods, fungicide-spraying, distributing disease-resistant varieties, and providing marketing-facilities to the coffee-farmers. In such fields, strengthened research programmes have been undertaken which will enable to boost coffee-production in the future, thereby increasing growth in the volume of coffee-exports. It should, however, be kept in mind that Ethiopia is a price-taker in the world coffee market and thus has no short-run alternative except exporting its coffee on the ruling world price in order to meet its foreign-exchange need. Furthermore, the country's share in the world coffee-market is about 2.5 percent a year for the period 1968/69 - 1979/80 (Coffee Statistics Handbook, 1982, p. 33). Hence, foreign demand and income-elasticities would not be controversial.

The importance of coffee to the Ethiopian economy is manifold. Coffee alone earned and still earns more foreign exchange than all the other export-commodities put together. On average it contributes 60-65 percent of the total foreign exchange. For example, the share of coffee export-earnings, which was about 50 percent in 1963/64, although having fluctuated, grew to 64.1 percent in 1980/81 (for more details, see annex I). Similarly, the volume of coffee-exports, which was 63388 tons in 1963/64 grew to 82522 tons in 1972/73. During this period higher growth in the volume of coffee-exports was obtained as a result of the expansion of feeder-roads in the producing regions, which facilitated the transportation of coffee marketable surplus to the terminal markets, thereby to the rest of the world via international trade. During the period 1973/74 - 1977/78, however, coffee export volume was constrained by a number of factors. Among others, according to the MCTD (Coffee Handbook, 1982, front-cover), "Severe Coffee-Berry Disease (CBD), surtax, illegal export and drought affected coffee arrival at the terminal markets and thus caused coffee-export to decline". After 1977, although the revival in coffee-exports was steady, the share of coffee in total foreign-exchange earnings grew very sharply, due mainly to favourable international prices of coffee.

With regard to government revenue, coffee contributes nearly 10 percent of total revenue per annum. As noted in the World Bank document (1984, p. 37) "in the late 1970s its contribution reached about 20 percent". In this regard government revenue is generated by different taxes levied on both the value and volume of coffee-exports. To this end four different taxes have been identified, namely: an export-duty, cess tax, turnover-tax, and surtax. The former two are fixed rates levied on the volume of coffee-exports; turnover-tax is also fixed, but is levied on unit-value; and surtax is progressive in nature and linked with the world coffee-price. The progressive nature of the coffee surtax-rate enables the government to generate higher revenue when world prices of coffee rise. On the other hand, it protects producers from the adverse effect of a fall in world coffee-market prices.

Concerning employment, 25 percent of the population depend on the production, processing and marketing of coffee. Coffee is also used as a consumer-good, and it has been estimated that over 50 percent of the total production is absorbed by domestic consumption. This higher rate of consumption is mainly in the producing regions and is associated with economic and cultural factors. Furthermore, the share of coffee in total GDP is about 9 percent (1975/76).

Recognizing the importance of the coffee micro-sector, in the Ten Year Perspective Plan (1983/84-1992/93), five major objectives have been explicitly specified to boost coffee-production, both in quality and quantity. These objectives as stated by the World Bank document (1984, p. 47) are as follows:

a) To raise coffee-production from an estimated 200,000 tons to 300,000 tons, and to increase coffee-exports to about 100,000 tons in 1987.

b) To raise the value added in coffee-production and export by increasing the output of washing-stations from the present level of 14,000 tons to 36,000 tons.

c) To raise average yields from about 400 kg. per hectare to about 600 kg. per hectare.

d) To increase progressively the number of producer cooperatives in the coffee areas from the present number of 177 (of which 15 are registered); and

e) To develop coffee state farms at a rate of about 3000 hectares per annum.

1.3 Economic Development in Ethiopia

In this section we briefly attempt to assess the economic development of the country during the period under study. Throughout the discussion we have estimated the average annual growth-rates, compounded, and have broken-up our analysis into two sub-periods (1963/64 - 1972/73 and 1973/74 - 1980/81) since Ethiopia underwent a structural change in 1973/74. To this end we assume an exponential growth-trend of the following form:

$$Y_t = Y_0 e^{gT} \qquad (1)$$

By taking the logarithm, equation (1) yields

$$l_n Y_t = l_n Y_0 + gT \qquad (2)$$

where: Y_t = value in year t (final value)

Y_0 = initial value

g = compound growth-rate

T = time trend

Fitting equation (2), by ordinary least squares (OLS) into the available data for the period (1963/64 - 1980/81), we have presented the estimated growth-rate coefficients in the subsequent tables, where applicable. Owing to lack of consistent data on price-indices of the respective years, it has been impossible to deflate the variables, and hence all coefficients are expressed in nominal terms. Nevertheless, the available data (in Gregorian

Calendar) for the first sub-period was fed into the formula discussed earlier, and the result indicates that inflation-rate was growing at 4.0 percent per year on average. Moreover, the reader is reminded that we have been unable to undertake a similar regression-analysis for the latter sub-period in particular, and for the entire period in general, due to lack of complete time-series data.

1.3.1 Output sectors

As mentioned earlier, agriculture is the mainstay of the economy, contributing 50 percent of the Gross Domestic Product at current factor cost (hereafter, CFC), 90 percent of exports, and providing about 85 percent of the total employment. The share of GDP of other commodity sectors, distributive services and other services is small when compared with agriculture. Although government's emphasis is on other commodity sectors next to agriculture, particularly on the manufacturing sector, other services sector is the second largest contributor to the overall GDP, while the distributive services sector is the least (1980/81. For more details, see Annex II).

As can be seen from Table 1.2 below, agricultural GDP at CFC grew 3.36 percent a year during 1963/64 - 1972/73 while in the second sub-period the annual growth-rate increased to 7.54 percent. The latter higher growth-rate, despite the 1973 drought, was achieved by the government's planning effort and good weather conditions in the late 1970s. After the 1975 nationalisation, rural land was distributed among peasants, and tractor services were provided to peasant associations and cooperatives following the land-reform. In general, agricultural GDP (at CFC) grew 5.15 percent a year during the entire period under study.

Table 1.2 Sectoral GDP Growth-Rate at Current Factor Cost (in percent)

SECTORS	1963/64 - 1972/73	1973/74 - 1980/81	1963/64 - 1980/81	Average growth-rate minus GDP growth-rate (at CFC 1963/64 - 1980/81)
AGRICULTURAL SECTOR	3.36	7.54	5.15	-1.10
- Agriculture	3.38	7.54	5.08	-1.17
- Forestry, hunting & fishing	4.66	4.02	4.05	-2.20
OTHER COMMODITY SECTORS	6.56	8.00	6.25	0.00
- Mining & quarrying	-2.66	-5.24	-4.21	-10.47
- Manufacturing	5.64	10.97	10.02	3.77
- Handicraft & small industry	9.08	2.42	3.20	-7.41
- Building & construction	3.92	10.51	2.75	-3.50
- Electricity & water	15.25	9.57	7.26	1.01
DISTRIBUTIVE SERVICES	11.06	7.75	8.17	1.92
- Wholesale & retail trade	10.28	7.49	8.82	2.57
- Transport & communication	12.93	6.64	5.84	-0.41
OTHER SERVICES	8.76	6.83	7.51	1.26
- Banking & insurance	13.08	15.19	14.34	8.09
- Public administration & defence	8.50	9.19	9.32	3.07
- Ownership of dwellings	6.52	2.64	-0.007	-6.26
- Educational services	12.60	4.98	7.45	1.20
- Medical & health services	8.45	6.88	5.54	-0.71
- Domestic services & others	7.93	2.34	2.95	-3.30
TOTAL GDP	5.91	7.12	6.25	-

Note: Autocorrelation is removed, where applicable, for all equations. All variables are expressed in nominal terms unless otherwise noted.

Source: Own regression estimates based on the available historical data.

Output in other commodity sectors is centred in mining and quarrying, manufacturing, handicrafts and small industry, building and construction, and electricity and water. Within other commodity sectors, manufacturing is the most important sub-sector, which grew, on average, 10.02 percent per year between 1963/64 - 1980/81. On the other hand, the mining and quarrying sub-sector grew negatively throughout the entire period as the sub-sector is quite small and at the same time constrained by investment levels. In other words, by the very nature of the sub-sector it calls for advanced technology and highly-skilled manpower, which the country cannot afford in the short run. Similarly, GDP in building and construction grew while GDP in electricity and water, and handicrafts and small-scale industry (hereafter, HASIDA) declined during the latter sub-period. The higher performance in the former was due mainly to available building-materials, increased skilled manpower and conditions conducive to public sector construction capacity. On the contrary the decline in the GDP of electricity and water sub-sector was attributed to shortages of electrical goods imports and lack of project finance. Similarly, output in HASIDA fell because less priority was given to the sub-sector in directing resources, as a result of higher priority to the manufacturing sub-sector. That is, the shortage of capital, technical and other services constrained the growth of output in HASIDA. However, in the Ten Year Perspective Plan, it is hoped that higher priority will be given to strengthen this sub-sector so as to increase employment and the production of consumption goods.

Overall, during the first sub-period, GDP (at CFC) in other commodity sectors grew 6.56 percent per annum, and the percentage rose to an annual average growth-rate of 8.0 percent for the latter sub-period. However, the annual growth-rate for the entire period matched the growth-rate of total GDP, which is 6.25 percent per annum. Major contribution to this growth-performance came from manufacturing, which benefited from the 1975 public-ownership and increased capacity-utilization, which was initiated by annual development campaigns of the late 1970s.

With regard to distributive services, GDP (at CFC) in trade and transport and communication, after growing at an annual rate of 10.28 and

12.93 percent between the 1963/64 - 1972/3 period, respectively, declined to 7.49 and 6.64 percent a year between 1973/74 - 1980/81. The slower growth-rate in the latter sub-period was due to shortages of skilled manpower and lower imports of transport capital goods, which was accompanied by more emphasis given to the productive sectors. Hence, in aggregate terms, GDP in distributive services declined from 11.06 percent a year to 7.75 percent a year during the same period as mentioned above. In general, however, the average annual growth-rate was 8.17 percent for the 1963/4 - 1980/81 period.

Other services sector of the economy include banking and insurance, public administration and defence, ownership of dwellings, educational services, medical and health services, and domestic services and others. During the first sub-period, GDP in other services grew 8.76 percent a year, and this percentage declined to 6.83 percent a year in the following sub-period. The slower growth-rate in the latter came from all the sub-sectors within other services except banking and insurance and public administration and defence, which showed an increase in their annual growth-rates over time as a result of increased productivity.

Table 1.2 also shows that between the period 1963/64 - 1980/81, the fastest-growing sub-sector of the Ethiopian economy was banking and insurance, followed by manufacturing, public administration and defence and trade. The slowest-growing sub-sector is mining and quarrying. Furthermore, although internal and external conflicts during the period 1974/75 through 1977/78 affected the economic growth of the country, overall GDP (at CFC) grew faster in the latter sub-period than in the former, and annual average growth-rate of GDP (at CFC) has been calculated to be 6.25 percent for the entire period.

1.3.2 Government Sector

Ethiopia's main sources of government revenue are indirect taxes (which we define as taxes on domestic sales, exports and imports), direct taxes on income and property, and non-tax revenue. Table 1.3 below shows that total revenue which was growing at the rate of 6.31 percent per annum during

1963/64 - 1972/73 rose to an annual average growth-rate of 15.82 percent in 1973/74 - 1980/81. The highest growth in the latter sub-period came from increases in indirect tax revenue and non tax revenue.

Table 1.3 Annual growth-rate of government revenues and expenditures (in percent)

VARIABLES	1963/64 - 1972/73	1973/74 - 1980/81	1963/64 - 1980/81
TOTAL REVENUE	6.31	15.82	14.90
- Direct tax revenue	11.08	14.30	11.24
- Indirect tax revenue	5.69	14.87	10.32
- Non-tax revenue	4.76	16.04	11.21
TOTAL EXPENDITURES	6.35	17.28	15.78
- Current government expenditure	4.82	15.09	12.13
- Public expenditure	12.02	22.98	18.20

Note: All variables are expressed in nominal terms.
Source: Own regression estimates.

Direct tax revenue grew faster than GDP (at CFC) throughout the entire period and the highest growth-rate during 1973/74 - 1980/81 was due to the progressive tax-rates on income, which have favoured low-income-earners. Indirect tax revenue rose substantially from 5.69 percent a year for the 1963/64 - 1972/73 period to 14.87 percent per annum during the latter sub-period. The growth in indirect tax revenue mainly came from higher import-duties and progressive export-tax rates. In an attempt to restrict luxurious consumption goods, a policy of higher tariffs has been applied in order to favour the import of investment goods. Similarly, different surtax-rates have been levied on various export-commodities, which is economistically believed to help redistribute income to the producers of non-exportables, particularly food, via increased government expenditure. With regard to non-tax revenue, after growing by 4.76 percent per annum in the former sub-period rose to 16.04 percent a year in the latter sub-period as a result of the increases in collection of surpluses from public enterprises and financial agencies. Overall, the annual growth-rate of total government revenue for the whole period was 14.9 percent.

On the other hand, government total expenditures grew 6.35 and 17.28 percent a year during the two sub-periods respectively. The largest increase in government expenditures for 1973/74 - 1980/81 was mainly on both social and economic infrastructures (public expenditures) followed by current expenditures (wages and salaries, services, etc.). In general, total government expenditures grew 15.78 percent per annum during the period 1963/64 - 1980/81.

From the above analysis, it is clear that total expenditures grew faster than total revenues over time and the overall budget deficit was financed by domestic credit as well as foreign finance in the form of loan and aid.

1.3.3 Demand Sector

Variables on the expenditure side of the economy include aggregate consumption, investments, export of goods and services, and import of goods and services. Table 1.4 below demonstrates the annual growth-rates, compounded, of these variables during the period under consideration.

Table 1.4 Average Annual Growth-rates of Macro-variables on the Expenditure-side of the Economy (in percent)

VARIABLES	1963/64 - 1972/73	1973/74 - 1980/81	1963/64 - 1980/81
CONSUMPTION	5.87	7.90	7.10
- Private consumption	5.73	8.10	6.70
- Government consumption	6.64	10.00	8.19
INVESTMENTS	1.25	11.77	3.50
EXPORTS OF GOODS & SERVICES	6.30	9.00	7.96
- Coffee exports	1.30	25.00	9.74
- Non-coffee export of goods & services	9.10	2.60	6.53
IMPORT OF GOODS & SERVICES	5.00	13.39	9.99

Note: All variables are expressed in nominal terms.
Source: Own regression estimates.

Aggregate consumption grew 7.10 percent a year between the 1963/64 - 1980/81 period and this high growth-rate was attributed rather to the faster growth in government consumption than to private consumption, particularly in the latter sub-period. The marginal propensity to consume out of GDP, which is slightly above unity, indicates higher basic consumer needs, which are typical in a low-income economy like Ethiopia. It follows that investments are always greater than domestic savings, and thus the gap is financed by external financial sources. Similarly, investments, after growing 1.25 percent a year in the former sub-period, substantially rose to 11.77 percent a year in the latter sub-period. The largest increase in total investments was as a result of the government's intention to invest in public infrastructure, which is expected to increase output indirectly in the long run.

With regard to exports, Ethiopia's main exports are coffee, hides and skin, pulses and oilseeds, and the like. The share of manufactures in total exports is insignificant, though growing steadily over time. As shown in Table 1.4 above, on average, export of goods and services grew 7.96 percent a year in nominal terms between 1963/64 and 1980/81. The largest increase in the value of total exports, particularly after 1973/74, came from coffee, followed by hides and skin, which was achieved as a result of both increased volumes and favourable international prices. On the other hand non-coffee exports of goods and services declined from 9.10 percent a year in 1963/64 - 1972/73 to 2.60 percent a year in 1973/74 - 1980/81, mainly because of the declining trend in the export prices of pulses and oilseeds. That is, as a result of lower international prices of these commodities, peasant producers have tended to shift to other profitable crops and hence export volumes declined, thereby reducing the export revenue from these commodities. However, despite agronomic limitations, attempts have still been made by state farms to expand the production of these crops. Furthermore, service exports stagnated, if not deteriorated, over time.

Similarly, Ethiopia's major imports include petroleum, capital goods, intermediate goods and consumer goods. As seen from Table 1.4 above, import of goods and services, after growing 5 percent a year between 1963/64 and 1972/73 increased to 13.39 percent a year during the 1973/74 - 1980/81 sub-period. The higher growth in the value of imports during the latter sub-period was the combined result of world inflation and increased government purchases of capital and intermediate goods in order to boost production in both the agricultural and industrial sectors, which was initiated by the development-campaign of the late 1970s.

Table 1.4 above also shows that import of goods and services grew faster than export of goods and services over time, particularly in the latter sub-period. The ratio of exports of goods and services to GDP (at CFC) increased from 11.6 percent in 1963/64 to 14.1 percent in 1972/73, and to 14.3 percent in 1980/81. On the other hand the ratio of imports of goods and services to GDP (at CFC) fell from 13.7 percent in 1963/64 to 11.9 percent in 1972/73, and increased to 20.4 percent in 1980/81. Thus, Ethiopia's balance of payments has been in a deficit for many years, except in 1972/73, which was mainly influenced by a widening gap in trade balance, as a result of slow growth of exports and accelerated increase in imports, combined with a decline in net transfer payments in the current account of the balance of payments. This implies that the limitation in capital inflows to finance the deficit has either led the country to the depletion of scarce foreign assets or constrained the capacity to import. To reverse this trend more effort has still to be made in the export sector to diversify the economy.

CHAPTER II

2.0 Export instability and economic development

In this section of our discussion we place the emphasis on identifying the causes of export instability, the theoretical argument against export instability, some empirical findings, and the world coffee market situation.

2.1 The causes of export instability

International trade has been playing an important role in national economies and hence the interdependence of these economies has gradually increased. It is obvious that imports of a country must be exports of another country and vice versa. In open economies, in LDCs in particular, international trade has become an instrument to promote development, since these countries are not endowed with all the necessary resources, such as technology, capital, etc. which are essential for economic development. That is, according to the Ricardian economic theory, countries entering world trade tend to specialise in producing and exporting commodities for which they have a comparative advantage in the world market. In other words, countries' trade is based either on a relative advantage in technology, or on relative factor abundance as were mentioned above (Begg D. et al, 1984, pp. 707-718).

However, given this scarcity of endowments, we argue that the benefit of comparative advantage has been lost in the developing economies for the following reasons. Firstly, these LDCs are price-takers in the world market where the prices of their commodities are largely determined by the industrialised countries. Secondly, the growing protectionism policy for primary commodities imports and food self-sufficiency in the developed economies have checked the competitiveness of LDCs. As has been noted by Begg, D. et al (1984, p.708), today's world trade centres on the industrialised countries and about 40 percent of world trade is in primary commodities, the remaining 60 percent in manufactures. According to them, in 1979, the industrialised countries share of world trade was 65.1 percent, oil producers 13 percent, non-oil LDCs 12.6 percent and socialist countries 9.3 percent. Similarly, the share of world income for industrialised countries was 63 percent, oil producers 2 percent, non-oil LDCs 16 percent and socialist countries 19 percent.

Many developing countries are heavily dependent on exports of primary commodities for their foreign exchange earnings. Yet, many of these countries' exports are concentrated on one or a few leading commodity exports. While studying the exports of 84 developing countries in the mid-1970s, Adams, F.G. and J.R. Behrman have shown that:

> "The single most important commodity export accounted for at least 30 percent of total export value in 75 percent of these countries, at least 50 percent of total export value in 43 percent of these countries, and at least 70 percent of total export value in 27 percent of these countries. The leading commodity exports accounted for at least 30 percent of total export value in 95 percent of these countries, at least 50 percent of total export value in 83 percent of these countries, and at least 70 percent of total export value in 56 percent of these countries (see annex III)." (Adams, F.G. and J.R. Behrman 1982, p.3)

Clearly, the role of primary commodity exports as the main source of foreign exchange for LDCs is of vital importance. For Ethiopia, about 90 percent of its exports are agricultural primary products, and as has been discussed in the preceding chapter, coffee is the single most important crop contributing 60-65 percent, on average, of the total foreign exchange earnings of the country.

However, it has been frequently claimed by many LDCs that export earnings from primary commodities suffered from wide fluctuations in the world market. Since export earning is a product of export price and export supply, instability in export revenue may be taken as a function of fluctuations in these variables. However, it can be argued that world export price fluctuations as a result of demand shocks, for primary products are more pronounced than fluctuations in the volume of exports. Many primary commodity exporting LDCs have attempted to offset demand shocks by supply shocks so as to maintain their export earnings from primary products. Of course it is an undeniable fact that volume of exports may fluctuate as a result of crop failure, bad weather conditions, disease, scarcity of resources, and other exogenous and endogenous factors. Nevertheless, fluctuation in volumes is less important than fluctuation in export prices (because the latter is dependent on world prices) with which we will be very much concerned in the core analysis of this paper, Chapter IV. Moreover, primary commodity export prices tend to fluctuate more than export prices of manufactures. With regard to this issue, many economic studies have been conducted. Among others, Adams F.g. and J.R. Behrman (1982) have estimated trends and fluctuation indices for different commodity prices, which are shown in Table 2.1 below:

Table 2.1 Trends and Fluctuation Indices for Commodity Prices

Sample period:	1950-1979		1950-1969		1969-1979	
	Exponential Trend	Fluctuations Index (I_{3b})	Exponential Trend	Fluctuations Index (I_{3b})	Exponential Trend	Fluctuations Index (I_{3b})
Manufactured goods (unit value)	0.0357	0.1800	0.0115	0.0343	0.1028	0.0538
Primary commodities	0.0436	0.3469	-0.0045	0.0479	0.1623	0.1764
Nonferrous base metal	0.0386	0.1748	0.0215	0.1426	0.0666	0.1342
Food	0.0377	0.2552	0.0006	0.0508	0.1173	0.1381
Agricultural nonfood	0.0246	0.2834	-0.0142	0.0854	0.1169	0.1356
Minerals	0.0614	0.4679	0.0003	0.0451	0.2280	0.2836
Copper	0.0378	0.2110	0.0345	0.2144	0.0202	0.2141
Tin	0.0575	0.2933	0.0271	0.1663	0.1586	0.1535
Iron ore	0.0299	0.2144	0.0109	0.1376	0.1026	0.1599
Crude petroleum	0.0676	0.5431	-0.0006	0.0365	0.2606	0.3386
Cocoa	0.0505	0.5153	-0.0124	0.2564	0.2055	0.2639
Coffee	0.0309	0.4308	-0.0238	0.1634	0.1712	0.2476
Sugar	0.0336	0.4241	-0.0132	0.1747	0.0738	0.5384
Wheat	0.0230	0.2576	-0.0072	0.0642	0.0905	0.2809
Maize	0.0224	0.3072	-0.0179	0.1076	0.1214	0.1684
Terms of trade	0.0078	0.1771	-0.0160	0.0407	0.0595	0.1379

Source: Adams F.G. and J.R. Behrman, Commodity Exports and Economic Development, Lexington Book, USA, 1982, p. 10.

As can be seen from the above table, they have concluded that:

> "export prices of primary commodities fluctuated by 34.7 percent, while unit value of manufactured goods fluctuated by 18 percent for the 1950-1979 period. For the 1969-1979 period, the index for the former is

> over three times the magnitude of the latter. Over the entire three decades and the 1970s, the index for coffee is relatively high although it is below the copper value for the 1950-1969 sub-period." (1982, p. 18)

More explicitly, the rate of fluctuation in the export price of coffee has been calculated to be 43.1 percent for the entire period, 1950-1979, and 16.3 percent and 24.8 percent for the two sub-periods (1950-1969 and 1969-1979) respectively. From this analysis, in general, it is clear that fluctuations in primary commodity prices have been relatively large when compared with fluctuations in the unit value of manufactures, and many writers argue that export earnings become more unstable as the share of primary commodities increases in total export of a country.

In this study our interest is coffee and it is now time to turn our discussion to the Ethiopian case. Hence, we estimate the trend lines of coffee export prices, export earnings and quantity of coffee exports based on exponential regressions. To this end, for the sake of simplicity, the rate of fluctuation is measured by the standard error of these regressions. Table 2.2 and Figures 2.1 and 2.2 below show fluctuation indices and the movement of these variables in the period 1963/4 to 1980/81.

Table 2.2 Trends and Fluctuation Indices for Ethiopian Coffee Prices, Revenue and Export Volume

	1963/64 - 1980/81		1963/64 - 1975/76		1976/77 - 1980/81	
	Expon. trend	Fluct. index	Expon. trend	Fluct. index	Expon. trend	Fluct. index
New York spot price	0.0100	0.2700	0.0269	0.1000	0.0260	0.3300
Export price (FOB)	0.1030	0.2600	0.0270	0.0960	0.0390	0.3290
Coffee export earnings	0.0974	0.2400	0.0155	0.1410	0.1080	0.1600
Quantity of coffee exports	-0.0103	0.1550	-1.7600	9.2000	4.6800	13.0670

Source: Own regression estimates

As seen above, for Ethiopia, the fluctuation in international coffee prices was lower in the 1963/64 - 1975/76 period. However, following the Brazilian

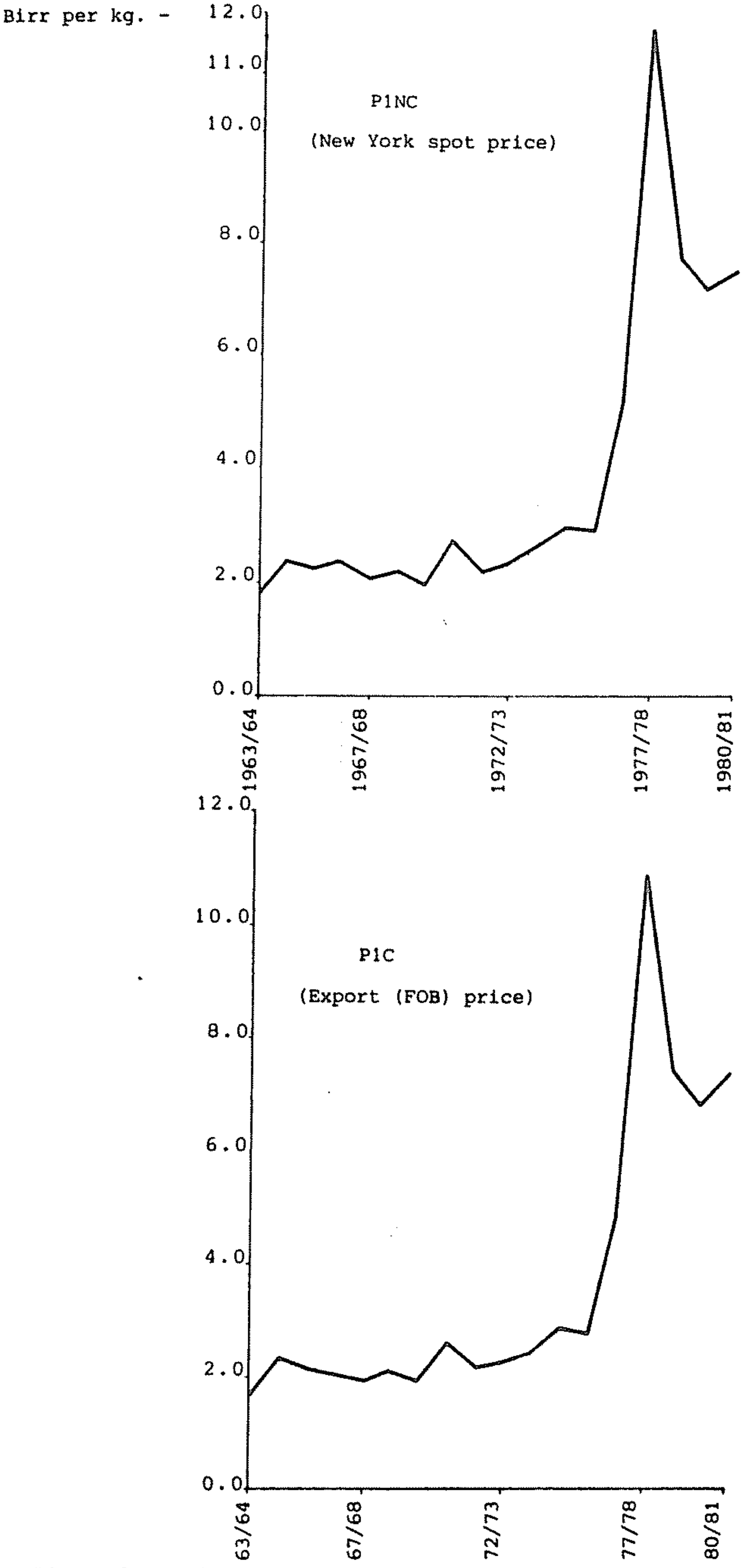

Figure 2.1: New York Spot Price and Export (FOB) Price of Coffee

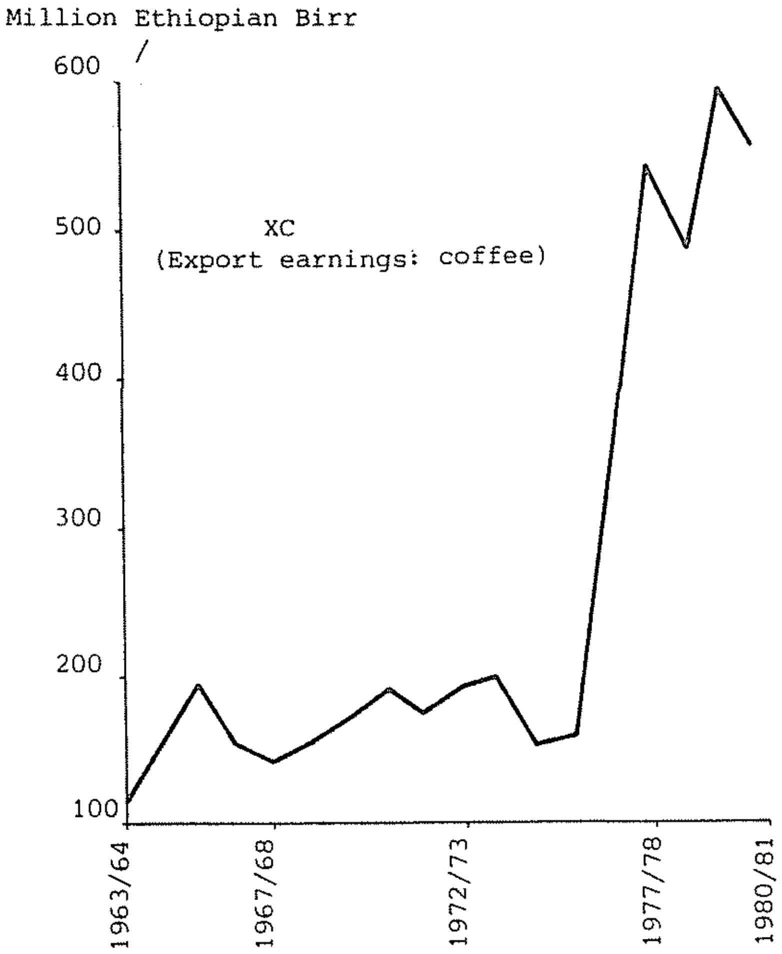

Figure 2.2: Coffee: Export earnings

coffee frost of 1975/76, these prices have tended to fluctuate largely and the effect was transmitted to the domestic economic variables via 'FOB' export price. Similarly, the volume of coffee exports fluctuated 15.5 percent a year for the whole period - mainly as a result of exogenous and domestic factors, such as disease, drought, illegal trade etc. The cumulative effect then would be fluctuation in coffee export earnings, which has been calculated to be 24 percent a year for the entire period. Therefore, it would be logical to argue that fluctuation in coffee export earnings is aggravated by larger fluctuations in export prices than in volumes.

2.2 The theoretical argument against export instability

Before appropriate policy measures have to be implemented it would be important that policy-makers must understand what really is the impact of export earnings instability on economic development. Therefore, before we proceed to our empirical analysis in the following chapters, we attempt to assess the theoretical argument of the issue in this section.

As to whether or not export earnings instability affects the economic development of a country has been widely discussed in the literature. It has been argued that a high degree of instability in export revenue would imply large fluctuations in export income of the country in question. Such fluctuations can have a negative effect on the economy of a primary commodity exporting countries. This argument, according to Ghatak, S. and K. Ingersent (1984, pp. 289-290), has been justified in that if there is a large fall in export income, then there could be a shortage of foreign exchange, which limits the capacity to import. It follows that a decline in the imports of capital goods will have an adverse effect on the rate of growth of investment, which in turn will reduce the overall economic growth. That is, as we know, many LDCs are technologically backward and lack the capacity to produce capital goods which are crucial for their economic development. It is this dependence that has made LDCs rely on the importation of these goods from the industrialised countries. At times of shortfalls in their foreign exchange earnings as a result of primary commodity export price fluctuations, their capacity to import will be limited, which in turn means lower investment and thereby affects various sectors of the economy through the multiplier.

It can also be argued that export price fluctuations increase risk and uncertainty and hence the decision to invest will be affected. In other words export commodity producers tend to reallocate their resources either to alternative uses or hold it in other forms of unproductive assets that may not increase output in the economy. Even if they invest output may be less than actual because of shortages of imported inputs. In a rural economy where agricultural export commodities are produced by a large peasant population, producers may tend to shift to the production of alternative profitable crops that may be used for domestic consumption rather than for exports. Moreover, when export price fluctuations are large, domestic consumption may be encouraged as a result of relatively better domestic prices. In such a situation where attempts are made to control domestic demand, the resulting effect would be both internal and external illegal trades. This has a significant effect on lowering the export of a country, thereby reducing its foreign exchange from primary products. In this regard, one may argue that domestic policies may play an indispensable role in stabilising producer prices. However, many LDCs have not attempted to adopt such policies effectively. Export price stabilisation efforts of the Ivory Coast economy in West Africa can be mentioned as the only exception.

Another most important effect of export earnings instability may be on direct government revenue. In an economy where the largest part of government revenue is determined by foreign trade, government savings would tend to fluctuate and therefore government investments - assuming that the budget is initially in equilibrium. Government revenue is expected to be higher as a result of increased exports as well as imports. Fluctuations in these variables can have an indirect effect on government revenues which are generated in the form of export taxes and import duties. At times of downswings the government's propensity to invest will be limited which in turn affects government activities as well as the output in public enterprises financed by tax revenues from the export of primary commodities. Furthermore, the fluctuation in government revenue has had a significant effect on low income earners of society which are supposed to benefit from government expenditures on goods and services. That is, both economic and social infrastructural developments which have been expected to increase output in the long run may be weakened as a result of shortfalls in government revenue.

With regard to the foreign trade, the direct effect of export earnings instability is on the trade balance and thereby on the current account of the balance of payments of an exporting country. When export prices are relatively higher than import prices, then the terms of trade turn in favour of the producing country. However, on average, as has been argued earlier, export prices of primary products fluctuate more than manufactures and therefore the terms of trade turn against the producer country and consequently a deficit on its trade balance. At times of significant shortfalls in commodity export earnings, if not compensated by net service exports and net transfer payments, then the widening gap in the trade balance in turn creates balance of payments difficulties. In such a situation a country may be required either to deplete its foreign exchange reserves or depend on external financing which may be possible at high cost.

2.3 Some empirical findings of export instability

There have been many economic studies which focussed on the impact of export instability since the 1960s. Of course these studies are different, based on two alternative hypotheses, different structures and assumptions. Moreover, some of them are either based on cross-country, cross-sectional, or a single-country approach. Nevertheless, their overall conclusion is that either export instability has a positive or a negative effect on the domestic economic variables of the country/countries in question. Some of these empirical works of the various economists have been shown by Obidegwu, C.F. and M. Nziamasanga (1981, pp. 26-28). For example, Coppock (1962) and

McBean (1966) have undertaken a cross-country analysis and found no significant relationship between export instability and growth-rate of GDP. However, this approach has been criticised due to its shortcomings in that it does not assume heterogeneity of economic structures, dynamics, and policies of LDCs, and because of the measurement problems associated with the approach. Similarly, cross-sectional studies have proven that there is a stable and significant positive relationship between the demand for reserves and export instability. This has been justified by the empirical work of Kelly (1970) and Iyoha (1976) who have found the coefficient of export instability to be positive and very significant. A similar study by Eaton and Gersoviz (1980) has proven that export instability increases the demand for international reserves by LDCs. With regard to the single country case, Rangaran and Sundarajan (1976) while studying the commodity problem of 11 LDCs, have shown that the impact of instability was not the same in all countries, and in five countries, the growth-rate declined with an increase in the instability of exports. Acquash (1972) has analysed the impact of cocoa price fluctuations on the Ghanaian economy and concluded that Ghana's cocoa price stabilisation would result in a potential growth-rate that is superior to that under unstable export prices. Lasaga (1979) while developing a model for the Chilean copper economy has found that stabilising the copper price reduced the level and variability of the aggregate price level.

A detailed econometric study by Obidegwu C.F. and M. Nziramasanga (1981, p. 183) in the Zambian copper economy has also shown that copper price fluctuations did not have any substantial impact on aggregate output and employment in the economy for the reasons that the impact of fluctuation was absorbed by the foreign shareholders and the government. That is, the ownership structure of the industry protected the economy from price fluctuations. However, they have not denied that copper price fluctuations did have an adverse effect on other major variables and result in higher domestic inflation. Privolos, Th. has also built an econometric model for the Ivory Coast coffee economy and concluded that "fluctuations in international coffee prices are found to have, on the average and without any active policy response from the government, a negative impact on prices and on the foreign sector position of the economy (1981, p. 195).

2.4 The world coffee market situation

Coffee has increasingly become an important traded commodity in the world market. As shown by the International Coffee Organisation (ICO) Quarterly Statistical Bulletin (1982, No. 23), the exchange has been undertaken by 47 exporting and 27 importing countries. Among the exporting countries, Brazil is the dominant supplier of green coffee to the world market and thereby influences the world coffee price. However, at times of frosts and drought, Brazil tends to lose its dominating position due to shortfalls in its supply, and hence cause prices to rise.

The distribution of world exportable production of green coffee by countries is shown in Table 2.3 below and the highlights are discussed, although the table is self-explanatory. Clearly, the world exportable coffee production is estimated at 60 million bags per annum in the period 1974/5 to 1982/3. The analysis also indicates that 19.52%, 42.96%, 28.22%, 9.30% of the total came from the producing countries located in North America, South America, Africa, and Asia/Oceania respectively. On the other hand, the share of Brazil and Colombia is recorded to be 39 percent per annum. With regard to the African countries, the Ivory Coast is the largest producer, followed by Uganda. Ethiopia's share is only 2.3 percent and this makes the country a price-taker in the world coffee market.

With regard to exports and imports of green coffee, recent data was unavailable. The available data for the period 1965 to 1975 in Table 2.4 below shows that over 90 percent of the imports have been absorbed by the United States and Europe. Table 2.4 also demonstrates that coffee consumption declined in the United States over time and the rate of decline is calculated to be 0.46 percent per annum. The fall in consumption may be due to a shift to other substitutes induced by coffee price increases. On the other hand, coffee consumption by the Europeans increased by 3.47 percent per annum due mainly to increased stocks and domestic coffee-processing industries. However, in general, the global exports of green coffee grew by 2.17 percent a year, while the annual growth-rate of total imports stood at 1.9 percent in the period 1965 to 1975.

At this stage it should be remembered that our hypothesis is that export instability has a negative effect on the economic variables of the country in question. Therefore, we proceed with our discussion to expose the problem through the model which will be constructed in the following chapter.

Table 2.3 Distribution of World Exportable Production of Green Coffee (thousands of 60-kilo bags)

	COUNTRY:	Average 1974/75-1978/79	1979/80	1980/81	1981/82	1982/83	Average 1974/75-1982/83
1.	North America	11037(20.20)	12293(19.70)	12584(19.10)	11875(15.40)	13467(21.80)	11714(19.52)
1.1	Mexico	2323(4.25)	2310(3.70)	2362(3.58)	2450(3.17)	2400(3.89)	2349(3.91)
1.2	El Salvador	2747(5.03)	3122(5.00)	2740(4.15)	2686(3.48)	2471(4.00)	2751(4.58)
1.3	Guatemala	2105(3.86)	2336(3.75)	2381(3.62)	2328(3.01)	2258(3.65)	2203(3.67)
1.4	Costa Rica	1265(2.30)	1311(2.10)	1932(2.93)	1539(1.99)	2227(3.60)	1482(2.48)
1.5	Honduras	833(1.53)	1023(1.64)	1149(1.75)	1110(1.45)	1636(2.65)	1009(1.68)
1.6	Nicaragua	789(1.45)	936(1.50)	849(1.29)	855(1.12)	1088(1.76)	853(1.42)
1.7	Dominican Republic	605(1.10)	724(1.16)	822(1.25)	555(0.72)	800(1.30)	659(1.10)
1.8	Others	370(0.68)	531(0.85)	349(0.53)	352(0.46)	587(0.95)	408(0.68)
2.	South America	22627(41.50)	27553(44.30)	27642(41.90)	39729(51.40)	23990(38.90)	25784(42.96)
2.1	Brazil	11760(21.55)	14000(22.50)	13500(20.46)	24500(31.70)	9750(15.81)	13395(22.31)
2.2	Colombia	8594(15.76)	10962(17.63)	11675(17.70)	12492(16.16)	11445(18.55)	9949(16.58)
2.3	Ecuador	1155(2.13)	1398(2.25)	1297(1.97)	1562(2.02)	1595(2.59)	1292(2.15)
2.4	Peru	727(1.33)	1015(1.63)	929(1.40)	842(1.09)	840(1.37)	807(1.35)
2.5	Others	391(0.73)	178(0.29)	241(0.37)	333(0.43)	360(0.58)	341(0.57)
3.	Africa	16394(30.00)	15740(25.30)	19004(28.80)	17934(23.20)	17772(28.80)	16936(28.22)
3.1	Ivory Coast	4258(7.80)	3908(6.28)	6026(9.13)	4019(5.20)	4192(6.79)	4382(7.30)
3.2	Uganda	2403(4.40)	2001(3.22)	2090(3.17)	2840(3.68)	3154(5.11)	2456(4.09)
3.3	Cameroon	1496(2.75)	1626(2.62)	1926(2.92)	1918(2.48)	1782(2.87)	1637(2.73)
3.4	Ethiopia	1179(2.16)	1555(2.50)	1664(2.52)	1596(2.07)	1720(2.79)	1381(2.30)
3.5	Kenya	1300(2.38)	1468(2.36)	1648(2.50)	1434(1.85)	1515(2.50)	1396(2.33)
3.6	Zaire	1077(1.95)	1141(1.83)	1346(2.04)	1240(1.60)	1205(1.95)	1146(1.91)
3.7	Malagasy Republic	962(1.75)	1158(1.86)	984(1.49)	1132(1.46)	823(1.33)	990(1.65)
3.8	Tanzania	855(1.55)	786(1.26)	945(1.43)	1094(1.42)	984(1.60)	898(1.50)
3.9	Angola	1312(2.40)	220(0.35)	545(0.83)	350(0.42)	387(0.62)	896(1.49)
3.10	Others	1552(2.85)	1877(3.02)	1830(2.77)	2311(2.99)	2010(3.26)	1754(2.92)
4.	Asia and Oceania	4521(8.30)	6672(10.70)	6741(10.20)	7718(10.00)	6490(10.50)	5581(9.30)
4.1	India	974(1.80)	1599(2.55)	1090(1.64)	1631(2.11)	1275(2.07)	1163(1.94)
4.2	Indonesia	2580(4.73)	3723(6.00)	4137(6.27)	4630(6.00)	3636(5.88)	3225(5.37)
4.3	Papua New Guinea	672(1.23)	824(1.32)	837(1.27)	664(0.86)	873(1.41)	729(1.21)
4.4	Philippines	202(0.37)	406(0.64)	512(0.77)	572(0.74)	450(0.73)	328(0.55)
4.5	Others	93(0.17)	120(0.19)	165(0.25)	221(0.29)	256(0.41)	136(0.23)
	WORLD TOTAL	54579 (100)	62258 (100)	65971 (100)	77256 (100)	61719 (100)	60015 (100)

Note: Figures in brackets are percentages of world total
Source: George Gordon Paten & Co. Inc.

Table 2.4 World: Exports and Imports of Green Coffee by Countries or Regions (thousands of 60-kilo bags)

EXPORTS:

Exports from:	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1965-1975* (%)
Western Hem.	28135	32009	32875	35596	35890	33404	34791	37109	39645	32380	36431	2.37
Africa	14295	15747	15196	16730	16114	17036	16215	17834	19191	18891	17054	1.62
Asia & Oceania	2539	2572	2271	2279	2462	2814	2274	2823	2959	3428	3454	2.84
WORLD TOTAL	44969	50328	50342	54605	54466	53254	53280	57766	61795	54699	56939	2.17

IMPORTS:

Imports from:	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1965-1975* (%)
United States	21347	22063	21312	25378	20233	19732	21655	20769	21789	19243	20289	-0.46
Canada	1258	1164	1344	1394	1363	1256	1412	1317	1293	1302	1386	0.89
Other W. Hem.	665	833	722	735	889	631	783	893	831	890	860	2.37
Europe	21604	22736	23613	25162	27165	27337	27970	29211	30215	29876	31440	3.47
Africa	853	1012	928	1184	1100	1258	1210	1216	1181	912	1074	2.12
Asia & Oceania	1486	1953	1824	1936	2534	2802	2405	2682	3794	2712	3033	6.70
WORLD TOTAL	47213	49761	49732	55749	53284	53016	54935	55195	59103	54935	58082	1.90

Note: Growth-rate figures are own calculations

*Annual growth-rate, compounded (%)

Source: Annual Coffee Statistics, Pan-American Coffee Bureau, No. 39, 1975

CHAPTER III

3.0 The Modelling of the External Sector: The Instability of Exports and Imports

A model builder is always constrained by a number of factors, the quality and form of data being the most crucial ones. Generally speaking LDCs lack complete statistical information on an economic phenomenon due to the shortage of qualified personnel, unstrengthened planning institutions, scarcity of resources to undertake research in the different fields and the like. Yet the degree differs from country to country and an economist interested in model building can attempt, at least, to establish some linkages of an economy in a mathematical form using the available data. It should, however, be noted that there cannot be any model which is perfect. That is to say, different models serve for different purposes depending on the objective reality of a given situation. As has been noted by many writers:

> "In the process of formulating models, one must not forget that models are always a way of thinking about socio-political and economic relationships that facilitate the understanding of micro or macro-economic problems. In this sense a model is no more than an information device." (Alarcon [mimeo--ISS], May 1980, pp. 3 - 4)

In principle, however, a simple, analytical and aggregated model which we are going to construct should not be expected to reflect every aspect of the economic situaton of the country.

3.1 General Characteristics of the Model and Equations Specification

We attempt to build a highly aggregated economic model for the Ethiopian economy, a model which considers specifically variables in the coffee micro-sector, as well as other selected macro-economic variables. The main purpose of our model has been to analyse the impact of coffee export earnings instability on other economic variables of the economy. Due to shortages of data on price indices, discussed in Chapter One, most of the variables in the model are expressed in current prices, while others are given in physical terms. It should also be clear that we have started from scratch and this piece of work may be a good start and can be advanced in the future. In our modelling effort we emphasize, among other things,on major macro-economic variables, namely: GDP of the various sectors, consumption, investment, government budget and the balance of payments variables. Other considerations of the model have been implicitly discussed through the previous chapters, nevertheless we now try to clear out the major ones.

(a) Since Ethiopia is a low per capita income economy with a shortage of re-investible surplus and low technological development, it would be legitimate to build a model with investment contstraint.

(b) We disaggregate the economy in four major output sectors. We also disaggregate consumption, investment, exports and imports of goods and services.

(c) We assume that government investment is equal to public expenditure and it is mainly used for economic and social infrastructural development. It follows that the components of aggregate investment consist of collective investment and government investment. The former is made exogenous and assumed to be spent on publicly owned enterprises.

(d) Since public ownership is dominant in the economy, we assume that the state is an active economic actor.

(e) For the last many years, imports have exceeded exports, thus we assume that domestic savings are less than investments and hence the deficit in the balance of payments is financed by capital inflow--which closes the model. We have also assumed that donor nations may be willing to finance the gap both in the form of aid and loans.

(f) We allow government credit to be affected by the surplus/deficit in the current account balance of the balance of payments.

(g) Domestic prices are controlled by the government so as to avoid imbalances and distortions.

(h) Unskilled labour is abundant and therefore complementarity of labour and capital follows.

(i) Due to lack of a disaggregated data on investments of the various productive sectors, aggregate investment is used as a proxy to explain incremental output in some of the sectors.

Our model consists of 50 equations and identities in which 23 exogenous variables are involved, of which four are dummy variables. Identities have been used in the model in order to keep the consistency of macro-economic variables, to transform actual prices of coffee to indices, and to disaggregate some of the variables to their respective components. Dummy variables are used to indicate either policy changes or disturbances in the coffee sub-sector caused by exogenous factors such as drought, drastic changes in the arrival of coffee, which is mainly associated with the biannual alternate bearing nature of the coffee tree. The sample period for estimation of all equations is 1963/64 - 1980/81 (1956 - 1973 Ethiopian Fiscal Year [EFY] which starts every July 8 and ends the following July 7). All equations have been estimated by using the ordinary least-squares (OLS) statistical method. The discussion of the model is organized around five blocks of variables: production functions, coffee, final demand & government sector, exports and imports of goods and services.

In spite of the fact that we have undertaken quite a number of regressions based on various economic relationships, all the equations in our model are taken on a selective basis. In other words, we have rejected those equations with wrong signs, weak relationships, high multicollinearity, and so forth. For convenience, however, some of those equations are annexed at the end (for details see Annex IV). Furthermore, since our study is limited by a given number of pages, we will not be discussing our regression coefficients in detail, but it should be kept in mind that we have strictly followed economic theory throughout our specifications.

3.2 Production Functions

The output sector is disaggregated into four: output in agriculture, other commodity sectors, distibutive services, and other services. Most of the quations are of definitional type (eqs. 1, 2, 3, 5 and 8). While GDP at current prices is defined as GDP (at CFC) plus net indirect taxes (eq. 1), GDP (at CFC) in turn is taken as the sum of GDP (at CFC) of the four main output sectors mentioned above (eq. 2). Agricultural GDP (at CFC) (eq. 3) is disaggregated into coffee and non-coffee agricultural GDP.

The non-coffee agricultural sector is dominated by the production of a variety of crops mainly for home consumption and hence output in the sector (eq. 4) is explained by aggregate consumption. GDP (at CFC) in other commodity sectors (eq. 5) is defined as the sum of the preceding year's GDP and changes in output of the sector. The latter explanatory variable (eq. 6) depends on the level of total investment. According to the principle of complementarity, GDP (at CFC) in the distributive sector (eq. 7) had to be determined by the growth of output in other sectors. However, in order to avoid the problem of multicollineraity, we have only used output in other commodity sectors as the main explanatory variable in the model. GDP (at CFC) in other services (eq. 8) is defined as the sum of last year's GDP and changes in the output of the sector, which in turn is defined (eq. 9) as a function of government investment lagged by four years. In this sector we assume that government investment is spent on infrastructure that may increase output in the long run. The equations are as follows (t-statistics for all coefficients are given in parenthesis):

1. $Y1 = Y2 + NIT$

2. $Y2 = YAG + YOC + YDIST + YOS$

3. $YAG = YC + YNC$

4. $YNC = 750.66 + 0.31\ CT$

$$(8.4) \quad (18.84)$$

$$R^2 = 0.959 \quad DW = 2.11 \quad SE = 103.12$$

5. $YOC = \overline{YOC_{(-1)}} + \Delta YOC$

6. $\Delta YOC = -27.37 + 0.085I$

$$(-0.99) \quad (2.33)$$

$$R^2 = 0.267 \quad DW = 1.95 \quad SE = 40.86$$

7. $YDIST = -134.97 + 1.11YOC$

$$(-2.33) \quad (16.10)$$

$$R^2 = 0.945 \quad DW = 1.95 \quad SE = 40.86$$

8. $YOS = \overline{YOS_{(-1)}} + \Delta YOS$

9. $\Delta YOS = 50.59 + 0.16\ \overline{GI_{(-4)}}$

$$(5.87) \quad (3.68)$$

$$R^2 = 0.552 \quad DW = 2.59 \quad SE = 18.02$$

3.3 The Coffee Micro-Sector

In modelling the coffee micro-sector, the author of this paper was constrained by the availability of detailed data on coffee. Some important technical data were unavailable in the sub-sector. For example, statistical information on rainfall, employment, inputs and their costs were lacking for the period under study. Nevertheless, reasonable estimates can be derived from the existing data that we hope would be sufficient to anaylse our problem.

The sub-model for the coffee sector consists of the following equations: output in the sub-sector, yield per hectare, quantity of coffee production, coffee arrival, quantity of coffee exports, domestic coffee consumption and export prices. In this regard, eqs. 10, 12, 14, 16, 18, 19, 21, and 24 are of definitional type while others are functional (eqs. 11, 13, 15, 17, 20, 22, 23 and 25). Since Ethiopia is a price-taker in the world coffee market, the international price of coffee determines its export price of coffee which in turn affects the producer price. Most of the Ethiopian unwashed coffee is exported to the U.S.A. and thus the New York international spot price for the Ethiopian "Jimma Grade 5" coffee has been selected to reflect the foreign demand for this commodity.

Since data on the producer price of coffee was not available for the period (1963/64 to 1973/74) we have assumed a 10 per cent differential from the available whole-sale price of coffee. The producer price is fixed by the government for each day, following the New York international spot price and the government uses the FOB "Assab" export prices less taxes, transportation and storage costs and exporters profit margins to fix the farm-gate price of coffee.

Assuming acreage under coffee (according to the land reform policy of 1974) is exogenous, coffee farmers might respond to the price incentive by improving the productivity of coffee through different cultural practices and harvesting methods and planting more coffee seedlings per hectare. Hence the producer price of coffee lagged by four years together with domestic coffee consumption determines output per hectare. The introduction of producer prices lagged by one to three years and did not yield a good result in our specification. Total coffee production is defined as a product of harvested acreage under coffee and yield per hectare. This preference is made due to the failure of aggregate investment, proxied by investment of the sub-sector, to explain changes in coffee production. Coffee arrival at the terminal markets which determines the quantity of coffee exports is explained by the quantity of coffee production. The dummy variable in this equation reflects disturbances as was mentioned earlier. Domestic coffee consumption, which also includes disappearances is a residual, that is, total production minus total exports. The equations are listed below:

10. (a) Original Form (O.F.): $YC = QC \times P3C$

    (b) Linearized Form (L.F.): $YC = 581.76 + 202P3C + 2.80QC$

11. $YHA = 0.14 + 0.0029\ \overline{P22C}_{(-4)} + 0.000037\ DC$

$$(3.07) \quad (5.06) \qquad\qquad (0.079)$$

$$R^2 = 0.748 \qquad DW = 1.8 \qquad SE = 0.0298$$

12. $\Delta YHA = YHA - \overline{YHA_{(-1)}}$

13. (a) O.F.: $QC = YHA \times \overline{A1}$

(b) L.F.: $QC = 250.0 + 0.471\overline{A1} + 429\ \Delta YHA$

14. $QC = QC - \overline{QC_{(-1)}}$

15. (a) O.F. : $l_n\ QCA_{11} = 2.26 + 0.44\ l_n\ QC - 0.23\ \overline{DUMARC12}$

$$(1.57) \qquad (1.58) \qquad (-3.57)$$

$$R^2 = 0.49 \qquad DW = 1.56 \qquad SE = 0.109$$

(b) L.F. : $QCA_{11} = 0.18\ \Delta QC + QCA_{11}\ (-1) - 19\ \Delta(\overline{DUMARC12})$

16. $\Delta QCA_{11} = QCA_{11} - \overline{QCA_{11(-1)}}$

17. (a) O.F. : $l_n\ QCX = 0.29 + 0.90\ l_n\ QCA_{11}$

$$(0.42) \qquad (5.91)$$

$$R^2 = 0.686 \qquad DW = 2.78 \qquad SE = 0.0913$$

(b) L.F. : $QCX = 0.70\ \Delta QCA_{11} + \overline{QCX_{(-1)}}$

18. $\Delta QCX = QCX - \overline{QCX_{(-1)}}$

19. $DC = QC - QCX$

20. $P1C = P1C - \overline{P1C_{(-1)}}$

21. $\Delta P1C = P1C - \overline{P1C_{(-1)}}$

22. $PXC = -0.139 + 0.96\overline{P11NC}$
$(-0.12) \quad (54.55)$
$R^2 = 0.994 \qquad DW = 2.50 \qquad SE = 2.7$

23. $P3C = 0.0288P22C$

24. $\Delta P3C = P3C - \overline{P3C_{(-1)}}$

25. $P22C = 34.4 + 0.68\ PXC$
$(7.26) \quad (7.96)$
$R^2 = 0.799 \qquad DW = 2.13 \qquad SE = 0.0727$

3.4 Final Demand and Government Sector

In this block we introduce final demand variables (consumption and investment) as well as variables which explain the government sector (see Chapter One, sections 1.3.2 and 1.3.3). Investment (eq. 26) is disaggregated into two: collective investment and government (unproductive) investment. The former is assumed to be exogenous, while the latter (eq. 27) is explained by total government revenue and credit from domestic banks and external financial sources. Similarly, total consumption is disaggregated into private and government consumption (eq. 28). Both of these endogenous variables are in turn determined by total GDP , at current prices (eqs. 29 and 30).

With regard to the government sector, total government revenue, according to the experience of Ethiopia, is disaggregated into three main sources, namely: direct tax revenue, indirect tax revenue, and non-tax revenue (assumed to be exogenous). While direct tax revenue (eq. 32) is determined by GDP (at current prices) indirect tax revenue (eq. 33) is explained by coffee and non-coffee export revenues as well as by imports. The introduction of GDP (at CFC) as an additional explanatory variable (in eq. 33) did not yield a good result and hence was dropped.

On the other hand, net indirect taxes (eq. 34) are defined as the difference between indirect tax revenue and subsidies. Total government expenditure (eq. 35) is disaggregated into two: current government expenditure and public expenditure (= government investment, as was explained before). Current government expenditure (eq. 36) is defined as a function of expenditures on general services plus social services. Since the budget is in deficit, government credit (eq.37) is defined as total government expenditures less government revenue and plus the deficit in the current account balance of the balance of payments. The full equations are presented below:

26. $I = \overline{I\ (coll)} + GI$

27. $GI = -113.42 + 0.42GR + 0.14CR$
$$(-3.20) \quad (6.86) \quad (3.52)$$
$$R^2 = 0.986 \qquad DW = 1.68 \qquad SE = 33.61$$

28. $CT = CP + CG$

29. $CP = -178.77 + 0.82Y1$
$$(-1.59) \quad (45.0)$$
$$R^2 = 0.993 \qquad DW = 1.77 \qquad SE = 80.53$$

30. $CG = -408.38 + 0.20\ Y1$
$$(-4.47) \quad (13.62)$$
$$R^2 = 0.930 \qquad DW = 2.09 \qquad SE = 68.25$$

31. $GR = TRD + TRI + \overline{NTR}$

32. $TRD = -133.63 + 0.06Y1$

$(-3.52) \quad (8.64)$

$R^2 = 0.833 \qquad DW = 1.85 \qquad SE = 30.06$

33. $TRI = -55.05 + 0.68XC + 0.22XCN + 0.34M$

$(-3.24) \quad (3.76) \quad (2.61) \quad (3.20)$

$R^2 = 0.993 \qquad DW = 2.19 \qquad SE = 36.3$

34. $NIT = TRI - \overline{S}$

35. $GEX = CGE + GI$

36. (a) O.F.: $l_n\ CGE = 3.13 + 0.61\ l_n\ \overline{SGS}$

$(4.17) \qquad (5.98)$

$R^2 = 0.704 \qquad DW = 1.84 \qquad SE = 0.057$

(b) L.F.: $CGE = 0.85\ \Delta\overline{SGS} + \overline{CGE_{(-1)}}$

37. $GCR = GEX - GR + BOP$

3.5 Exports

For the sake of convenience and simplicity, the value of total exports of goods and services is disaggregated into two: namely, coffee and non-coffee export of goods and services (eq. 38). Coffee export revenue (eq. 39) is defined as the quantity of coffee exports times actual export price of coffee. Non-coffee exports revenue from goods and services (eq. 40) is mainly determined by the growth of non-coffee agricultural output. The equations are as follows:

38. $X = XC + XCN$

39. (a) O.F.: $XC = QCX \times P1C$

(b) L.F.: $XC = 585 + 110\ \Delta P1C + 7.40\ \Delta QCX$

40. $XCN = -49.13 + 0.19YNC$

$(-0.48) \quad (4.37)$

$R^2 = 0.54 \qquad DW = 0.70 \qquad SE = 112.63$

3.6 Imports

In the Ethiopian context, total imports of goods and services are disaggregated into five major components (eq. 41), namely: imports of consumer goods, intermediate goods, capital goods, fuel, and other imports of goods and services. While a constant value is given to the import of consumer goods (eq.42), import of intermediate goods (eq. 43) is related to the growth of output in other commodity sectors. Import of capital goods (eq. 44) is of a definitional nature which is disaggregated into imports of agricultural, transport and industrial capital goods . The former (eq. 45) is explained by agricultural GDP and dummy variable for disturbances. Import of transport capital goods (eq. 46) and industrial capital goods (eq. 47) are explained by the output of distributive sector and other commodity sectors, respectively. Government consumption is used as a determinant of fuel imports (eq. 48) and total GDP together with dummy variable are assumed to explain the import of other goods and services (eq.49). Finally, the current account balance in the balance of payments (eq. 50) which is negative, is defined as the difference between total export of goods and services and total import of goods and services. It should be noted that the balance in equation 50, not only includes the trade balance and non-factor services, but also comprises net investment incomes and remittances. The equations are as follows:

41. $M = MC + MRSG + MK + MF + MO$

42. $MC = 391.2$

43. $MRSG = -104.01 + 0.36YOC$

$(-2.57) \quad (8.0)$

$R^2 = 0.81 \qquad DW = 1.83 \qquad SE = 11.45$

44. $MK = MKA + MKT + MKI$

45. $MKA = -9.35 + 0.0095YAG + 40.54\ \overline{DUMKA}$

$(-1.39) \quad (3.71) \quad (6.78)$

$R^2 = 0.841 \quad DW = 1.78 \quad SE = 7.67$

46. $MKT = -24.65 + 0.18YDIST$

$(-0.57) \quad (3.62)$

$R^2 = 0.466 \quad DW = 1.63 \quad SE = 24.99$

47. $MKI = -23.47 + 0.21\ YOC - 65.27\overline{DUMKI}$

$(-0.50) \quad (4.18) \quad (-4.34)$

$R^2 = 0.727 \quad DW = 1.63 \quad SE = 24.99$

48. $MF = -76 + 0.36\ CG$

$(4.01) \quad (11.13)$

$R^2 = 0.886 \quad DW = 0.78 \quad SE = 38.56$

49. $MO = 0.77 + 0.001Y1 - 54.83\ \overline{DUMO}$

$(0.30) \quad (2.74) \quad (24.63)$

$R^2 = 0.976 \quad DW = 2.52 \quad SE = 3.52$

50. $BOP = X - M$

3.7 An Aggregated Economic Model for the External Sector of Ethiopia

(Algebraic non-linear form)*

1. $Y1 = Y2 + NIT$

2. $Y2 = YAG + YOC + YDIST + YOS$

3. $YAG = YC + YNC$

4. $YNC = \alpha_{11}CT^{\beta^{12}}$

5. $YOC = \overline{YOC_{(-1)}} + \Delta YOC$

6. $\Delta YOC = \alpha_{21} I^{\beta_{22}}$

7. $YDIST = \alpha_{31} YOC^{\beta_{32}}$

8. $YOS = \overline{YOS_{(-1)}} + \Delta YOS$

9. $\Delta YOS = \alpha_{41} \overline{(GI_{(-4)})}^{\beta_{42}}$

10. $YC = QC \times P3C$

11. $YHA = \alpha_{51} \overline{[P22C_{(-4)}]}^{\beta_{52}} DC^{\beta_{53}}$

12. $\Delta YHA = YHA - \overline{YHA_{(-1)}}$

13. $QC = YHA \times \overline{A1}$

14. $\Delta QC = QC - \overline{QC_{(-1)}}$

15. $QCA_{11} = \alpha_{61} QC^{\beta_{62}} (\overline{DUMARC12})^{\beta_{63}}$

16. $\Delta QCA_{11} = QCA_{11} - \overline{QCA_{11(-1)}}$

17. $QCX = \alpha_{71} (QCA_{11})^{\beta_{72}}$

18. $\Delta QCX = QCX - \overline{QCX_{(-1)}}$

19. $DC = QC - QCX$

20. $P1C = \frac{P1C\ (b)}{100}\ PXC$

21. $\Delta P1C = P1C - \overline{P1C_{(-1)}}$

22. $PXC = \alpha_{81}(P11NC)^{\beta_{82}}$

23. $P3C = \frac{P3C(b)}{100}\ P22C$

24. $\Delta P3C = P3C - \overline{P3C_{(-1)}}$

25. $p22C = \alpha_{91} PXC^{\beta_{92}}$

26. $I = \overline{I\ (coll)} + GI$

27. $GI = \alpha_{101} GR^{\beta_{102}} GCR^{\beta_{103}}$

28. $CT = CP + CG$

29. $CP = \alpha_{111} YI^{\beta_{112}}$

30. $CG = \alpha_{121} Y1^{\beta_{122}}$

31. $GR = TRD + TRI + \overline{NTR}$

32. $TRD = \alpha_{131} Y1^{\beta^{132}}$

33. $TRI = \alpha_{141}\ XC^{\beta^{142}} XCN^{\beta^{143}} M^{\beta^{144}}$

34. $NIT = TRI - \bar{S}$

35. $GEX = CGE + GI$

36. $CGE = \alpha_{151} \overline{SGS}^{\beta^{152}}$

37. $GCR = GEX - GR + BOP$

28. $X = XC + XCN$

39. $XC = QCX \times P1C$

40. $XCN = \alpha_{161} YNC^{\beta^{162}}$

41. $M = MC + MRSG + MK + MF + MO$

42. $MC = 391.2$

43. $MRSG = \alpha_{171} YOC^{\beta^{172}}$

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*Variables in value terms are expressed in millions of Ethiopian Birr (at current prices). Coffee production, arrival, coffee exports, and domestic coffee consumption are expressed in thousands of tons. Yield per hectare is given in tons, harvested acreage under coffee is in thousands of hectares, coffee export and producer prices are indexed (1980/81 = 100) and their actual equivalents per kilogram of coffee is in Ethiopian birr. Exogenous variables, which are barred, and endogenous variables of the model are fully explained in the subsequent sections.

44. $MK = MKA + MKT + MKI$

45. $MKA = \alpha_{181} YAG^{\beta^{182}} (\overline{DUMKA})^{\beta^{183}}$

46. $MKT = \alpha_{191} YDIST^{\beta^{192}}$

47. $MKI = \alpha_{201} YOC^{\beta^{202}} (\overline{DUMKI})^{\beta^{203}}$

48. $MF = \alpha_{211} CG^{\beta^{212}}$

49. $MO = \alpha_{221} Y1^{\beta^{222}} (\overline{DUMO})^{\beta^{223}}$

50. $BOP = X - M$

3.8 Endogenous Variables

1. Y1 = GDP at current market prices.

2. Y2 = GDP at current factor cost (CFC).

3. YAG = Agricultural GDP, at CFC.

4. YNC = Non-coffee agricultural GDP, at CFC.

5. YOC = GDP in other commodity sectors, at CFC.

6. ΔYOC = Increase in the GDP of other commodity sectors, at CFC.

7. YDIST = GDP in distributive sector, at CFC.

8. YOS = GDP in other services sector, at CFC.

9. ΔYOS = increase in the GDP of other service sector, at CFC.

10. YC = Coffee GDP at CFC.

11. YHA = Coffee yield per hectare.

12. ΔYHA = changes in coffee yield per hectare.

13. QC = quantity of coffee produced.

14. ΔQC = increase in coffee production.

15. QCA_{11}= arrival of coffee at the terminal market.

16. ΔQCA_{11}= increase on the arrival of coffee at the terminal markets.

17. QCX = Quantity of coffee exports.

18. ΔQCX = increase in the quantity of coffee exports.

19. DC = Domestic coffee consumption.

20. P1C = export price of coffee per kilogram (kg.).

21. $\Delta P1C$ = increase in the export price of coffee.

22. PXC = export price of coffee per kg. (index: 1980/81 = 100)

23. P3C = producer price of coffee per kg.

24. $\Delta P3C$ = increase in the producer price of coffee per kg.

25. P22C = producer price of coffee per kg. (index: 1980/81).

26. I = total investments.

27. GI = government investments.

28. CT = Total consumption.

29. CP = private consumption.

30. CG = government consumption.

31. GR = total government revenue.

32. TRD = Direct tax revenue.

33. TRI = indirect tax revenue.

34. NIT = Indirect taxes net of subsidies.

35. GEX = total government expenditures.

36. CGE = current government expenditures.

37. GCR = government credit.

38. X = total export of goods and services, value.

39. XC = coffee export earnings.

40. XCN = Non-coffee export of goods and services, value.

41. M = total import of goods and services, value.

42. MC = consumer goods import, value.

43. MRSG = import of intermediate goods, value.

44. MK = import of capital goods, value.

45. MKA = import of agricultural capital goods, value.

46. MKT = import of transport capital goods, value.

47. MKI = import of industrial capital goods, value.

48. MF = fuel imports, value.

49. MO = import of services and other goods.

50. BOP = current account balance in the balance of payments.

3.9 Exogenous Variables

1. $YOC_{(-1)}$ = GDP in other commodity sectors, at CFC, lagged by one year.

2. $YOS_{(-1)}$ = GDP in other services sector, at CFC, lagged by one year.

3. $YHA_{(-1)}$ = coffee yield per hectare lagged by one year.

4. $QC_{(-1)}$ = quantity of cofee production lagged by one year.

5. $QCA_{11(-1)}$ = coffee arrival at the terminal markets lagged by one year.

6. $QCX_{(-1)}$ = quantity of coffee exports lagged by one year.

7. A1 = harvested acreage under cofffee.

8. ΔA1 = increase in the harvested cofee acreage.

9. I (coll) = collective investment.

10. $CGE_{(-4)}$ = government investment lagged by four years.

11. $CGE_{(-1)}$ = current government expenditure lagged by one year.

12. ΔSGS = changes in the expenditure on social services plus general services.

13. S = subsidies.

14. NTR = non-tax revenue.

15. P11NC = New York (International) spot price of coffee per kilogram, (index: 1980/81 = 100).

16. $P22C_{(-4)}$ = producer price of cofee per kg., lagged by four years (index: 1980/81 = 100).

17. $P3C_{(-1)}$ = actual producer price of cofee per kg., lagged by one year.

18. $P1C_{(-1)}$ = actual export price of coffee lagged by one yea.

19. DUMARC12 = dummy variable for coffee arrival (Normal = 1, abnormal = 2).

20. ΔDUMARC12 = changes in the dummy variable for coffee arrival.

21. DUMKA = dummy variable for the import of agricultural capital goods.

22. DUMKI = dummy variable for the import of industrial capital goods.

23. DUMO = dummy variable for the import of services and other goods.

3.10 Final Linearized Form*

1. $Y1 = Y2 + NIT$

2. $Y2 = YAG + YOC + YDIST + YOS$

3. $YAG = YC + YNC$

4. $YNC = 750.66 + 0.31\ CT$

5. $YOC = \Delta YOC + \overline{YOC_{(-1)}}$

6. $\Delta YOC = -14.31 + 0.085I$

7. $YDIST = -134.97 + 1.11\ YOC$

8. $YOS = \Delta YOC + \overline{YOS_{(-1)}}$

9. $\Delta YOS = 50.59 + 0.16\ \overline{GI_{(-4)}}$

10. $YC = 581.76 + 202\Delta P3C + 2.88\Delta QC$

11. $YHA = 0.14 + 0.0029\ \overline{P22C_{(-4)}} + 0.000037DC$

12. $\Delta YHA = YHA - \overline{YHA_{(-1)}}$

13. $QC = 250.0 + 0.471\Delta A1 + 429\Delta YHA$

14. $\Delta QC = QC - \overline{QC_{(-1)}}$

15. $QCA_{11} = 0.18\Delta QC + \overline{QCA_{11(-1)}} - 19\Delta\overline{DUMARC12}$

16. $\Delta QCA_{11} = QCA_{11} - \overline{QCA_{11(-1)}}$

17. $QCX = 0.70\Delta QCA_{11} + \overline{QCX_{(-1)}}$

18. $\Delta QCX = QCX - \overline{QCX_{(-1)}}$

19. $DC = QC - QCX$

20. $P1C = 0.074PXC$

21. $\Delta P1C = P1C - \overline{P1C_{(-1)}}$

22. $PXC = -0.139 + 0.96\ \overline{P11NC}$

23. $P3C = 0.0288P22C$

24. $\Delta P3C = P3C - \overline{P3C_{(-1)}}$

25. $P22C = 34.4 + 0.68PXC$

26. $I = \overline{I\ (coll)} + GI$

27. $GI = -113.42 + 0.42GR + 0.14GCR$

28. $CT = CP + CG$

29. $CP = -178.77 + 0.82Y1$

30. $CG = -408.38 + 0.20\ Y1$

31. $GR = TRD + TRI + \overline{NTR}$

32. $TRD = -133.63 + 0.06Y1$

33. $TRI = -55.05 + 0.68XC + 0.22XCN + 0.34M$

34. $NIT = TRI - \bar{S}$

35. $GEX = CGE + GI$

36. $CGE = 0.85\Delta\overline{SGS} + \overline{CGE_{(-1)}}$

37. $GCR = GEX - GR + BOP$

38. $X = XC + XCN$

39. $XC = 585.0 + 110.0\Delta P1C + 7.40\Delta QCX$

40. $XCN = -49.13 + 0.19YNC$

41. $M = MC + MRSG + MK + MF + MO$

42. $MC = 391.2$

43. $MRSG = -104.01 + 0.36YOC$

44. $MK = MKA + MKT + MKI$

45. $MKA = -9.35 + 0.0095YAG + 40.54\overline{DUMKA}$

46. $MKI = -24.65 + 0.18YDIST$

47. $MKI = -23.47 + 0.21YOC - 65.27\overline{DUMKI}$

48. $MF = -76 + 0.36CG$

49. $MO = 0.77 + 0.001Y1 + 54.83\overline{DUMO}$

50. $BOP = X - M$

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* For the linearization procedure, see Appendix I. In the process, the second derivatives have been assumed to be zero.

CHAPTER IV

4.0 Model Performance and Simulation Analysis

In this part of our core analysis, we attempt to solve the model and undertake a simulation analysis in order to examine the impact of international coffee price changes on selected variables of the Ethiopian economy.

The base year of our model is 1980/81 and the model is of short-run dynamic equilibrium nature since it is simultaneous and lagged variables are involved. In specifying the equations, discussed earlier, it has been impossible to extend our sample period up to 1984/85 as data for the period 1981/82 - 1984/85 were lacking at the time of conducting this research and therefore our simulation analysis considers the following assumptions for calculations after 1980/81:

(a.) generated values by the model are used for those variables lagged by one year.
(b.) base year values are taken for historical export and producer prices of coffee as well as their respective indices.
(c.) the available historical data is used for those variables lagged by four years.
(d.) increase in harvested coffee acreage is made to remain unchanged.
(e.) the level of subsidies is assumed to remain constant.
(f.) for all other exogenous variables, a forecasted approximation is made on the basis of the respective average annual growth rates, discussed in Chapter One, of the latter sub-period.

From the above assumptions, it follows that the simulation results of the model may not necessarily reflect the economic realities that occurred in Ethiopia after 1980/81. Furthermore, despite all our efforts, time limitations coupled with data unavailability have been the major constraints to construct a more comprehensive and less aggregated model and therefore the reader is reminded to interpret all the outcomes in this context.

4.1 Solution of the Model and Multiplier Analysis*

In solving the model, we have presented the coefficients of the equations in Matrix A, coded from 1 to 50 in the column (see Annex V)--which is, after rearranging terms, consequently inverted. (see Annex VI). Similarly, the coefficients of exogenous variables are given in Matrix B, coded from 1 to 23 in the row (see Annex VII). And the consistency of the solution of the model is checked by the base year values in the control solution. That is, the difference between the observed and estimated values as a ratio of the former is calculated to be plus or minus 3 to 5 per cent, which indicates that the equations are reasonably well estimated. In other words, the percentage deviation of the error terms from the control solution can be put in the form of the following equations:

1). $X = Ax + B\bar{y} + \varepsilon$

2). $\hat{X} = [I - A]^{-1} By$

implies $\frac{X - \hat{X}}{X} = \varepsilon = \pm 3$ to 5%

Constants and numerical values are coded as 24 and 25, respectively.

The partial impact multipliers which can be read columnwise in the inverse matrix demonstrate the effect of each of the endogenous variables on the corresponding endogenous variables. Moreover, it should be kept in mind that it is beyond the scope of this study to analyse these multipliers. Similarly, time limitation may not allow us to discuss the impact of all true exogenous variables on the endogenous ones. Therefore, as has been mentioned earlier, our main focus will be to deal with the full matrix of multipliers (exogenous effects and endogenous variables), selectively, which is obtained as a product of inverse matrix and Matrix B.

To summarize, in the language of matrix algebra notation, it is arrived at the solution of the model as follows:

$\hat{X} = A\hat{x} + B\bar{y}$..(1)

rearranging terms, equation (1) gives us:

$$\hat{x} - A\hat{x} = B\bar{y} \; \{=\} \; (I - A)\,\hat{x} = B\bar{y} \ldots\ldots (2)$$

Solving for $\hat{x}$, equation (2) yields:

$$\hat{x} = [I - A]^{-1}\, B\bar{y} \ldots\ldots (3)$$

Where: $\hat{x}$ = estimated endogenous variables

$\bar{y}$ = values

A = matrix of coefficients of endgenous variables

B = matrix of coefficients of exogenous variables

$(I - A)^{-1}$ = inverse matrix

$(I - A)^{-1}B\bar{y}$ = solution of the model

Full multiplier effects in the solution of the model which show the impact of exogenous variables on the endogenous ones are presented in Table 4.1 below.

As seen from the table, the impact of a unitary increase in the exogenous variables is transmitted to the corresponding endogenous variables.

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*monetary values are expressed in millions of Ethiopian Birr. Coffee prices per kg. are indexed (1980/81 = 100) and their equivalents in actual terms are given in Ethiopian Birr per kilogram of clean coffee. The quantity of coffee production, arrival, exports and their respective increases as well as domestic coffee consumption are expresssed in thousands of tons. Yield per hectare and its increase are given in tons. Hence, throughout our discussion a unit should be interpreted in this context.

MATRIX A-INV[illegible]

TABLE 4.1 IMPACT MULTIPLIERS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	3.79	1.57	-2412.72	-5.53	0.00	-0.09	0.00	2.65	0.32	0.25	0.05	0.04	-1.57	0.10
2	3.37	1.51	-2036.39	-4.67	0.00	-0.06	0.00	2.24	0.29	0.24	0.05	0.04	-0.51	0.07
3	1.20	0.50	-2015.30	-4.52	0.00	-0.07	0.00	2.21	0.10	0.08	0.02	0.01	-0.50	0.03
4	1.20	0.50	-762.90	-1.75	0.00	-0.03	0.00	0.84	0.10	0.06	0.02	0.01	-0.50	0.05
5	1.03	0.00	-9.52	-0.02	0.00	0.00	0.00	0.01	0.09	0.00	0.01	0.01	0.00	0.03
6	0.03	0.00	-9.52	-0.02	0.00	0.00	0.00	0.01	0.09	0.00	0.01	0.01	0.00	0.03
7	1.14	0.01	-10.57	-0.02	0.00	0.00	0.00	0.01	0.10	0.00	0.02	0.01	-0.01	0.03
8	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.16	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00
10	0.00	0.00	-1252.50	-1.37	0.00	-0.05	0.00	1.39	0.00	0.00	0.00	0.00	0.00	0.03
11	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	-1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	-435.04	[illegible]	0.00	-0.02	0.00	0.43	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	-435.04	-1.00	0.00	-0.02	0.00	0.43	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	-78.31	-0.18	1.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	-78.31	-0.18	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	-54.41	-0.13	0.00	1.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	-54.41	-0.13	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	-380.22	[illegible]	0.00	-1.01	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.35	0.06	-113.12	[illegible]	0.00	0.00	0.00	0.12	1.03	0.01	0.17	0.14	-0.36	0.34
27	0.35	0.06	-113.12	[illegible]	0.00	0.00	0.00	0.12	0.33	0.01	0.17	0.14	-0.36	0.34
28	3.56	1.20	-2463.47	-5.65	0.00	-0.09	0.00	2.70	0.33	0.26	0.05	0.05	-1.50	0.11
29	3.11	1.17	-1474.42	-4.54	0.00	-0.07	0.00	2.17	0.26	0.21	0.04	0.04	-1.29	0.07
30	0.76	0.31	-482.54	-1.11	0.00	-0.02	0.00	0.53	0.06	0.05	0.01	0.01	-0.31	0.02
31	0.44	[illegible]	[illegible]	[illegible]	0.00	-0.02	0.00	0.57	0.05	0.03	0.01	0.01	-0.15	[illegible]
32	0.23	[illegible]	[illegible]	-0.38	0.00	-0.01	0.00	0.16	0.02	0.02	0.00	0.00	-0.09	0.01
33	0.42	0.06	-376.52	-0.46	0.00	-0.01	0.00	0.41	0.04	0.01	[illegible]	0.00	-0.35	0.01
34	0.42	0.05	-376.33	[illegible]	0.00	-0.01	0.00	0.41	0.04	0.01	0.01	0.00	-1.06	0.01
35	0.35	0.06	-113.12	[illegible]	0.00	0.00	0.00	0.12	0.03	0.01	1.17	0.99	-0.36	0.34
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.85	0.00	0.00
37	0.56	-0.07	755.17	1.73	0.00	0.03	0.00	-0.83	0.05	-0.01	1.17	0.99	0.07	-1.65
38	0.43	0.07	-552.88	-1.25	0.00	-0.01	0.00	0.60	0.02	0.02	0.00	0.00	-0.09	0.01
39	0.00	[illegible]	-405.03	[illegible]	0.00	-0.02	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00
40	0.23	0.05	[illegible]	[illegible]	0.00	-0.01	0.00	0.15	0.02	0.02	[illegible]	0.00	-0.09	0.01
41	1.05	0.12	[illegible]	-0.42	0.00	-0.01	0.00	0.22	0.39	0.01	0.01	0.01	-0.12	0.03
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00
43	0.37	0.00	-3.45	-0.01	0.00	0.00	0.00	0.00	0.33	0.00	0.01	0.00	0.00	0.01
44	0.43	0.11	-23.35	-0.05	0.00	0.00	0.00	0.03	0.04	0.01	0.01	0.01	-0.01	0.01
45	0.01	0.00	-19.15	-0.04	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
46	0.21	0.01	[illegible]	-0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01
47	0.21	0.00	[illegible]	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01
48	0.27	0.11	-173.72	-1.40	0.00	-0.01	0.00	0.19	0.02	0.32	0.00	0.00	-0.11	0.01
49	0.00	0.00	-2.41	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00
50	-0.45	-0.03	[illegible]	[illegible]	0.00	-0.01	0.00	0.33	-0.07	0.00	-0.01	-0.01	0.00	-0.02

MATRIX A-INVERSE

TABLE 4.1 Continued

	15	16	17	18	19	20	21	22	23	24	25
1	14.46	7.00	-318.01	-119.39	0.00	-135.64	25.19	-40.55	24.07	7271.65	6871.34
2	3.55	5.91	-304.57	-39.69	0.00	-34.51	10.15	-16.34	13.73	7044.27	8041.83
3	3.37	5.65	-302.55	-37.75	0.00	-32.79	7.96	-12.82	10.77	3093.07	3999.57
4	4.57	2.21	-200.56	-37.75	0.00	-33.40	7.96	-12.82	10.77	2667.94	3373.76
5	0.08	0.03	-1.00	-0.92	0.00	-0.82	1.04	-1.67	1.40	1237.15	1246.06
6	0.08	0.03	-1.00	-0.92	0.00	-0.82	1.04	-1.67	1.40	47.75	56.66
7	0.09	0.03	-1.11	-1.02	0.00	-0.91	1.15	-1.85	1.55	1236.26	1248.16
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1475.79	1548.09
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.99	122.89
10	3.80	3.63	-202.00	0.00	0.00	0.62	0.00	0.00	0.00	225.14	625.81
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.47
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.13	0.19
13	0.00	1.25	0.00	0.00	0.00	0.21	0.00	0.00	0.00	194.85	202.12
14	0.00	1.25	0.00	0.00	0.00	0.21	0.00	0.00	0.00	1.86	9.12
15	0.00	0.23	0.00	0.00	0.00	-18.96	0.00	0.00	0.00	83.42	84.72
16	0.00	0.23	0.00	0.00	0.00	-18.96	0.00	0.00	0.00	-18.56	-17.36
17	0.00	0.15	0.00	0.00	0.00	-13.27	0.00	0.00	0.00	74.01	74.93
18	0.00	0.15	0.00	0.00	0.00	-13.27	0.00	0.00	0.00	-13.07	-12.15
19	0.00	1.10	0.00	0.00	0.00	13.49	0.00	0.00	0.00	120.85	127.19
20	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	7.09
21	0.07	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	-6.52	0.26
22	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.14	95.56
23	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	2.57
24	0.02	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.79	0.09
25	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.31	99.59
26	0.99	0.33	-11.62	-10.83	0.00	-9.61	12.18	-19.61	15.48	893.72	968.57
27	0.99	0.33	-11.42	-10.60	0.00	-9.61	12.18	-19.61	16.48	944.42	949.27
28	14.75	7.14	-324.37	-121.73	0.00	-107.75	25.59	-41.36	34.75	5829.93	8461.62
29	11.36	5.74	-263.77	-97.93	0.00	-86.62	20.59	-33.25	27.93	5783.98	7095.73
30	2.39	1.42	-63.50	-23.83	0.00	-21.13	5.04	-8.11	6.91	1045.95	1365.39
31	5.76	1.51	-32.42	-86.57	0.00	-77.47	13.55	-26.65	22.38	1526.54	2224.31
32	0.37	0.42	-19.05	-7.15	0.00	-6.34	1.51	-2.43	2.04	302.67	398.65
33	5.91	1.09	-13.34	-79.73	0.00	-71.13	15.04	-24.21	20.34	334.47	986.56
34	5.91	1.09	-13.34	-79.73	0.00	-71.13	15.04	-24.21	20.34	227.37	829.46
35	0.99	0.33	-11.62	-10.83	0.00	-9.61	12.18	-19.61	15.46	2526.17	2631.02
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1681.75	1681.75
37	-13.27	-2.19	12.84	133.46	0.00	152.77	37.37	-60.17	50.54	2261.22	915.93
38	5.58	1.60	-19.11	-117.17	0.00	-134.57	1.51	-2.44	2.05	233.86	1118.18
39	7.61	1.15	0.00	-110.00	0.00	-98.22	0.00	0.00	0.00	-261.92	526.29
40	0.87	0.42	-19.11	-7.17	0.00	-6.35	1.51	-2.44	2.05	495.78	591.38
41	1.20	0.59	-25.55	-9.73	0.00	-8.65	43.25	-69.64	58.50	1495.75	1628.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	391.20	391.20
43	0.03	0.01	-0.36	-0.32	0.00	-0.29	0.37	-0.60	0.50	341.36	344.57
44	0.11	0.07	-3.29	-0.73	0.00	-0.65	41.04	-56.03	0.68	454.60	466.87
45	0.08	0.06	-2.87	-0.35	0.00	-0.31	40.62	-0.12	0.10	20.03	28.65
46	0.02	0.01	-0.20	-0.18	0.00	-0.16	0.21	-0.33	0.28	198.24	200.02
47	0.02	0.01	-0.21	-0.19	0.00	-0.17	0.22	-55.62	0.29	236.33	238.20
48	1.04	0.52	-22.30	-5.60	0.00	-7.61	1.91	-2.92	2.45	300.54	415.72
49	0.01	0.01	-0.32	-0.12	0.00	-0.11	0.09	-0.04	54.36	8.04	9.64
50	7.46	1.01	7.75	-107.39	0.00	-95.92	-41.74	67.20	-55.45	-1251.89	-509.32

As mentioned earlier, we now proceed with our discussion to evaluate the impact multipliers of the New York coffee price (coded as no. 15 in the column) on key variables of the model. Moreover, to be able to study the performance of the model, a three-year simulation is carried out (for details, see Annex VIII, codes 26, 27, 28). To gain a better understanding of the model, we have also presented an impact flow chart of the New York price of coffee in Figure 4.1

Clearly, the most significant effects of the New York international price of coffee (column 15) is on GDP, consumption, government revenue, government credit and current account balance of the balance of payments. From Table 4.1, a one percent increase in the New York price of coffee (indexed) increases GDP (at market prices) by 14.5 million Birr which is effected by an increase in GDP (CFC) and net indirect taxes by 8.6 million Birr and 15.91 million Birr, respectively. Since subsidies are exogenously determined, the increase in indirect taxes follows the growth in indirect tax revenues. The major effect among the productive sectors is reflected in the agricultural sector. As a result of growth in overall GDP, aggregate consumption increases by 14.75 million Birr. However, the faster growth in consumption than GDP is due mainly to higher marginal propensity to consume. That is, the multiplier analysis follows the sum of the two marginal propensities, discussed in Chapter III, which is above unity (see eqs. 29 and 30, p. 40). On the other hand, the multiplier effect of a one percent increase in the New York coffee price is to increase aggregate investments almost exactly by the same amount but with different dimensions. As collective investments are predetermined, the main change in aggregate investments comes from increased government investments which is effected by changes in the overall government revenue.

With regard to the coffee sub-sector, a one percent increase in the New York coffee price has no immediate effect on coffee yield per hectare as the variable is determined by four years' lagged producer prices due mainly to

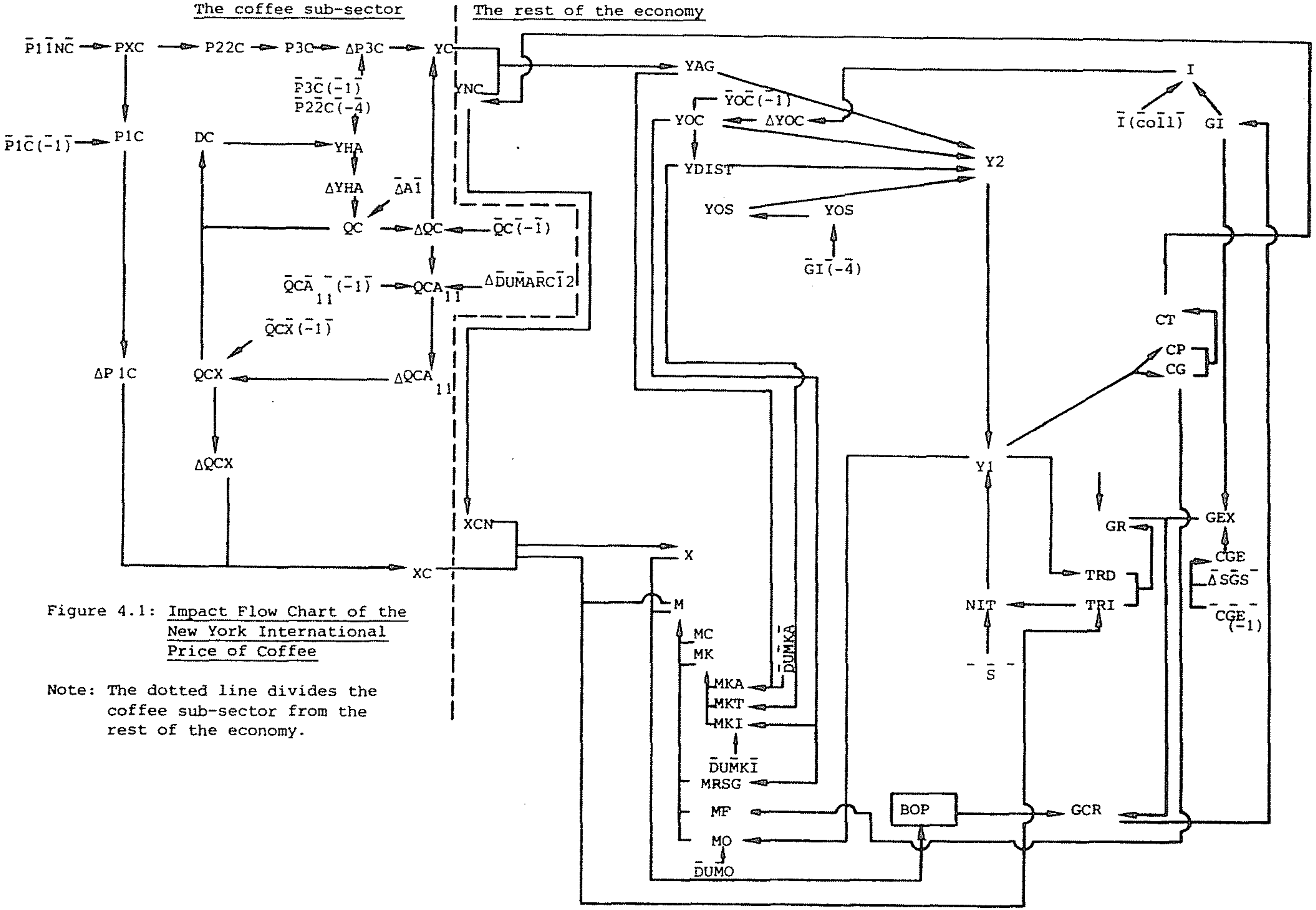
The coffee sub-sector
The rest of the economy
P1INC
PXC
P22C
P3C
ΔP3C
YC
YNC
P3C(-1)
P22C(-4)
P1C(-1)
P1C
DC
YHA
ΔYHA
ΔA1
QC
ΔQC
QC(-1)
QCA11(-1)
QCA11
ΔDUMARC12
QCX(-1)
ΔP1C
QCX
ΔQCA11
ΔQCX
XCN
XC
YAG
YOC(-1)
YOC
ΔYOC
YDIST
Y2
YOS
YOS
GI(-4)
I
I(coll)
GI
CT
CP
CG
Y1
GR
GEX
CGE
ΔSGS
CGE(-1)
TRD
TRI
NIT
S
X
M
MC
MK
MKA
MKT
MKI
DUMKA
DUMKI
MRSG
MF
MO
DUMO
BOP
GCR

Figure 4.1: Impact Flow Chart of the New York International Price of Coffee

Note: The dotted line divides the coffee sub-sector from the rest of the economy.

increased planting and the botanical cycle of the coffee tree. Similarly, the export and producer prices of coffee increase by 0.96 percent and 0.65 percent respectively. Another impact of a one percent increase in the New York price of coffee is to increase coffee export earnings by 7.81 million Birr, which together with non-coffee export earnings increases the value of aggregate exports of goods and services to a level of 8.68 million Birr. Similarly, the value of total import of goods and services increases by 1.20 million Birr. The slower growth in imports is due to the government's priority to maintain the existing capacity as well as repay its debt obligations. Overall, the current account balance in the balance of payments improves and the government is able to ease the balance of payments problem.

Although its effect is to increase direct tax revenues by 0.9 million Birr, total government revenues increase by 6.78 million Birr, which is attributed to a 5.91 million Birr increase in indirect tax revenues. Total government expenditures increase exactly by one million Birr. Since current government expenditures are determined by exogenous variables, New York price of coffee has no impact in this context. That is, expenditures on wages and salaries and social and general services are predetermined and do not follow the growth in government revenues. On the other hand a slow growth in public expenditures is due to the government's intention to finance its previous borrowing from domestic banks and thereby decrease its reliance on credit. Finally, the larger increase in government revenues than its expenditures brings a surplus in the budget and, together with an improvement in the current account balance of the balance of payments, brings down total government credit by 13.27 million Birr, which is 1.5% of the base year value.

4.2 Effects of Changes in the New York Price of Coffee

In this section an attempt is made to undertake a sensitivity analysis to examine the impact of changes in the new York price of coffee on major variables of the model. To this end both one-period and permanent 27%

increases/decreases are considered and the effects are analysed. This percentage is chosen on the basis of our empirical finding of fluctuation index, discussed in Chapter Two of this paper. Moreover, the assumptions mentioned in the preceeding section are also applicable in this simulation. From the results, a comparison is made between the upward and downward movements. Additionally, we have presented the simulation results to see what the effect would be to the economy if New York coffee prices change in the first year and return to their previous places in the following year. In this regard explanation is not given and hence the reader is reminded to refer to Annex VIII(codes -- increase: 29, 30, 31; decrease: 32, 33, 34).

4.2.1 Effects of a One-Period Change in the New York Price of Coffee

Table 4.2 assumes a one-period 27 percent increase in the New York price of coffee and presents the percentage differences between the consecutive three-year simulations in relation to the control solution values for the major variables of the model (for details, see Annex VIII, codes: 35, 36, 37). Evaluating the results, in the first year, a one-period 27% increase in the New York price of Arabica coffee for Ethiopia is transmitted into a one-period 21.78% increase in the 'FOB' export price which, in turn, increases the producer price of coffee by 17.21%. Since coffee yield per hectare is mainly related to four years lagged producer prices, the increase in coffee production must be interpreted as a trend-result of previous years' effects. Nevertheless,the increase in producer prices and coffee production expand coffee GDP by 22.05%. Changes in the quantity of coffee exports decline due mainly to an expansion in domestic coffee consumption and increased disappearances, because casuality gets reversed in the coffee sub-sector. That is, the growth in coffee GDP is in turn reflected in increased coffee production and thereby in overall coffee output. Despite a fall in the yield per hectare, higher coffee output in turn allows domestic consumption and disappearances to grow by 29.52% and therefore coffee exportable surplus and its increase decline by 13.1% and 19.4% respectively.

Table 4.2 Effects of a One-Period 27 Percent Increase in The New York Price of Coffee (Percentage deviations from the control solution) (in percent)

eq. no.	Variable	Years 1	2	3	3-year average
1	GDP, at current prices	10.06	1.21	5.35	5.54
2	GDP, at CFC	8.78	2.87	5.61	5.75
3	Agricultural GDP	10.51	-2.06	2.11	3.52
4	Non-coffee Agr. GDP	8.37	1.00	4.45	4.61
5	GDP, other comm. sectors	5.26	5.67	6.31	5.75
7	GDP, distributive sector	5.83	6.28	7.00	6.37
8	GDP, other services	9.53	10.61	12.95	11.03
10	Coffee GDP	22.05	-18.54	-10.56	-2.35
11	Coffee yield per hectare	-9.34	0.89	2.28	-2.06
13	Quantity of coffee prod.	13.72	11.49	0.14	8.45
14	Changes in coffee prod.	204.13	-49.50	-251.55	-32.30
16	Changes in the quantity of coffee arrival	-19.31	4.68	23.78	3.05
18	Changes in the quantity of coffee exports	-19.31	4.68	23.78	3.05
19	Domestic coffee consumpt.	29.52	26.42	10.64	22.19
22	Export price of coffee	21.78	0.00	0.00	9.00
25	Producer price of coffee	17.21	0.00	0.00	5.87
26	Total investments	10.55	6.09	9.55	8.73
27	Government inv.	10.99	6.34	9.94	9.09
28	Total consumption	10.76	1.29	5.73	5.93
29	Private consumption	10.32	1.23	5.49	5.68
30	Government consumption	13.07	1.57	6.96	7.20
31	Government revenue	16.86	1.73	10.53	9.71
32	Direct tax revenue	13.44	1.61	7.15	7.40
33	Indirect tax revenue	18.93	-12.58	2.47	2.94
34	Net indirect taxes	22.52	-14.97	2.94	3.50
35	Government expenditure	4.82	3.13	4.44	4.13
37	Government credit	-41.48	34.33	-3.13	-3.43
38	Export of goods & services	22.46	-18.69	0.64	1.47
39	Coffee export earnings	37.54	-40.93	-4.07	-2.49
40	Non-coffee export earnings	9.06	1.09	4.82	5.00
41	Import of goods & services	7.35	3.77	5.90	5.67
50	Current account deficit	-25.81	53.04	17.43	14.89

Source: Own computer output

The immediate impact of an increase in the export price of coffee is to increase coffee export earnings. Despite a fall in the incremental coffee exportable surplus, favourable export prices increase coffee export revenue by 37.54%. And non-coffee export revenues are expanded by 9.04%. Overall, the increase in aggregate export earnings is 22.46%. Such high export revenues enable the government to expand its capacity to import by 7.35%. As a result, the current account deficit in the balance of payments fall by 25.81% and the government is able to finance its external debt obligations.

The main contributors to government revenues in the Ethiopian context are export taxes and import duties levied on foreign trade transactions. Hence, higher export earnings, coupled with the expansion of imports increase indirect tax revenue by 18.93%. On the other hand, direct tax revenues increase by 13.44% as a result of higher growth of GDP. Furthermore, higher government revenues increase the capacity of the government to invest on economic and social infrastructures by 11% and thereby increasing total investments by 10.55%. Thus, the government budget shows a surplus which, combined with an improvement in the current account balance of the balance of payments, decreases government credit by 41.48%. In other words, less domestic and foreign resources are required to sustain the economy and it will be to the advantage of the government either to increase its foreign assets or to repay its external debt obligations.

A higher increase in the coffee GDP is reflected in total agricultural GDP, which is increased by 10.51%. Changes in the output of other commodity sectors initiated by the growth in total investments tends to increase output in the sector by 5.26%. Consequently, the distribution of industrial products to the consumers of the different regions calls for an improvement in the transport sub-sector as well as domestic trade by 5.83 %. Changes in the output of other services is effected by the government's effort to invest on public infrastructures in the previous four years and therefore current output in the sector to increase by 9.53%. Totally, the growth in the output of the various productive sectors expands aggregate GDP (at CFC) by 8.78%. Since the level of subsidies is considered to be exogenous, the increase in indirect tax revenue pushes net indirect taxes by 22.52% thereby, together with GDP (at CFC), increasing GDP (at current prices) which in turn increases total consumption by 10.76%. It follows that consumer demand for non-coffee agricultural products, which are the main staples in most cases, increase by 8.37%.

In the following two years, both export and producer prices of coffee remain unchanged as compared with the first year values. However, the quantity of coffee production expands by 11.49% as a result of increased coffee yield per hectare, which is followed by higher domestic consumption as well as smuggling to the neighbouring non-coffee producing countries and consequently the volume of coffee exports declines further. Unchanged export prices together with low supply of export volumes in turn leads to a fall in coffee export earnings by 41%, thereby reducing total export revenues by 18.69%. Since the government is committed to maintain the ongoing projects, priority is given to the import of essential goods and hence aggregate imports expand by 3.77%. Overall, the larger decline in exports than imports accelerates the growth in the current account deficit of the balance of payments.

Similarly, the growth in government revenues deteriorates, despite a 1.73% increase in direct tax revenues, as a result of a sharp fall in indirect tax revenues which is a reflection of weak performance in the foreign sector of the economy. Nevertheless, public expenditures are increased due to government objectives to promote economic and social development in the long run. Eventually, the budget and current account deficits substantially increase government's indebtedness by 34.33%. That is to say, to maintain the economy at least at the subsistence level, more inflow of resources to the domestic economy are required from the rest of the world. As export revenues become insufficient to cover the cost of import expenditures, the government tends to depend heavily on foreign borrowing and aid which might be possible at a high cost.

While agricultural GDP falls by 2.06% due to a decline in the coffee GDP, output in other commodity sectors and distributive services grow at 5.67% and 6.28%, respectively. On the other hand, GDP in the other service sector increases according to the normal trend because of lagged exogenous explanatory variable. However, a sluggish growth in aggregate GDP retards the growth in total consumption.

In the final year of the simulation period, the economy recovers quickly as compared with the previous year, though it does not return to its initial place. In the coffee sub-sector a 19% fall in the coffee GDP causes a decline in the coffee output. Although domestic coffee consumption increases at a decreasing rate, incremental coffee exportable surplus improves, because the fall in the current quantity of exports is relatively large as compared with the previous year. Thus, export revenue from coffee declines by 4.07%. However, a better performance in the export of non-coffee goods and services keeps total export revenues at least from falling.

For the economy to grow at 5.35%, it necessitates inputs which are of an imported nature. The expansion of imports faster than exports makes the government run a current account deficit in the balance of payments by 17.43%. Although the external account is in deficit, government borrowing from the central bank declines by 3.13% because a surplus is obtained in the budget. Higher government revenues are also reflected in increased government investments which in turn together with collective investments brings changes in the output of other commodity sectors.

The simulation results of a one-period 27% decrease in the New York coffee price are summarised in Table 4.3 (see Annex VIII, codes: 38, 39, 40). In the first year, a 27% fall in the New York coffee price leads to a fall in the export and producer prices by 30% and 18%, respectively. Although total and incremental coffee output increases, a fall in the producer prices of coffee deteriorates coffee GDP by 10.72% which, in turn, lowers total agricultural GDP by 0.79%. Output in other productive sectors increases, but the growth is below the price increase case and overall GDP (at current prices) shrinks due to a fall in net indirect taxes, which are, in turn, determined by indirect tax revenues.

Lower export prices of coffee together with a fall in the volume of exports, effected by higher domestic consumption, decreases coffee export earnings by 42.64%. Since the growth in non-coffee export of goods and services is steady, aggregate export revenues decline by 19.5%. On the other hand, imports increase by 3.37% to achieve the current growth rate and

Table 4.3 Effects of a One-Period Change 27 Percent Decrease in The New York Price of Coffee (Percentage deviations from the control solution) (in percent)

eq. no.	Variable	Years			3-year average
		1	2	3	
1	GDP, at current prices	1.26	9.82	5.35	5.48
2	GDP, at CFC	3.04	8.44	5.60	5.69
3	Agricultural GDP	-0.79	9.14	2.10	3.48
4	Non-coffee Agr. GDP	1.05	8.17	4.44	4.55
5	GDP, other comm. sectors	4.89	5.66	6.31	5.62
7	GDP, distributive sector	5.42	6.27	6.99	6.23
8	GDP, other services	9.53	10.61	12.95	11.03
10	Coffee GDP	-10.72	14.38	-10.55	-2.29
11	Coffee yield per hectare	-9.34	0.89	2.28	-2.06
13	Quantity of coffee prod.	13.72	11.49	0.14	8.45
14	Changes in coffee prod.	204.13	-49.5	-251.55	-32.30
16	Changes in the quantity of coffee arrival	-19.31	4.68	23.78	3.05
18	Changes in the quantity of coffee exports	-19.31	4.68	23.78	3.05
19	Domestic coffee consumpt.	29.52	26.42	10.64	22.19
22	Export price of coffee	-30.00	0.00	0.00	-9.00
25	Producer price of coffee	-18.00	0.00	0.00	-5.92
26	Total investments	5.15	11.33	9.54	8.67
27	Government inv.	5.36	11.80	9.94	9.03
28	Total consumption	1.35	10.50	5.72	5.68
29	Private consumption	1.29	10.07	5.49	5.62
30	Government consumption	1.64	12.76	6.95	7.12
31	Government revenue	0.40	18.04	10.52	9.65
32	Direct tax revenue	1.69	13.11	7.14	7.31
33	Indirect tax revenue	-13.43	19.54	2.47	2.86
34	Net indirect taxes	-15.97	23.24	2.93	3.40
35	Government expenditure	2.78	5.11	4.44	4.11
37	Government credit	36.78	-44.09	-3.14	-3.48
38	Export of goods & services	-19.47	23.10	0.63	1.47
39	Coffee export earnings	-42.64	39.12	-4.07	-2.53
40	Non-coffee export earnings	1.14	8.94	4.82	4.97
41	Import of goods & services	3.37	7.45	5.89	5.57
50	Current account deficit	53.46	-26.85	17.41	14.67

Source: Own computer output

thus the current account deficit increases by 53.46%. Similarly indirect tax revenues fall by 15.97% mainly as a result of a sharp fall in coffee export earnings. While total government revenues grow by less than a percent, expenditures increase by 2.78%. Overall, the budget and current account deficits increase the need for credit by as much as 36.78%.

In the second year, the situation is improved and higher growth is achieved as a result of a relatively better performance in the export sector, as compared with the previous year. In this regard, all the values except for the coffee sub-sector non-price variables, are almost the same with the values in the first year of the price-increase case. Finally, the results in the third year of the simulation period are almost identical in both scenarios.

4.2.2. Effects of a Permanent Change in the New York Price of Coffee

This section analyses the reaction of economic variables to a permanent change in the New York price of coffee. The simulation results of upward and downward movements of the variable are presented in Tables 4.4 and 4.5, respectively (for details, see annex VIII; codes--permanent increase 41, 42, 43, and permanent decrease: 44, 45, 46). In both cases there is no change in the coffee sub-sector non-price variables, and hence the results remain the same as compared with the outcomes of one-period price shocks. More specifically, the values for coffee production should be interpreted according to the normal trend since yield per hectare is mainly determined by four years lagged exogenous variable. Furthermore, since the first year effects are identical with the preceeding discussion, we will start our analysis from the following year onwards.

A permanent 27 per cent increase (means a 27% yearly increase for 3 years) in the New York price of coffee is transmitted into the export price by 32.93 and 41.86% in the second and third years, as compared with the

Table 4.4 Effects of a Permanent 27 Percent Increase in The New York Price of Coffee (Percentage deviations from the control solution) (in percent)

eq. no.	Variable	Years			3-year
		1	2	3	average
1	GDP, at current prices	10.06	6.80	7.01	7.96
2	GDP, at CFC	8.78	6.52	6.73	7.34
3	Agricultural GDP	10.51	5.12	4.17	6.60
4	Non-coffee Agr. GDP	8.37	5.65	5.83	6.62
5	GDP, other comm. sectors	5.26	5.90	6.61	5.92
7	GDP, distributive sector	5.83	6.54	7.33	6.57
8	GDP, other services	9.53	10.61	12.95	11.03
10	Coffee GDP	22.05	2.27	-4.75	6.52
11	Coffee yield per hectare	-9.34	0.89	2.28	-2.06
13	Quantity of coffee prod.	13.72	11.49	0.14	8.45
14	Changes in coffee prod.	204.13	-49.48	-255.55	-32.31
16	Changes in the quantity of coffee arrival	-19.31	4.68	23.78	3.05
18	Changes in the quantity of coffee exports	-19.31	4.68	23.78	3.05
19	Domestic coffee consumpt.	29.52	26.42	10.64	22.19
22	Export price of coffee	21.78	32.93	41.86	32.19
25	Producer price of coffee	17.21	22.39	28.46	22.69
26	Total investments	10.55	9.53	10.58	10.22
27	Government inv.	10.99	9.92	11.02	10.64
28	Total consumption	10.76	7.27	7.49	8.51
29	Private consumption	10.32	6.97	7.18	8.16
30	Government consumption	13.07	8.83	9.10	10.33
31	Government revenue	16.86	12.18	13.44	14.16
32	Direct tax revenue	13.44	9.07	9.36	10.62
33	Indirect tax revenue	18.93	7.97	8.15	11.68
34	Net indirect taxes	22.52	9.48	9.69	13.90
35	Government expenditure	4.82	4.43	4.82	4.69
37	Government credit	-41.48	-15.37	-16.38	-24.41
38	Export of goods & services	22.46	7.95	7.89	12.77
39	Coffee export earnings	37.54	10.00	9.67	19.07
40	Non-coffee export earnings	9.06	6.12	6.31	7.16
41	Import of goods & services	7.35	6.30	6.78	6.81
50	Current account deficit	-25.81	2.69	4.35	-6.26

Source: Own computer output

consecutive years' results. Following the movement, the government adjusts the producer price by 22.39% and 28.46% in the respective years. The faster increase in export prices than producer prices is due mainly to the progressive nature of the surtax, implicit in this model, levied on the value of coffee exports. In the second year, a slower growth in the coffee GDP is translated to increased coffee production. However, the volume of coffee exports declines due to further increases in domestic coffee consumption and disappearances. Yet favourable export prices expand coffee export earnings by 10% as compared with the previous year. On the other hand, non-coffee export revenues expand by 6.12% and hence total export earnings grow by 7.95%.

Direct tax revenues grow faster than indirect tax revenues which, in turn, is translated to a 12.18% increase in total government revenues. Higher government revenues than expenditures bring a surplus in the budget and therefore the need for additional government credit to decline. Although government credit falls, higher government revenues increase unproductive investments by 9.92% which in turn are reflected in aggregate investments. Consequently, due to increased capacity to invest, incremental output in other commodity sectors affects the growth of total output in the sector by 5.90% which in turn increases distributive GDP by 6.54%. While agricultural GDP expands by 5.12%, GDP in other services grows at 10.61 percent as a result of indirect effects of past government investments. Overall, GDP (at CFC) grows by 6.52% and in turn, together with the growth in indirect taxes raises GDP (at market prices) by 6.80 per cent, and apparently aggregate consumption grows by 7.27%.

In the final year, regardless of the coffee sub-sector, most of the results are improved. It should, however, be noted that a 7.01% growth achievement is possible only at the expense of a 4.35% deterioration, as compared with the previous year, in the current account balance of the balance of payments.

On the contrary, a permanent fall in the New York price of coffee has a detrimental effect on the economy. In the first year the economy grows by

Table 4.5 Effects of a One-Period Change 27 Percent Increase in The New York Price of Coffee (Percentage deviations from the control solution) (in percent)

eq. no.	Variable	Years			3-year average
		1	2	3	
1	GDP, at current prices	1.26	6.63	6.13	4.67
2	GDP, at CFC	3.04	6.35	6.09	5.16
3	Agricultural GDP	-0.79	5.03	3.14	2.46
4	Non-coffee Agr. GDP	1.05	5.51	5.09	3.88
5	GDP, other comm. sectors	4.89	5.53	6.20	5.54
7	GDP, distributive sector	5.42	6.13	6.87	6.14
8	GDP, other services	9.53	10.61	12.95	11.03
10	Coffee GDP	-10.72	2.48	-7.40	-5.21
11	Coffee yield per hectare	-9.34	0.89	2.28	-2.06
13	Quantity of coffee prod.	13.72	11.49	0.14	8.45
14	Changes in coffee prod.	204.13	-49.48	-251.55	-32.31
16	Changes in the quantity of coffee arrival	-19.31	4.68	23.78	3.05
18	Changes in the quantity of coffee exports	-19.31	4.68	23.78	3.05
19	Domestic coffee consumpt.	29.52	26.42	10.64	22.19
22	Export price of coffee	-30.06	-18.83	-13.90	-20.93
25	Producer price of coffee	-18.04	-12.81	-9.45	-13.43
26	Total investments	5.15	9.37	10.01	8.18
27	Government inv.	5.36	9.76	10.42	8.51
28	Total consumption	1.35	7.08	6.56	5.00
29	Private consumption	1.29	6.80	6.28	4.79
30	Government consumption	1.64	8.61	7.96	6.07
31	Government revenue	0.40	12.06	12.07	8.18
32	Direct tax revenue	1.69	8.84	8.18	6.24
33	Indirect tax revenue	-13.43	7.78	5.53	-0.04
34	Net indirect taxes	-15.97	9.26	6.57	-0.04
35	Government expenditure	2.78	4.37	4.61	3.92
37	Government credit	36.78	-15.66	-10.81	3.44
38	Export of goods & services	-19.47	7.86	4.66	-2.32
39	Coffee export earnings	-42.64	10.00	3.69	-9.65
40	Non-coffee export earnings	1.14	5.96	5.52	4.21
41	Import of goods & services	3.37	6.01	6.16	5.18
50	Current account deficit	53.46	1.94	9.47	21.62

Source: Own computer output

only 1.26% and the external account deteriorates substantially thereby, together with lower government revenues than expenditures, the need to expand government credit amount to 36.78%. Due to government's effort, in the second year, a better performance is achieved both in the domestic economic activities and in the external sector. The economy grows at 6.63%. The current account deficit is increased only by 1.94% from its previous year's level as a result of increased exports than imports. Government credit falls due mainly to higher government revenues than expenditures. In the final year GDP grows at 6.13% while the current account deficit increases by 9.47%. Moreover, in the last two years the fall in producer prices of coffee is lower than the fall in export prices which indicates that the progressive nature of the surtax protects coffee producers from a sharp fall in their income.

4.2.3 Summary of the Results

In summarizing our results it seems that the net effects of one-period changes in the New York price of coffee, on average, has a positive impact on growth and other domestic variables of the economy. However, fluctuations in the New York price of coffee are found to have adverse effects on the external sector of the economy. That is, the net effect is to increase the current account deficit by 15.36%. After the shocks in the first year, as discussed in the preceeding sections, it is clear that domestic economic activities are benefitted due to government's effort in adjusting quickly to the new deteriorated situation. At times of short falls in coffee export earnings, aggregate export revenues are benefitted from a steady growth of non-coffee exports. The expansion of government expenditures are slower than revenues and hence additional government credit needs to fall.

The simulation results of permanent price changes are mostly similar, despite there are some important differences, as compared with one-period price shocks in the international coffee market. The main differences are that changes in the current account deficit are lower and government credit falls slower in the case of permanent changes than one-period changes.

Furthermore, all other results, except the coffee sub-sector variables in the former are above the latter .

In general, our analysis proves that changes in international coffee prices, on average, have a positive effect on growth and a negative effect on the current account balance of the balance of payments. Nevertheless, we are not yet convinced about the positive effects on growth and other variables for the following reasons. First, the government is responsible to rescue the economy at times of shortfalls in international coffee prices and thus it might not be possible to see the full impact of instability explicity. Second, the results may have been influenced by the assymetric nature of the model. Third, the positive impact of fluctuations on growth is only achievable at the expense of the external balance and therefore it would be difficult to conclude that instability has a positive effect on growth and other related economic variables. This is true only if the government is allowed to use foreign credit as a cushion and disregarding the effect of credit changes on debt servicing and repayment of the principal.

Following our empirical analysis, however, it is noteworthy to formulate policy recommendations, by way of conclusion, which can help reduce the deficit in the external balance and maintain a given rate of growth in the following final chapter.

CHAPTER V

5.0 Policy Considerations

In this part of our final analysis, we set targets to reduce the current account deficit in the balance of payments by 3 per cent and maintain the growth rate at 5 per cent. To achieve these objectives, policy recommendations are formulated using the true exogenous variables of the model. That is, policy variables are simulated and those which give a feasible solution will be considered. It should, however, be noted that we have been forced to include some of the most crucial policy instruments as endogenous variables for the reasons repeatedly mentioned through the previous chapters and therefore our analysis will be limited to the true exogenous variables of the model. Of course, once we have passed over this model building stage a reversal of that situation is possible.

In general, 11 policy scenarios can be formulated from the combination of instruments in the model. These policy scenarios are listed below:

Policy Scenarios	Instruments
I	--collective investment & changes in the increase harvested coffee acreage
II	--changes in general & social services and changes in the increase harvested acreage of coffee
III	--non-tax revenue and changes in general & social services

IV	--Non-tax revenue and collective investment
V	--non-tax revenue and changes in the increase harvested coffee acreage
VI	--non-tax revenue and subsidies
VII	--changes in general & social services and collective investment
VIII	--changes in general & social services and subsidies
IX	--collective investment and subsidies
X	--collective investment and changes in social & general services
XI	--changes in the increase harvested coffee acreage and subsidies

From the above, the solution of policy scenario I (which considers collective investment and changes in the increase harvested coffee acreage) has been found to be relatively more feasible as compared with others. Before we deal with the results, it is interesting to see how these instruments affect other variables of the model through the multipliers.

Changes in the increase coffee harvested acreage immediately affect the quantity of coffee production. As a result, increased coffee production boosts the quantity of coffee marketable surplus which, in turn, through its increase, affects the quantity of coffee exports. Assuming the base year values for coffee export prices, higher changes in the quantity of coffee exports bring a valuable foreign exchange to the economy.Changes in the increase harvested coffee acreage also increase agricultural GDP through the multiplier. It follows that the expansion of output in the agricultural sector calls for the import of capital goods, such as farm machineries, fertilizers, insecticides, and herbicides for state farms' and peasant cooperatives' use.

Another important impact is on government revenues. That is to say, government revenues are favoured as a result of increased direct tax revenues and indirect tax revenues. The growth in direct tax revenues is achieved by the expansion of the overall GDP, while increased indirect tax revenues come from a better performance in export earnings and accelerated growth in aggregate imports. Government expenditures are increased less than its revenues. Although the fall in government credit is effected by an improvement both in the government budget and the external sector, unproductive investments are still maintained by favourable government revenues. These investments in turn increase aggregate investment, which indirectly determines the growth of output in other commodity sectors. Such an expansion, especially in the manufacturing sector, necessitates the import of spare parts and intermediate goods which are crucial inputs for industrial production. The expansion of output in other commodity sectors in turn determines the growth of output in the distributive sector and hence the demand for transport capital goods increases. GDP (at CFC) grows as a result of changes in the GDP of agricultural, other commodity, and distributive sectors; and the cumulative effect, together with increased net indirect taxes is reflected in the overall economic growth. Such an economic growth is followed by both higher private and government consumption.

Similarly, the immediate impact of changes in collective investment is reflected in higher aggregate investment. It follows that more resources will be allocated in other commodity sectors in order to expand output in the sector and thereby increase the production of consumer goods. Such an expansion, especially in the industrial sector, requires the import of industrial capital goods, raw materials and semi-finished goods. The growth of output in other commodity sectors favours the distributive sector to grow almost in the same amount. As a result, the expansion in the import of transport capital goods is required to facilitate the regional distribution of output to the ultimate consumer. While collective investments bring changes in the agricultural output through the multiplier, it has no effect on the output of other services sector as changes in output of the sector is determined by lagged exogenous variable. Overall, GDP (at CFC) increases and in turn, together with the increase in net indirect taxes affects GDP at current prices. As a result of changes in the economic growth rate, both private and government consumption expand and thus the demand for non-coffee agricultural commodities, which are the main staples, increase.

Government revenue is benefited from direct and indirect tax revenues. While changes in direct tax revenues come from a better performance in the overall economic growth, indirect tax revenues change due to changes in non-coffee export revenues and imports of capital goods. Increases in government revenues also bring changes in government expenditures through increased government investments. Despite a surplus in the government budget, government credit increases due to imbalances in the external sector. That is to say, higher investment expenditures are accompanied by increased imports of capital and intermediate goods which in turn increase aggregate imports. And the slower growth in overall export earnings fails to finance changes in import expenditures and hence the current account balance deteriorates. To meet the growing import demand by the different productive sectors, the inflow of foreign resources are necessitated which may be possible in the form of aid and loans.

Following our multiplier analysis, it is now time to speak of the results. That is, solving the instruments simultaneously (in relation to the targets), the outcome of policy scenario I -- which is of export promotion and import substitution nature -- suggests that 27.3% of harvested coffee acreage be expanded and collective investments, amounting to 417 million Ethiopian Birr, has to be spent on public enterprises in other commodity sectors to achieve our objectives. Since Ethiopia is endowed with a high potential of forest coffee, the above recommended expansion should be interpreted in this context. For example, wild coffee is largely grown in the forests of Kaffa and Illubabor regions of the country where labour is scarce. Shortages of labour can be overcome through settlement programs.

Furthermore, some of the expansion can be undertaken by expanding the rehabilitation programs in coffee state farms. It should also be noted that the above solution is interpreted on the basis of a *cetris paribus* assumption. In reality, however, all other things may not remain constant and adjustments can be made in all other variables of the model.

ANNEX I

Foreign Trade and Coffee Exports by Calender Year

Year	Total Imports (million Birr)	Total Exports and Re-exports (mln. Birr)	Visible balance of trade (mln. Birr)	Coffee Exports		
				Quantity (tons)	Value (mil. Birr)	Col. 6 as % of col. 3
1	2	3	4	5	6	7
1963/64	276.1	223.4	-52.7	66387.5	110.883	49.6
1964/65	307.6	262.5	-45.1	70227.8	158.842	60.5
1965/66	375.7	289.8	-85.9	87653.8	188.180	64.9
1966/67	404.3	277.0	-127.3	73641.8	155.672	56.2
1967/68	357.4	252.7	-104.7	73063.6	139.182	55.1
1968/69	432.5	266.0	-166.5	80270.2	152.962	57.5
1969/70	388.3	298.1	-90.2	88383.4	173.947	58.4
1970/71	429.1	305.9	-123.2	70860.7	181.268	59.3
1971/72	469.5	314.4	-155.4	80822.4	175.210	55.7
1972/73	435.6	387.3	-48.3	82521.9	182.535	47.1
1973/74	448.2	499.5	+51.3	75981.6	189.515	37.9
1974/75	586.0	556.2	-29.8	55666.2	151.864	27.3
1975/76	613.1	478.3	-134.8	57723.5	152.661	31.9
1976/77	736.7	603.9	-132.8	71245.9	341.751	56.6
1977/78	810.9	722.0	-88.9	50180.6	547.515	75.8
1978/79	1080.8	640.9	-439.9	67231.7	496.864	77.5
1979/80	1174.6	873.9	-300.6	87075.6	592.648	67.8
1980/81	1493.3	879.1	-614.2	76201.7	563.908	64.1

Source: Coffee Statistical Handbook 1961/62-1980/81, Ministry of Coffee and Tea Development, Planning and Programming Department, Statistical Division, January 1982.

ANNEX II

Sectoral Composition of GDP at Current Factor Cost (percent)

Sectors	1963/64	1973/74	1980/81
Agricultural Sector	62.00	50.68	50.00
Agriculture	58.80	48.38	48.11
Forestry, hunting and fishing	3.20	2.30	1.89
Other commodity sectors	13.16	15.49	15.48
Mining and quarrying	0.17	0.24	0.10
Manufacturing	2.45	5.18	7.01
Handicraft and small industry	4.14	4.69	3.81
Building and construction	5.94	4.59	3.83
Electricity and water	0.46	0.79	0.73
Distribution services	9.92	15.48	15.28
Wholesale and retail trade	6.55	10.36	10.60
Transport and communication	3.37	5.12	4.68
Other services	14.92	18.35	19.24
Banking and insurance	1.01	1.90	3.62
Public administration, defence	4.57	5.92	7.26
Ownership of dwellings	4.26	3.70	2.56
Educational services	1.00	2.37	2.22
Medical and health services	0.66	0.70	0.67
Domestic services and others	3.42	3.76	2.92

Source: Percentage share of each output sector has been calculated from the available data which was obtained from annual reports of the Central Statistical Office of Socialist Ethiopia (1963/64-1980/81).

ANNEX III

Share of Leading Single-Commodity Export and of All Leading Commodity Exports in Exports of Developing Countries

Region and country	Leading single-commodity export as % of total exports (1975-79 ave)	Number of leading commodity exports (IFS) (1979)	Leading commodity exports of % of total exports(75-79 ave)
Oil Exporting Countries			
Algeria	92	1	92 (0)
Bahrain	80	2	87 (7)
Ecuador	43	4	74 (30)
Gabon	77	3	91 (14)
Indonesia	67	3	81 (15)
Iran	97	1	96 (0)
Iraq	99	1	99 (0)
Kuwait	91	1	91 (0)
Libya	100	1	100 (0)
Nigeria	93	2	97 (4)
Qatar	97	1	97 (0)
Suadia Arabia	100	1	100 (0)
Trinidad and Tobago	90	2	92 (2)
Venezuela	95	2	97 (2)
Other Western Hemisphere			
Argentina	12	5	37
Bahamas	94	1	94 (0)
Barbados	27	1	27
Bolivia	48	8	96 (82)
Brazil	16	4	44
Chile	53	2	57
Colombia	47	1	47
Costa Rica	31	4	63
Dominican Republic	36	7	89
El Salvador	53	2	63
Guatemala	36	5	66
Guyana	36	4	88
Haiti	36	3	52
Honduras	25	4	67
Jamaica	50	3	79
Mexico	26	5	44 (18)
Nicaragua	24	3	56
Panama	25	4	78 (48)
Paraguay	26	8	81

Annex III con't...

Peru	18	9	73
Uruguay	19	3	41
Other Middle East			
Cyprus	13	4	26
Egypt	26	2	29
Israel	34	2	40
Jordan	27	1	27
Syria	64	2	79 (15)
Yemen, Arab Republic	45	3	76 (0)
Other Asia			
Afghanistan	36	6	86
Bangladesh	73	1	73
Burma	46	4	81
China, Republic of	5	2	9
Fiji	58	2	63
India	6	2	10
Malaysia	22	5	73 (60)
Pakistan	20	2	27
Philippines	22	4	55
Singapore	30	2	41 (11)
Sri Lanka	46	3	70
Thailand	15	6	58
Western Samoa	46	2	80
Other Africa			
Benin	24	3	49
Burundi	89	2	93
Cameroon	29	4	61
Central African Republic	7	6	89
Chad	61	1	61
Congo, Peoples Republic	67	3	82 (15)
ETHIOPIA	62	4	85
Gambia	82	1	82
Ghana	59	2	67
Ivory Coast	15	3	65
Kenya	28	3	59 (41)
Liberia	64	3	83
Madagascar	40	3	63
Malawi	49	4	80
Mali Republic	48	2	57
Mauritania	82	2	95
Mauritius	74	1	74
Morocco	38	2	49
Niger	62	2	64
Rwanda	70	3	87
Senegal	36	2	51

Annex III con't...

Sierra Leone	58	4	84
Somalia	70	3	88
Sudan	56	4	83
Tanzania	30	4	55
Togo	50	3	83
Tunisia	41	3	60 (20)
Uganda	88	3	96
Zaire	42	4	85
Zambia	93	1	93

Note: Calculated from data in IMF (198) for latest years for which data were then available (generally average of 1975-1979; 1979 data for China and Zambia)

For the share of all of the leading commodities in exports, the number in parenthesis gives the percentage if petroleum-related products are excluded for countries for which such products are one of the leading commodities.

Source: Adams, F.G. and J.R. Behrman, Commodity Exports and Economic Development, Lexington: Lexington Books, 1982:5-7.

ANNEX IV

Rejected equations:

1. $\Delta YAG = 158.85 - 0.023I$
$(0.83) \quad (-0.071)$
$R^2 = 0.00034$ $\quad DW = 1.80$ $\quad SE = 177.39$

2. $YOC = 812.73 + 0.038\, YAG + 1.08\, MRSG$
$(2.79) \quad (0.69) \quad (3.15)$
$R^2 = 0.438$ $\quad DW = 2.11$ $\quad SE = 41.08$
Note: YAG and MRSG are highly multicollinear

3. $YDIST = -200.84 + 0.73\, YOC + 0.13\, YAG$
$(-2.23) \quad (5.41) \quad (3.11)$
$R^2 = 0.92$ $\quad DW = 1.87$ $\quad SE = 33.2$

Note: The explanatory variables are highly multicollinear.

4. $YDIST = -146.86 + 1.17 YOC - 0.016\overline{YAG}_{(-1)}$
$(-2.01) \quad (5.79) \quad (-0.22)$
$R^2 = 0.947$ $\quad DW = 1.94$ $\quad SE = 43.29$

5. $\Delta YDIST = 7.70 + 0.11I$
$(-0.16) \quad (1.36)$
$R^2 = 0.11$ $\quad DW = 2.46$ $\quad SE = 45.5$

6. $\Delta YOS = 1230.18 + 0.26I$
$(4.25) \quad (0.86)$
$R^2 = 0.047$ $\quad DW = 1.23$ $\quad SE = 74.31$

7. $\Delta YOS = -772.69 + 1.57I - 0.10\overline{I}_{(-1)} - 0.61\overline{I}_{(-2)} - 0.16\overline{I}_{(-3)} + 2.40\overline{I}_{(-4)}$

(02.08) (2.62) (-0.11) (0.54) (0.14) (2.41)

$R^2 = 0.86$ DW = 1.04 SE = 139.06

8. $YHA = 0.16 - 0.00033\,\overline{P22C}_{(-1)} + 0.0028\overline{P22C}_{(-4)}$

(5.68) (-0.90) (5.20)

$R^2 = 0.74$ DW = 1.37 SE = 0.029

9. $YHA = 0.15 - 0.00011\overline{P22C}_{(-3)} + 0.0027\overline{P22C}_{(-4)}$

(5.45) (-0.21) (3.78)

$R^2 = 0.72$ DW = 1.43 SE = 0.03

10. $\Delta YC = -144.32 - 0.50\overline{I}_{(-1)} + 1.02\overline{I}_{(-2)} - 0.19\overline{I}_{(-4)}$

(0.70) (1.30) (1.41) (-0.45)

$R^2 = 0.20$ DW = 2.19 SE = 89.41

11. $\Delta YC = 0.039 - 0.13\overline{I}_{(-1)} + 0.20\overline{I}_{(-4)}$

(0.00021) (-0.43) (0.61)

$R^2 = 0.036$ DW = 2.37 SE = 93.36

12. $\Delta YC = 23.92 - 0.0033I$

(0.26) (-0.021)

$R^2 = 0.041$ DW = 1.97 SE = 91.80

13. $QC = 173.70 - 0.041\overline{A1}_{(-4)} + 0.51\overline{P22C}_{(-4)}$

(3.22) (-0.45) (1.91)

$R^2 = 0.249$ DW = 1.36 SE = 16.00

14. $QC = 118.11 + 0.37\overline{P22C}_{(-4)} + 0.08\overline{I}_{(-4)}$

(2.63) (1.49) (0.93)

$R^2 = 0.248$ DW = 1.92 SE = 14.59

15. $QC = 141.80 + 0.41\overline{P22C}_{(-1)} + 0.15\overline{P22C}_{(-4)}$

(11.69) (2.60) (0.65)

$R^2 = 0.527$ DW = 1.98 SE = 12.70

16. $QC = 141.74 + 0.40\overline{P22C}_{(-1)} + 0.011\overline{P22C}_{(-2)} + 0.15\overline{P22C}_{(-3)}$

(11.07) (1.68) (0.041) (0.59)

$R^2 = 0.527$ DW = 1.98 SE = 13.3

17. $QC = 141.94 + 0.41\overline{P22C}_{(-1)} - 0.027\overline{P22C}_{(-2)} + 0.068\overline{P22C}_{(-3)} + 0.11\overline{P22C}_{(-4)}$

(10.51) (1.61) (-0.082) (0.21) (0.32)

$R^2 = 0.529$ DW = 1.98 SE = 14.01

18. $QCX = 81.8 - 0.15PXC$

(13.98) (-1.74)

$R^2 = 0.12$ DW = 1.40 SE = 10.53

19. $TRI = -72.38 + 1.25XC + 0.40XCN + 0.0052CP$

(-1.53) (4.76) (2.26) (0.14)

$R^2 = 0.967$ DW = 2.61 SE = 51.17

Note: XC and CP in equation 19 are multicollinear, the coefficient of the latter is insignificant and hence was dropped.

APPENDIX I

LINEARIZATION METHODS

In linearizing the different non-linear equations, we have followed Alarcon's way of presentation. That is:

> "The Taylor expansion method was used for those equations in which the product of two variables was involved, and the first relative difference approach was used for those equations which were originally estimated in exponential form." (J.V. Alarcon-Rivero, 1978, p. 98).

To illustrate the first method we have presented one example (eq. 13) below.

The quantity of coffee production is defined as the product of yield per hectare and harvested acreage under coffee.

$$QC = YHA \cdot \overline{A1} \ldots\ldots\ldots\ldots (1)$$

In terms of first absolute differences, eq. 1 yields (b = base):

$$QC_{(b)} + \Delta QC = (YHA_{(b)} + \Delta\ YHA)(\overline{A1}_{(b)} + \Delta\overline{A1}) \ldots\ldots\ldots\ldots (2)$$

$$QC_{(b)} + \Delta QC = (YHA_{(b)}\overline{A1}_{(b)}) + YHA_{(b)}\Delta\overline{A1} + \overline{A1}_{(b)}\Delta YHA + \Delta YHA\ \Delta\overline{A1} \ldots\ldots\ldots (3)$$

Assuming the product of the increases is equal to zero, eq. 3 gives:

$$QC_{(b)} + \Delta QC = YHA_{(b)}\overline{A1}_{(b)} + YHA_{(b)}\Delta\overline{A1} + \overline{A1}_{(b)}\Delta YHA \ldots\ldots\ldots\ldots (4)$$

We know that the left hand side equation is equal to total coffee procution, thus to arrive at the linearized form, eq. 4 can be rewritten as:

$$QC = [YHA_{(b)}\overline{A1}_{(b)}] + YHA_{(b)}\Delta\overline{A1} + \overline{A1}_{(b)}\Delta YHA \ldots\ldots\ldots\ldots (5)$$

Similarly, to illustrate the second method, we consider equation 17:

$$QCX = \alpha QCA_{11}{}^{\beta} \tag{1}$$

by taking the logarithm, eq. (1) gives:

$$l_n\, QCX = l_n \alpha + \beta l_n\, QCA_{11} \tag{2}$$

Equation (2) can also be written in the following form:

$$\frac{\partial\, QCX}{QCX} = \beta\, \frac{\partial QCA_{11}}{QCA_{11}} \tag{3}$$

Assuming that $\partial QCA_{11} = \Delta QCA_{11}$, equation (3) yields:

$$\frac{\Delta QCX}{QCX_{(b)}} = \beta\, \frac{\Delta QCA_{11}}{QCA_{11}} \tag{4}$$

After rearranging terms, equation 4 gives:

$$\Delta QCX = \beta\, \frac{QCX_{11}(b)}{QCA_{11(b)}} \cdot \Delta QCA_{11} \tag{5}$$

By adding the preceeding year's coffee production to both sides of equation 5, we arrive at the final linearized form as follows:

$$\Delta QCX + \overline{QCX}_{(-1)} = \partial\, \frac{QCX(b)}{QCA_{11(b)}} \cdot \Delta QCA_{11} + \overline{QCX}_{(-1)}$$

$$\text{implies } QCX = \beta\, \frac{QCX(b)}{QCA_{11(b)}} \cdot \Delta QCA_{11} + \overline{QCX}_{(-1)} \tag{6}$$

ORIGINAL MATRIX A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	1.00	-1.00	0.00	-1.00	0.00	-1.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	1.00	-1.00	0.00	0.00	0.00	0.00	0.00	-1.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	-1.11	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	-2.82
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	1.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-429.00	1.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	1.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.18
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	-0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	-0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	-0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	-0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	-0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	-0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	-0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ORIGINAL MATRIX A

ANNEX V Continued

	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.31
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.08	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-202.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	-1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	-0.70	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	-1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	1.00	0.00	-0.07	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	-1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	-0.03	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.30	1.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.69	0.00	0.00	1.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	-7.40	0.00	0.00	-110.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ANNEX V Continued

	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1	0.00	0.00	0.00	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	-0.42	0.00	0.00	0.00	0.00	0.00	-0.14	0.00	0.00	0.00	0.00	0.00
28	-1.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	1.00	-1.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	-0.68	-0.22	-0.34	0.00
34	0.00	0.00	0.00	0.00	-1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	1.00	0.00	0.00	0.00	-1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00	-1.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-1.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	-0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	0.00	0.00	1.00	0.00

```
ORIGINAL MATRIX A

          43      44      45      46      47      48      49      50

  1      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
  2      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
  3      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
  4      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
  5      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

  6      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
  7      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
  8      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
  9      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 10      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

 11      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 12      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 13      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 14      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 15      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

 16      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 17      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 18      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 19      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 20      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

 21      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 22      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 23      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 24      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 25      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

 26      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 27      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 28      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 29      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 30      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

 31      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 32      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 33      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 34      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 35      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

 36      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 37      0.00    0.00    0.00    0.00    0.00    0.00    0.00    1.00
 38      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 39      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 40      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 41     -1.00   -1.00    0.00    0.00    0.00   -1.00   -1.00    0.00
 42      0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 43      1.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 44      0.00    1.00   -1.00   -1.00   -1.00    0.00    0.00    0.00
 45      0.00    0.00    1.00    0.00    0.00    0.00    0.00    0.00

 46      0.00    0.00    0.00    1.00    0.00    0.00    0.00    0.00
 47      0.00    0.00    0.00    0.00    1.00    0.00    0.00    0.00
 48      0.00    0.00    0.00    0.00    0.00    1.00    0.00    0.00
 49      0.00    0.00    0.00    0.00    0.00    0.00    1.00    0.00
 50      0.00    0.00    0.00    0.00    0.00    0.00    0.00    1.00
```

ANNEX VI

MATRIX A-INV

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.57	1.57	1.57	1.63	3.79	3.79	1.58	1.57	1.57	1.57	2412.72	2412.72	5.62	5.52
2	1.51	1.51	1.51	1.52	3.37	3.37	1.55	1.51	1.51	1.51	2035.39	2036.09	4.75	4.67
3	0.50	0.50	1.50	1.52	1.20	1.20	0.53	0.50	0.50	1.50	2015.80	2015.80	4.70	4.62
4	0.50	0.50	0.50	1.52	1.20	1.20	0.53	0.50	0.50	0.50	762.90	762.90	1.75	1.75
5	0.00	0.00	0.00	0.00	1.03	1.03	0.01	0.00	0.00	0.00	9.62	9.62	0.02	0.02
6	0.00	0.00	0.00	0.00	0.03	1.03	0.01	0.00	0.00	0.00	9.62	9.62	0.02	0.02
7	0.01	0.01	0.01	0.00	1.14	1.14	1.01	0.01	0.01	0.01	10.67	10.67	0.02	0.02
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1252.90	1252.90	2.92	2.87
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.01	0.01	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.01	1.01	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	435.04	435.04	1.01	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	435.04	435.04	1.01	1.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	78.31	78.31	0.18	0.18
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	78.31	78.31	0.13	0.18
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.81	54.81	0.12	0.13
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.81	54.81	0.13	0.13
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	380.22	380.22	0.89	-0.13
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.06	0.06	0.06	0.04	0.35	0.35	0.11	0.06	0.06	0.26	113.12	113.12	0.26	0.26
27	0.06	0.06	0.06	0.04	0.35	0.35	0.11	0.06	0.06	0.06	113.12	113.12	0.25	0.25
28	1.60	1.60	1.61	1.67	3.86	3.86	1.71	1.60	1.60	1.61	2460.97	2460.97	5.74	5.65
29	1.29	1.29	1.29	1.34	3.11	3.11	1.38	1.29	1.29	1.29	1974.43	1974.43	4.61	4.54
30	0.31	0.31	0.31	0.33	0.76	0.76	0.34	0.31	0.31	0.31	462.54	462.54	1.12	1.11
31	0.16	0.16	0.16	0.21	0.64	0.64	0.23	0.16	0.16	0.16	521.39	521.39	[illegible]	1.20
32	0.09	0.09	0.09	0.10	0.23	0.23	0.10	0.09	0.09	0.09	144.75	144.75	0.34	0.33
33	0.06	0.06	0.07	0.11	0.42	0.42	0.12	0.06	0.06	0.07	376.53	376.53	0.85	0.86
34	0.06	0.06	0.07	0.11	0.42	0.42	0.12	0.06	0.06	0.07	376.53	376.53	0.88	0.85
35	0.06	0.05	0.06	0.04	0.35	0.35	0.11	0.06	0.05	0.06	113.12	113.12	0.26	0.26
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	-0.07	-0.07	-0.06	-0.32	0.55	0.55	0.09	-0.07	-0.07	-0.06	-756.17	-756.17	-1.75	-1.73
38	0.09	0.09	0.09	0.29	0.23	0.23	0.16	0.09	0.09	0.09	550.58	550.58	[illegible]	[illegible]
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	415.49	[illegible]	0.93
40	0.09	0.09	0.09	0.29	0.23	0.23	0.16	0.09	0.09	0.29	144.75	144.75	0.34	0.33
41	0.12	0.12	0.12	0.14	1.05	1.05	0.31	0.12	0.12	0.13	200.59	[illegible]	0.47	0.46
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	0.00	[illegible]
43	0.00	0.00	0.00	0.00	0.37	0.37	0.00	0.00	0.00	0.00	[illegible]	[illegible]	0.01	0.01
44	0.01	0.01	0.02	0.02	0.43	0.43	0.19	0.01	0.01	0.02	[illegible]	[illegible]	0.05	0.05
45	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	[illegible]	[illegible]	0.04	0.04
46	0.00	0.00	0.00	0.00	0.21	0.21	0.18	0.00	0.00	0.00	[illegible]	1.92	0.00	0.00
47	0.00	0.00	0.00	0.00	0.22	0.22	0.00	0.00	0.00	0.00	[illegible]	[illegible]	0.00	0.00
48	0.11	0.11	0.11	0.12	0.27	0.27	0.12	0.11	0.11	0.11	[illegible]	[illegible]	0.40	0.40
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.41	1.41	0.01	0.01
50	-0.03	-0.03	-0.04	[illegible]	-0.35	-0.35	-0.21	-0.03	-0.03	-0.04	[illegible]	[illegible]	[illegible]	[illegible]

ANNEX VI Continued

MATRIX A-INV

	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	5.56	5.55	7.94	8.03	0.09	119.39	119.39	15.06	318.01	318.01	9.16	0.32	0.37	0.51
2	1.82	1.82	2.59	2.67	0.08	39.69	39.69	3.90	304.67	304.67	3.77	0.29	0.33	0.47
3	1.73	1.73	2.47	2.54	0.07	37.75	37.75	9.72	302.56	302.56	8.71	0.10	0.12	0.47
4	1.76	1.76	2.51	2.54	0.03	37.75	37.75	4.75	100.56	100.56	2.90	0.10	0.12	0.47
5	0.04	0.04	0.06	0.05	0.00	0.92	0.92	0.09	1.00	1.00	0.03	0.09	0.10	0.00
6	0.04	0.04	0.06	0.05	0.00	0.92	0.92	0.09	1.00	1.00	0.03	0.09	0.10	0.00
7	0.05	0.05	0.07	0.07	0.00	1.02	1.02	0.10	1.11	1.11	0.03	0.10	0.11	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	-0.03	-0.03	-0.05	0.00	0.05	0.00	0.00	3.95	202.00	202.00	5.92	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	-0.01	-0.01	-0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	-0.01	-0.01	-0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.70	0.70	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.70	0.70	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	-0.71	-0.71	-1.01	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.00	0.00	0.03	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.00	1.00	0.03	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	1.00	0.00	0.00	0.00
26	0.51	0.51	0.74	0.73	0.00	10.80	10.80	1.03	11.82	11.82	0.34	1.03	1.20	0.01
27	0.51	0.51	0.74	0.73	0.00	10.80	10.80	1.03	11.82	11.82	0.34	0.03	1.20	0.01
28	5.67	5.67	8.10	8.19	0.09	121.73	121.75	15.36	324.37	324.37	9.34	0.33	0.38	1.52
29	4.56	4.56	5.51	5.59	0.07	97.90	97.90	12.35	260.77	260.77	7.51	0.25	0.31	0.42
30	1.11	1.11	1.59	1.61	0.02	23.36	23.36	3.01	63.60	63.60	1.83	0.05	0.07	0.10
31	4.36	4.36	5.34	5.54	0.02	35.87	35.87	7.05	32.42	32.42	0.93	0.05	0.06	0.05
32	0.33	0.33	0.48	0.48	0.01	7.16	7.16	0.90	19.08	19.08	0.55	0.02	0.02	0.03
33	3.74	3.74	5.33	5.36	0.01	79.70	79.70	6.16	13.34	13.34	0.38	0.04	0.04	0.03
34	3.74	3.74	5.33	5.36	0.01	79.70	79.70	6.15	13.34	13.34	0.38	0.04	0.04	0.03
35	0.51	0.51	0.72	0.73	0.00	10.80	10.80	1.03	11.82	11.82	0.34	0.03	1.20	0.01
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
37	-8.62	-8.62	-12.31	-12.34	-0.03	-133.46	-133.46	-13.53	-12.34	-12.34	-0.37	0.05	1.22	-0.10
38	5.50	5.50	7.8[illegible]	7.85	0.02	117.17	117.17	9.04	19.11	19.11	0.55	0.02	0.02	0.09
39	5.17	5.17	[illegible]	7.4[illegible]	0.02	110.30	110.30	8.14	0.00	0.00	0.00	0.00	0.00	0.00
40	0.33	0.33	[illegible]	0.48	0.01	7.17	7.17	0.90	19.11	19.11	0.55	0.02	0.02	0.09
41	0.46	0.46	[illegible]	0.65	0.01	9.76	9.76	1.25	25.86	25.86	0.77	0.09	0.11	0.04
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.02	0.02	[illegible]	0.02	0.00	0.33	0.33	0.03	0.35	0.35	0.01	0.03	0.04	0.00
44	0.03	0.03	0.05	0.05	0.00	0.73	0.73	0.12	3.29	3.29	0.09	0.04	0.04	0.00
45	0.02	0.02	0.02	0.02	0.00	0.36	0.36	0.08	2.87	2.87	0.08	0.00	0.00	0.00
46	0.01	0.01	0.01	0.01	0.00	0.16	0.16	0.02	0.20	0.20	0.01	0.02	0.02	0.00
47	0.01	0.01	0.01	0.01	0.00	0.19	0.19	0.02	0.21	0.21	0.01	0.02	0.02	0.00
48	0.40	0.40	0.57	0.58	0.01	8.50	8.50	1.08	22.90	22.90	0.56	0.02	0.03	0.04
49	0.01	0.01	0.01	0.01	0.00	0.12	0.12	0.02	0.32	0.32	0.01	0.00	0.00	0.00
50	5.05	5.05	7.21	7.22	0.01	107.39	107.39	7.80	-7.76	-7.76	-0.22	-0.07	-0.08	0.05

MATRIX A-INV

	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1	0.51	0.73	0.10	0.10	1.67	1.57	0.05	0.05	0.05	-0.05	1.09	0.32	0.62	0.62
2	0.47	0.55	0.09	0.09	0.50	0.51	0.05	0.05	0.05	-0.05	0.36	0.09	0.25	0.25
3	0.47	0.54	0.03	0.03	0.53	0.50	0.02	0.02	0.02	-0.02	0.34	0.10	0.20	0.20
4	0.47	0.54	0.03	0.03	0.53	0.50	0.02	0.02	0.02	-0.02	0.34	0.10	0.20	0.20
5	0.00	0.01	0.03	0.03	0.03	0.00	0.01	0.01	0.01	-0.01	0.01	-0.01	0.03	0.03
6	0.00	0.01	0.03	0.03	0.03	0.00	0.01	0.01	0.01	-0.01	0.01	-0.01	0.03	0.03
7	0.00	0.01	0.03	0.03	0.04	0.01	0.02	0.02	0.02	-0.02	0.01	-0.01	0.03	0.03
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	[illegible]	[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	[illegible]	[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.01	0.12	0.34	0.34	0.39	0.06	0.17	0.17	0.17	-0.17	0.10	-0.03	0.30	0.30
27	0.01	0.12	0.34	0.34	0.39	0.06	0.17	0.17	0.17	-0.17	0.10	-0.03	0.30	0.30
28	1.52	1.74	[illegible]	[illegible]	1.71	1.60	0.05	0.05	0.05	-0.05	1.11	0.32	0.63	0.63
29	1.42	0.60	[illegible]	[illegible]	1.37	1.29	0.04	0.04	0.04	-0.04	[illegible]	0.25	0.51	0.51
30	0.10	1.15	[illegible]	[illegible]	0.33	0.31	0.01	0.01	0.01	-0.01	0.22	0.05	0.12	0.12
31	0.06	0.21	[illegible]	[illegible]	1.17	0.15	0.01	0.01	0.01	-0.01	[illegible]	0.25	0.41	0.41
32	0.03	0.04	0.02	[illegible]	0.10	0.09	0.00	0.00	0.00	0.00	0.07	0.02	0.04	0.04
33	0.03	0.17	0.01	0.01	1.07	0.06	0.01	0.01	0.01	-0.01	0.72	0.23	0.37	0.37
34	0.03	0.17	[illegible]	0.01	1.07	1.06	0.01	0.01	0.01	-0.01	0.72	0.23	0.37	0.37
35	0.01	0.12	0.34	0.34	0.39	0.06	1.17	1.17	0.17	-0.17	0.10	-0.09	0.30	0.30
36	0.00	0.00	[illegible]	[illegible]	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
37	-0.10	0.2	[illegible]	[illegible]	-0.73	-0.07	1.17	1.17	1.17	-1.17	-1.57	-1.33	0.42	0.42
38	0.09	0.10	[illegible]	[illegible]	0.10	0.09	0.00	0.00	0.00	1.00	1.07	1.00	0.04	0.04
39	0.00	0.00	[illegible]	[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
40	0.09	0.10	[illegible]	[illegible]	0.10	0.09	0.00	0.00	0.00	0.00	0.07	1.02	0.04	0.04
41	0.04	0.43	[illegible]	[illegible]	0.15	0.12	0.01	0.01	0.01	-0.01	0.09	0.02	1.07	1.07
42	0.00	0.20	[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
43	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	-0.01	0.00	0.00	0.01	0.01
44	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	-0.01	0.01	0.00	0.01	0.01
45	0.00	0.01	[illegible]	[illegible]	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
47	0.00	0.00	0.01	[illegible]	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
48	0.04	0.41	0.01	[illegible]	0.12	0.11	0.00	0.00	0.00	0.00	0.08	0.02	0.04	0.04
49	0.00	0.00	0.00	[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.05	-0.32	[illegible]	[illegible]	-0.09	-0.03	-0.01	-0.01	-0.01	1.01	[illegible]	1.00	-1.03	-1.03

ANNEX VI Continued

MATRIX A-INV

	43	44	45	46	47	48	49	50
1	0.62	0.62	0.62	0.62	0.62	0.62	0.62	-0.05
2	0.25	0.25	0.25	0.25	0.25	0.25	0.25	-0.05
3	0.20	0.20	0.20	0.20	0.20	0.20	0.20	-0.02
4	0.20	0.20	0.20	0.20	0.20	0.20	0.20	-0.02
5	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.01
6	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.01
7	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.02
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.30	0.30	0.30	0.30	0.30	0.30	0.30	-0.17
27	0.30	0.30	0.30	0.30	0.30	0.30	0.30	-0.17
28	0.63	0.63	0.63	0.63	0.63	0.63	0.63	-0.05
29	0.51	0.51	0.51	0.51	0.51	0.51	0.51	-0.04
30	0.12	0.12	0.12	0.12	0.12	0.12	0.12	-0.01
31	0.41	0.41	0.41	0.41	0.41	0.41	0.41	-0.01
32	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00
33	0.37	0.37	0.37	0.37	0.37	0.37	0.37	-0.01
34	0.37	0.37	0.37	0.37	0.37	0.37	0.37	-0.01
35	0.30	0.30	0.30	0.30	0.30	0.30	0.30	-0.17
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.92	0.92	0.92	0.92	0.92	0.92	0.92	-1.17
38	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00
41	1.07	1.07	1.07	1.07	1.07	1.07	1.07	-0.01
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	1.01	0.01	0.01	0.01	0.01	0.01	0.01	-0.01
44	0.01	1.01	1.01	1.01	1.01	0.01	0.01	-0.01
45	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
46	0.01	0.01	0.01	1.01	0.01	0.01	0.01	0.00
47	0.01	0.01	0.01	0.01	1.01	0.01	0.01	0.00
48	0.04	0.04	0.04	0.04	0.04	1.04	0.04	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
50	-1.03	-1.03	-1.03	-1.03	-1.03	-1.03	-1.03	1.01

ORIGINAL MATRIX 5

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.85	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ORIGINAL MATRIX 3

ANNEX VII Continued

	15	16	17	18	19	20	21	22	23	24	25
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	750.66	750.66
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1139.40	1189.40
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-27.37	-27.37
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-134.97	-134.97
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1425.20	1425.20
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.59	122.89
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	531.76	581.76
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.46
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.27	-0.27
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	250.00	119.06
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-193.00	-193.00
15	0.00	0.00	0.00	0.00	0.00	-19.00	0.00	0.00	0.00	33.08	83.08
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-102.08	-102.08
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.08	67.08
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-37.08	-67.08
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	-6.81	-6.81
22	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.14	95.36
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.78	-2.75
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.40	34.40
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.30	39.30
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-113.42	-113.42
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-178.77	-173.77
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-408.33	-408.38
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	839.70	839.70
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-133.63	-133.63
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-55.05	-55.05
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-157.10	-157.10
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1631.75	1681.75
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	545.00	585.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-49.15	-49.15
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	391.20	391.20
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-104.01	-104.01
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	40.54	0.00	0.00	-9.33	-9.33
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-24.65	-24.65
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-65.27	0.00	-23.47	-23.47
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-76.06	-75.06
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.83	0.77	0.77
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ANNEX VIII

SELECTED SOLUTION COLUMNS AS PERCENTAGE OF CONTROL SOLUTION

	CONTROL	25	26	27	28	29	30	31	32	33	34	35	36	37
1	8871.34	100.00	105.60	111.75	115.65	110.06	106.87	116.54	101.26	115.49	116.53	110.06	111.27	116.64
2	8041.88	100.00	105.91	111.84	117.23	108.76	108.78	117.17	103.04	114.35	117.17	108.78	111.65	117.25
3	3999.57	100.00	104.36	108.80	110.59	110.51	102.80	110.51	99.21	114.00	110.50	110.51	108.45	110.56
4	3373.76	100.00	104.71	109.77	113.84	108.37	105.71	113.75	101.05	112.88	113.75	108.37	109.37	113.82
5	1246.06	100.00	105.08	110.96	117.27	105.26	110.75	117.05	104.89	110.74	117.04	105.26	110.93	117.24
6	56.66	100.00	111.54	128.03	138.87	115.65	120.67	138.73	107.63	128.45	138.72	115.65	124.68	138.64
7	1248.16	100.00	105.63	112.14	119.14	105.83	111.91	118.90	105.42	111.90	118.89	105.83	112.11	119.11
8	1548.09	100.00	109.53	120.14	133.09	109.53	120.14	133.09	109.53	120.14	133.09	109.53	120.14	133.09
9	122.89	100.00	120.01	133.66	163.20	120.01	133.66	163.20	120.01	133.66	163.20	120.01	133.66	163.20
10	625.81	100.00	105.66	103.57	93.03	122.05	57.12	93.03	89.28	120.05	93.03	122.05	103.51	92.75
11	0.47	100.00	90.66	91.55	93.83	90.66	91.55	93.83	90.66	91.55	93.83	90.66	91.55	93.83
12	0.19	100.00	-24.25	3.71	4.05	-24.25	3.71	4.05	-24.25	3.71	4.05	-24.25	3.71	4.05
13	202.12	100.00	113.72	125.21	125.35	112.72	125.21	125.35	113.72	125.21	125.35	113.72	125.21	125.35
14	9.12	99.99	304.13	254.65	3.10	304.13	254.65	3.10	304.13	254.65	3.10	304.13	254.65	3.10
15	84.72	100.00	83.47	65.97	43.60	83.47	65.97	43.60	83.47	65.97	43.60	83.47	65.97	43.60
16	-17.36	99.99	80.69	85.37	109.15	80.69	55.37	109.15	80.69	85.37	109.15	80.69	85.37	109.15
17	74.93	99.99	86.91	73.06	55.37	86.91	73.06	55.37	86.91	73.06	55.37	86.91	73.06	55.37
18	-12.15	100.00	80.69	85.37	109.16	80.69	65.37	109.16	80.69	85.37	109.16	80.69	85.37	109.15
19	127.19	100.00	129.52	155.94	165.58	129.52	155.94	166.58	129.52	155.94	166.58	129.52	155.94	155.53
20	7.09	100.00	100.00	100.00	100.00	127.04	100.00	100.00	72.96	100.00	100.00	127.04	127.04	127.04
21	0.28	100.00	1.28	1.28	1.28	677.35	-675.43	1.28	-674.72	674.47	1.28	677.35	0.63	0.63
22	100.00	95.86	95.36	95.86	95.36	121.78	95.96	95.86	69.94	95.86	95.36	121.78	121.78	121.78
23	2.87	99.93	99.93	99.93	99.93	117.62	99.93	99.93	82.25	99.93	99.93	117.62	117.62	117.62
24	0.09	100.00	-2.22	-2.22	-2.22	574.21	-591.34	-2.22	-573.61	576.89	-2.22	574.21	-4.92	-4.92
25	100.00	99.59	99.58	99.58	99.58	117.21	99.58	99.58	81.96	99.58	99.58	117.21	117.21	117.21
26	958.57	100.00	107.35	116.90	126.21	110.55	113.94	126.12	105.15	119.18	126.11	110.55	116.54	126.17
27	949.27	100.00	108.15	119.69	127.29	110.99	114.52	127.20	105.36	119.98	127.19	110.99	117.33	127.27
28	6461.62	100.00	106.05	112.55	117.31	110.75	107.35	117.69	101.35	116.56	117.68	110.76	112.05	117.72
29	7095.73	100.00	105.81	112.04	117.37	110.32	107.04	116.96	101.29	115.88	116.95	110.32	111.55	117.04
30	1365.39	100.05	107.36	115.25	121.62	113.07	108.92	121.43	101.64	120.12	121.42	113.07	114.54	121.50
31	2224.31	100.00	105.63	119.55	129.14	116.86	110.36	129.05	100.40	126.67	129.36	116.86	115.59	129.12
32	398.65	100.00	107.56	115.59	122.23	113.44	109.17	122.03	101.69	120.68	122.08	113.44	115.05	122.23
33	965.56	100.00	102.75	109.15	108.55	118.93	90.17	108.74	86.57	122.29	108.74	118.93	105.35	[illegible]
34	829.46	100.00	103.27	110.59	110.53	122.52	98.30	110.40	64.03	126.52	110.39	122.52	107.55	110.47
35	2631.02	100.00	103.50	108.60	112.40	104.82	106.94	112.36	102.78	108.91	112.36	104.82	107.95	112.37
36	1681.75	100.00	101.33	102.65	103.99	101.33	102.66	103.99	101.33	102.66	103.99	101.33	102.66	103.97
37	915.93	100.00	97.65	100.35	89.70	58.52	121.92	89.54	136.76	53.56	89.53	58.52	92.55	89.72
38	1118.16	100.00	101.50	104.02	104.44	122.46	92.81	104.39	80.53	124.59	104.39	122.46	103.77	104.41
39	526.29	100.00	97.44	95.65	92.58	137.54	55.52	92.58	57.36	136.57	92.58	137.54	96.61	92.54
40	591.38	100.00	105.10	110.51	115.30	109.06	106.19	114.89	101.14	113.95	114.89	109.06	110.15	114.97
41	1628.00	100.00	105.36	116.60	117.35	107.35	109.13	116.87	103.37	112.81	116.86	107.35	111.12	117.02
42	391.20	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
43	344.57	100.00	106.51	114.27	122.49	106.85	113.99	122.20	106.37	113.98	122.19	106.85	114.23	122.45
44	466.37	100.00	105.95	112.70	119.75	106.61	111.98	119.51	105.29	112.83	119.50	106.61	112.54	119.72
45	28.65	99.99	106.43	111.65	114.03	113.92	103.70	113.92	98.93	118.55	113.92	113.92	111.20	113.99
46	200.02	100.00	106.32	113.64	121.50	106.54	113.38	121.23	105.09	113.36	121.21	106.54	113.52	121.45
47	233.20	100.00	105.58	112.04	118.98	105.75	111.21	118.74	105.38	111.79	118.72	105.78	112.01	118.74
48	415.72	100.00	108.70	136.33	125.58	115.45	110.55	125.41	101.94	123.79	125.40	115.45	117.32	125.54
49	9.64	100.01	109.23	110.62	115.34	109.29	104.34	115.23	101.18	114.26	115.23	109.28	110.35	115.21
50	-509.82	100.00	113.33	142.23	144.59	74.19	155.27	144.25	153.46	96.93	144.23	74.19	127.23	144.55

SELECTED SOLUTION COLUMNS AS PERCENTAGE OF CONTROL SOLUTION

	38	39	40	41	42	43	44	45	46
1	101.26	111.08	116.43	110.06	116.86	123.87	101.26	107.89	114.02
2	103.04	111.48	117.08	108.78	115.30	122.03	103.04	109.39	115.48
3	99.21	108.35	110.45	110.51	115.63	119.80	99.21	104.24	107.38
4	101.05	109.22	113.65	108.37	114.02	119.85	101.05	106.56	111.65
5	104.89	110.55	116.86	105.26	111.16	117.77	104.89	110.42	116.62
6	107.63	124.44	138.59	115.65	129.77	145.46	107.63	121.53	136.37
7	105.42	111.69	118.68	105.83	112.37	119.70	105.42	111.55	118.42
8	109.53	120.14	133.09	109.53	120.14	133.09	109.53	120.14	133.09
9	120.01	133.66	163.20	120.01	133.66	163.20	120.01	133.66	163.20
10	89.28	103.66	93.11	122.05	124.32	119.57	89.28	91.76	84.36
11	90.66	91.55	93.83	90.66	91.55	93.83	90.66	91.55	93.83
12	-24.25	3.71	4.05	-24.25	3.71	4.05	-24.25	3.71	4.05
13	113.72	125.21	125.35	113.72	125.21	125.35	113.72	125.21	125.35
14	304.13	254.65	3.10	304.13	254.65	3.10	304.13	254.65	3.10
15	83.47	65.97	43.60	83.47	65.97	43.60	83.47	65.97	43.60
16	80.69	85.37	109.15	80.69	85.37	109.15	80.69	85.37	109.15
17	86.91	73.06	55.37	86.91	73.06	55.37	86.91	73.06	55.37
18	80.69	85.37	109.16	80.69	85.37	109.16	80.69	85.37	109.16
19	129.52	155.94	166.58	129.52	155.94	166.58	129.52	155.94	166.58
20	72.96	72.96	72.96	127.04	161.39	205.06	72.96	53.32	38.31
21	-674.73	-1.54	-1.54	677.35	859.45	1091.13	-674.73	-492.71	-361.91
22	69.94	69.94	69.94	121.78	154.71	196.57	69.94	51.11	37.21
23	82.25	82.25	82.25	117.62	140.09	168.65	82.25	69.40	59.91
24	-578.61	0.50	0.50	574.21	727.35	931.41	-578.61	-418.23	-307.34
25	81.96	81.96	81.96	117.21	139.60	168.06	81.96	69.15	59.70
26	105.15	116.46	126.02	110.55	120.08	130.66	105.15	114.52	124.53
27	105.36	117.16	127.10	110.99	120.91	131.93	105.36	115.12	125.54
28	101.35	111.65	117.57	110.76	113.03	125.52	101.35	108.43	114.99
29	101.29	111.36	116.35	110.32	117.29	124.47	101.29	108.09	114.37
30	101.64	114.40	121.35	113.07	121.90	131.00	101.64	110.25	118.21
31	100.40	118.44	128.96	116.86	129.04	142.45	100.40	112.46	124.53
32	101.69	114.80	121.94	113.44	122.51	131.87	101.69	110.53	118.71
33	86.57	106.11	108.59	118.93	126.90	135.05	86.57	94.35	99.68
34	84.03	107.27	110.20	122.52	132.00	141.69	84.03	93.29	99.36
35	102.78	107.89	112.33	104.82	109.25	114.07	102.78	107.15	111.76
36	101.33	102.66	103.99	101.33	102.66	103.99	101.33	102.66	103.99
37	136.78	92.69	89.55	58.52	43.15	26.77	136.78	121.12	110.31
38	80.53	103.63	104.26	122.46	130.41	138.30	80.53	88.39	93.05
39	57.36	96.43	92.41	137.54	147.54	157.21	57.36	67.35	71.04
40	101.14	109.98	114.30	109.05	115.18	121.49	101.14	107.10	112.62
41	103.37	110.82	116.71	107.35	113.65	120.43	103.37	109.39	115.54
42	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
43	106.37	113.74	121.94	106.85	114.53	123.14	106.37	113.57	121.64
44	105.29	112.22	119.28	106.61	113.48	121.05	105.29	111.74	118.78
45	98.93	111.06	113.34	113.92	120.72	126.25	98.93	105.61	109.76
46	105.09	113.13	120.98	106.54	113.89	122.12	105.09	112.97	120.69
47	105.38	111.59	118.52	105.78	112.26	119.53	105.38	111.45	118.26
48	101.94	117.03	125.25	115.46	125.91	136.67	101.94	112.12	121.53
49	101.18	110.21	115.14	109.28	115.53	121.98	101.18	107.27	112.91
50	153.46	126.61	144.02	74.19	76.88	81.23	153.46	155.40	164.37

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