MACROECONOMIC POLICIES AND THE AGRICULTURAL SECTOR IN THE SUDAN, WITH SPECIFIC REFERENCE TO THE EXPORT SUB-SECTOR (1970 - 1995)

A Thesis
Submitted to the School of Graduate Studies
Addis Ababa University

In Partial Fulfilment for the Degree of Master of Science in Economics (Economic Policy Analysis) in the Addis Ababa University

By

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June 1996

ADDIS ABABA UNIVERSITY
School of Graduate Studies

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ACKNOWLEDGEMENT

Great thanks are extended to my GOD for giving me life and help to do this degree, to my family in Sudan for prayers and well wishes. I extend much thanks to the African Economic Research Consortium and Economic Department (Addis Ababa University) for covering my post graduate studies. Special regards are directed to Dr Elbadawi and Mr Mekonnen Tadesse. I also extend a lot of thanks to my advisor, Dr Mulat Demeke for constructive and timely assistance and to all my instructors in this program. The comments from my colleagues namely Alimamy Kamara, Amos Kipronoh and all the graduating group is unmeasurable. I would like to thank Mr Alegally Mohammed and Mr Mohammed Bashir (UNECA) for their help. My great thanks to my best friends Elisabeth and Trufat for their love and kindness. Lastly, to all scholars of Africa.

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Table of Contents

List of Tables

List of Figures

ABSTRACT

This paper seeks to address the effect of government intervention on the agricultural sector with particular reference to the export sub-sector at the aggregate and crop levels in the Sudan. In the study 5 major export crops were examined. The intervention was analyzed through sector specific and macroeconomic policies. From the analyses it was quite evident that agricultural exports have been taxed directly through trade policies, export regulations, price and market controls; and indirectly through unfavourable exchange rates on export and import tariffs and quotas on non-agricultural goods. Exchange rate was overvalued during the period of the study, this overvaluation has been relaxed in recent years due to trade liberalization and flexible exchange rate system. The implicit tax on agricultural exports is extensively more higher than the direct one.

Further analysis was done using Ordinary Least Square estimates. Most of the data were non-stationary and the variables of interest were co-integrated and therefore, Engle-Granger methods of error correction model was used. Agricultural export share on current GDP respond positively to the relative prices of agricultural goods , the response at crop level is stronger than at aggregate level. Labour force has a positive effect in some cases and negative in others. Export share adjusts with terms of trade shocks in the short-run but inefficient policies caused disequilibrium in the long-run. The protection rates have a negative effect on the export share, and this share was declining through time.

Chapter One

1. THE PROBLEM AND OBJECTIVES

1.1 Introduction

Government interventions in agriculture are wide and common in all developing countries and to the same extent in the developed countries. Such interventions are helpful to agriculture and are needed especially in the least developed countries (LDCs). The interventions often pertain to the price policy, exchange rate, and trade policies.

The practical motivations for price policy are to stabilize prices, protect consumers and producers through floor prices. Exchange rate policies such as devaluation are also used to solve problems of the balance of payments and capital flows, and to improve the deficit in the current account through promotion of exports and decreasing of imports. Trade policies such as export and import taxes and quotas are widely used in many developing countries in order to control trade and to generate government revenue. In fact developing countries depend heavily on these types of taxes as a major source of government revenue.

Recently it has become widely accepted that the structure of incentives in agriculture is influenced by trade and exchange rates as well as other macroeconomic policies. Real exchange rates have an implicit effect on the economy specially on primary goods, which are agricultural on the main.

In addition to such induced implicit policies on the agricultural sector, it may also be influenced by other factors such as changes in the terms of trade associated with external changes which have direct effects on trade of primary agricultural commodities. For example, the effect of oil boom which is known in the literature as "Dutch Disease " creates real exchange rate overvaluation in some countries.

In the Sudan, this phenomenon was demonstrated by the remittances of Sudanese working in oil countries. It has been estimated, on average, at $1.6 billion per annum for the period 1980 to 1989 (Elbadawi 1992). These flows have substantially influenced domestic absorption and thus influenced the real exchange rate.

Sector specific policies are the policies which are imposed directly on the agricultural sector. These are: trade policies and barriers such as export and import taxes on the intermediate and final agricultural goods, and quota restrictions; prices and markets control which are meant to protect producers through determining producer price and subsidizing agricultural inputs, or to control markets and goods movement through marketing boards.

Beside other domestic taxes on agricultural goods direct export tax in the Sudan ranged between 5 to 25 percent since 1970 to 1995. Quotas and barriers on export and imports prevailed, and internal and external trade was controlled by parastatals and market boards. Sector specific policies have direct effect on agriculture.

I.2 Statement of the problem

Structural adjustment programmes (SAPs) and their impact on agriculture in developing countries particularly in Sub-Saharan African countries, SSA, have been a focus of major

concern to international organizations, and attracted much academic discussions in the literature on economic development. SAPs have also prevailed in Sudan and affected the economic growth as a whole and agriculture sector in particular.

Sudan as one of the SSA countries has experienced more of government interventions in the form of sector-specific policies which restricted farmers' access to the world market, partly through export duties and royalties and partly as a result of the marketing boards' behaviour. Exports duties on most of the country's traditional exports have been at the rates of 5 - 25 percent during the 80's and adjusted to 6 - 11 percent in 1992. Exports of cotton, gum arabic and oil seeds (sesame and groundnuts) (together constituting more than 80 percent of Sudan's exports) were entrusted to public entities between 1970 and 1992. Other exports have been subjected to formal licensing and quotas, and since February, 1992 comprehensive policy decisions were being made with respect to trade and exchange rate policies. These policy decisions were reduction of export tax, elimination of subsidies, abolition of trade barriers and license, unification of exchange rates, lifting of price controls and raising of the credit ceiling for agriculture to 50 percent of total credit ceiling for each commercial bank, and dismantling monopoly power of parastatals. As of 1994 exchange rate was allowed to be determined freely by market forces.

Exchange rate system in Sudan had a multiple nature: the fixed rate on exports, and free or Parallel Exchange Rate on imports and transaction activities. These two exchange rate policy operated side by side with the black market rate.

Import of goods and other inputs for the agricultural sector are mostly financed through the black market channels. Exchange rate premia in the black market is usually high due to the high risk involved. Official rates are usually adjusted by the authorities taking into

account the free or parallel rate. This adjustment usually follows the behaviour of the black market rate. It follows that the black market rate has a significant influence in the adjustment and determination of the official government exchange rates.

Exporters are usually restricted in their operation. Sometimes they have to transfer the total export earnings through the official channels, and in other cases they are obliged to use specific proportion to import specific goods. Such policy restraints and foreign exchange controls led to underinvoicing of exports and overinvoicing of imports. As a result the influence of black market on foreign exchange increased.

The policy shift towards food security has had a negative impact on incentives for agricultural exports during the 1990s, where the government intervened to increase wheat's cultivated area at the expense of cotton. This led to a reduction in cotton production, and so its share on exports.

Given the high treatability of the agricultural sector in Sudan, the real exchange rate would certainly have an effect on the sector[1]. The purpose of this study is to analyze the macroeconomic and sector-specific policies on agriculture with special emphasis on agricultural exports.

1.3 The objectives:

In order to evaluate and measure the macroeconomic and sector specific policies on the agricultural exports, this study attempts to:

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[1] Real exchange rate = price of tradable goods/price of nontradable.

1- Measure the impact of exchange rate regimes for 5 main export crops. These crops are cotton, gum arabic, sesame, groundnuts[2] and sorghum.

2- Assess the impact of sector specific policies such as export and import taxes, price and market controls and institutional parastatals.

3- Highlight the liberalization policy of institutional structure and trade regime effect during 1990s.

1.4 Significance of the study

Agricultural exports are the main source of foreign exchange earnings in Sudan as well as the main source of government revenue. More than 80 percent of export earnings come from the 5 crops mentioned earlier. The share of the agriculture sector in the GDP is 30 to 40 percent. Tables 1 and 2 show the percentage share of agricultural exports in selected years.

Government economic policy induced by political considerations in Sudan has been assumed to be the source of aggregate decline of the agricultural sector. Reevaluating these policies can help to find solutions for tremendous improvements in this sector.

Most of the studies on the Sudan's economy (see chapter three) emphasize exchange rates evaluation at nominal rates. In this study, the equilibrium real exchange rate will be used to reflect the real and actual distortions in the sector.

Chapter two presents the methodology, chapter three highlight the general background of the Sudan economy, chapter four the literature review, chapter five is on the trade and

[2]Sesame and groundnuts are oilseeds crops.

exchange rate incentive policies, chapter six discusses the econometric model and the cost to the export sub-sector in general and to each crop in particular. The conclusion of this study is presented in chapter seven.

Table 1: The share of export- 1980 - 1985 (in percentage)

Crop	80/81	81/82	82/83	83/84	84/85
Cotton	42.5	19.5	25.1	49	49.5
Gum	6.7	10.0	8.3	9	7.9
Sesame	9.2	9.9	7.9	9	11.8
Groundnut	2.2	18.6	6.9	2	3.3
Sorghum	15.8	12.0	22.3	8	0.9
Animals & meat	8.5	12.3	14.7	12	13.6
Total	84.9	82.3	85.2	89	87

Source: Economic Review, 1984/85, Ministry of Finance and Economic planning, Sudan.

Table 2: The share of exports 1989 - 1994

Crop	89/90	90/91	91/92	92/93	93/94
Cotton	51.8	51.8	33	18.2	12.9
Gum Arabic	9.8	14.5	11.7	5.7	17.5
Oil Seeds	13.9	11.4	14	20.2	20
Sorghum	-	-	-	12.7	8
Animals & meat	11.5	6.5	9.2	20.9	18.5
Total	87	84.2	67.9	77.7	76.9

Source : Economics Review, 1993/1994.

Chapter Two

2. METHODOLOGY

2.1 Data type and source

This study depends on secondary time series data. The necessary information is collected from the statistical departments, Bank of Sudan, Ministry of Agriculture, Ministry of Finance and other similar institutions in the Sudan. Also some data were computed from UNCTAD annual reports.

2.2 Data analysis

To understand the impact of macroeconomic and sector-specific policies on the agricultural sector we need to measure the effect of these policies directly and indirectly, i.e the direct nominal protection rate, NPR_D and indirect nominal protection rate, NPR_I. These will be calculated using the model used by Krueger, Schiff, and Valdés (1988). This will help in measuring the direct and indirect effects of policy interventions on agricultural exports using the equilibrium real exchange rate. The analysis will be run in 2 stages: (1) the mathematical calculation to estimate the direct and indirect protection rates, (2) the econometric model to analyze the cost at aggregate level and on each crop.

2.2.1 Direct and indirect protection rates:

Let p_i be the domestic producer price of a tradable agricultural product i, and P_i^B be the border price of product i. The P_i^B can be defined as:

$$P_i = P_i^B E_o$$

where E_o is the official nominal exchange rate (and adjusted for transport, storage, and other costs, and quality difference). Let $P_i^* = P_i^B E^*$ be the border price P_i^B evaluated at the equilibrium real exchange rate e^*.

Let P_{NAT} be price of non-agricultural tradables, P_{NAH} be price of non-agricultural home goods and then let P_{NA} be non-agricultral sector price index which is defined as:

$$P_{NA} = \alpha P_{NAT} + (1 - \alpha) P_{NAH}$$

where α is the share of tradable part and $(1-\alpha)$ is the share of home goods. And let $P_{NA}^* = \alpha P_{NAT} e^* (1 + t_{NA}) + (1-\alpha) P_{NAH}$ is the non-agricultural price index where the tradable part is evaluated at e^* and in the absence of trade policy, t_{NA}, affecting nonagricultural tradables.

Hence the direct nominal protection rate, which measures the proportional difference between the relative domestic price and the relative border price of agricultural tradable, is

$$NPR_D = \frac{P_i / P_{NA}}{P_i^* / P_{NA}} - 1 = P_i / P_i^* - 1 \qquad (1)$$

NPR_D measures the effect of price controls, export taxes or quotas and the other policies affecting P_i. The indirect nominal protection rate which measures the effect of the exchange rate E_o differing from E^*, and the effect of trade policy on P_{NAT}, is

NPR_I is the same for all tradable products since P_i does not appear in equation 2. Finally,

$$NPR_I = \frac{P_i' / P_{NA}}{P_i^* / P_{NA}^*} - 1 = \frac{P_{NA}^* E_o}{P_{NA} E^*} - 1 \text{----------(2)}$$

the total nominal protection rate

is

$$NPR_T = \frac{P_i / P_{NA}}{P_i^* / P_{NA}^*} - 1 \text{----------(3)}$$

From equation 1, 2 and 3, $NPR_D + NPR_I \neq NPR_T$ because the denominator of NPR_D differs from that of NPR_I and NPR_T. Therefore, to make the three measures comparable, other new direct protection rate is defined as follows:

$$npr_D = \frac{P_i / P_{NA} - P_i' / P_{NA}}{P_i^* / P_{NA}^*} \text{----------(4)}$$

which measure the impact $(P_i / P_{NA} - P_i' / P_{NA})$ of the direct policies as a percentage of

P_i^* / P_{NA}^* , the relative price which would prevail in the absence of all interventions and

with $E = E^*$. Then $npr_D + NPR_I = NPR_T$.

Equilibrium Real Exchange Rate (ERER) Computation

The real exchange rate is defined as the price of tradable goods, (P_x price of exportable and P_m price of importable), to nontradable goods price P_H. In this model the real exchange rate, e, is defined as the ratio of the nominal exchange rate E and the price of nontradable goods H, that is

$$e \equiv E/P_H$$

Foreign prices are considerd in the definition of e in the case of a large country where its

share in the world market affects the world prices of export and import. But in a small country case these prices are given and will not be affected by policy changes.

The interest here is to consider the changes in e which would result from the elimination of interventions and of the unsustainable part of the current account deficit.

The assumption is that both the demand for and supply of foreign exchange, Q_d and Q_s, are functions of the real exchange rate, with elasticities - η and ϵ - respectively. Also we assume that the unsustainable part of the deficit in the current account is ΔQ_o, so the real exchange rate needed to eliminate this deficit is

$$e_1 = \left(\frac{\Delta Q_o}{\epsilon Q_s + \eta Q_d} + 1\right) e_o$$

where, e_o is the prevailing real exchange rate and $\epsilon Q_s + \eta Q_d$ measure the reduction in excess demand for foreign exchange (the deficit) due to a one unit increase in real exchange rate.

With the existence of import tariff (t_m) on importable goods and export tax (t_x) on exportable, the change in the deficit will be

$$\Delta Q_1 = \frac{t_m}{1 + t_m} Q_d \eta - \frac{t_x}{1 - t_x} Q_s \epsilon$$

Then the equilibrium in real exchange rate exist when

$$\Delta Q_o = t_x = t_m = 0$$

and in this case the equilibrium real exchange rate e^* is given by

$$e^{*} = \left(\frac{\Delta Q_o + \Delta Q_1}{\epsilon Q_s + \eta Q_d} + 1 \right) e_o$$

The non-tradable sector (Home goods, H) is assumed almost to consist of non-agricultural goods and services.

To introduce equilibrium real exchange rate as a solution rather than the nominal rate E in NPR_I and NPR_T above, the following equations were defined:

$$\frac{P_i}{P_{NA}} = \frac{P_i^B e_o (1 - t_x)}{\alpha P_{NAT}^B (1 + t_{NA}) e_o + (1 - \alpha)} \qquad (6)$$

$$\frac{P_i'}{P_{NA}} = \frac{P_i^B e_o}{\alpha P_{NAT}^B (1 + t_{NA}) e_o + (1 - \alpha) P_H} \qquad (7)$$

and

$$\frac{P_i^*}{P_{NA}^*} = \frac{P_i^B e^*}{\alpha P_{NAT}^B e^* + (1 - \alpha) P_H} \qquad (8)$$

As can be seen from equations 6,7, and 8, to drive NPR_I and NPR_T it is sufficient to know e_o and obtain e^*.

This methodology on ERER is different from the one used by Elbadawi (1992), where he used the determinant variables of RER through an econometric model which gave different values to the e^* than the values obtained by this method. Another difference is the definition of real exchange rate, ELbadawi used $E_o P^*/P_h$ to determine the RER and so ERER. Therefore, world prices were considered in his method.

2.2.2 The econometric model:

The study measures how the share of the agricultural export sub-sector to the aggregate GDP is affected by exchange rate policies, terms of trade, government investment on the sector, and the labour force on the sector.

The model uses time series data about the Sudan for the period 1970 - 1995. Most time series data are non-stationary, and non-stationarity creates problem of invalid estimates. To test for stationarity the methods of Co-integration analysis will be used. This method analyzes the time series characteristics of the variables and test for non-stationarity using the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) methods. To achieve stationarity in the variables the first difference of X_{t-1} must be used. If each element of a vector of time series X_t first achieves stationarity after differencing, but a linear combination $\alpha' X_t$ is already stationary, the time series X_t are said to be co-integrated with co-integrating vector α (Engle and Granger 1987).

From experience, most aggregate time series variables of the type used in this study appear to be "Integrated" variables which "drift" over time without any apparent tendency to return to constant long-run mean value (Marin and Warr 1991). Co-integration implies that deviations from equilibrium are stationary, with finite variance, even though the series themselves are nonstationary and have infinite variance (Maddala). Error correction allows long-run components of variables to obey equilibrium constraints while short-run components have a flexible dynamic specification.

The basic statistical approach in this study has four stages: (i) test the data for non-stationarity, (ii) test for existence of long run or cointegrated relationship between the

variables of interest, (iii) fit error correction models to allow inferences about both the short run dynamics and long run equilibrium relationship, and (iv) assess the resulting models against both economic and statistical criteria.

The analysis will be used at both aggregate and disaggregate levels. The aggregate level refers to total agricultural export that comes from the 5 major crops (mentioned before) and disaggregate level at crop level.

The estimation process begins with running OLS regression to provide an initial indication of the nature of the relationship between the variables of interest and their dynamic structure. Then it runs using Engle-Granger of the ECM (error correction model). This linear estimator allows the application of a wide range of diagnostic tests provided for heteroscedasticity, residual autocorrelation and parameter stability. The OLS estimating equation is :

$$(9)\quad \ln X_A/GDP = \alpha_o + \alpha_1 \ln(P_a/P_{na}) + \alpha_2 \ln(GI) + \alpha_3 \ln L + \alpha_4 \ln ToT + \alpha_5 \ln npr_D + \alpha_6 \ln NPR_I + \alpha_7 t + \alpha_8 D + e_t$$

where,

X_a/GDP the share of agricultural exports on the aggregate GDP.

P_a = price of tradable agriculture.

P_{na} = price of non-agricultural.

GI = government investment on the agricultural sector.

L = labour force in agricultural sector.

ToT = Sudan terms of trade.

npr_D = direct nominal protection rate.

NPR_I = indirect nominal protection rate (these two variables would further be verified in chapter five).

D = dummy variable for policy changes.

t = is simple time trend.

The behaviour of the relative price series P_a/P_{na} over time

reflects all of the factors considered in the literature such as world price changes and changes in nontraded good prices. The actual behaviour of the relative price series (together with the other right hand side variables) can then be used to decompose the observed changes in the share of agricultural exports.

Deflating the price of agricultural output by the prices of non-agriculture follows from the theoretical requirement that any valid profit function must be homogeneous of degree one in prices.

The Engle-Granger estimator can be viewed as,

$$(10)\quad \Delta\ln(X_A/GDP) = \alpha_1 \Delta\ln(P_a/P_{na}) + \alpha_2 \Delta\ln(GI) + \alpha_3 \Delta\ln L + \alpha_4 \Delta\ln ToT + \alpha_5 \Delta\ln npr_D + \alpha_6 \Delta\ln NPR_I + \alpha_7 t + \alpha_8 D + \alpha_9 e_{t-1} .$$

where, e_{t-1} is the residual from the OLS equation (9) and Δ in equation (10) is the first difference operator. The α_i terms in equation (10) are influenced by the dynamic behaviour of the model and hence should not be viewed as estimates of the long-run parameters. This presents no difficulties since this equation will be estimated primarily to assess the consistency of a general ECM form with the behaviour of the data, as well as to provide starting values for the non-linear ECM. The model will be,

$$\Delta(X_a/GDP) = A[\ \alpha_1\ \Delta\ln(P_a/P_n) + \alpha_2\ \Delta\ln(GI) + \alpha_3\ \Delta\ln\ L + \alpha\Delta_4\ \ln ToT + \alpha_5\ \Delta\ln\ npr_D + \alpha_6\ \Delta\ln\ NPR_I + \alpha_7\Delta D] +$$

$$B[\ (X_a/GDP)_{t-1} - \alpha_o - \alpha_1\ \ln(P_a/P_n)_{t-1} - \alpha_2\ \ln(GI)_{t-1}$$

$$- \alpha_3\ \ln L_{t-1} + \alpha_4\ \ln(ToT)_{t-1} - \alpha_5\ \ln\ npr_{Dt-1}$$

$$- \alpha_6\ \ln NPR_{It-1} - \alpha_7\ D]$$

where, the α_i variables represent the long-run response parameters and A and B, respectively, represent the rate of adjustment to changes in the exogenous variables and deviation from equilibrium of the previous period.

Chapter Three

3. BACKGROUND

3.1 The structure of the economy

Sudan is the largest country in Africa with total area of 2.5 million squire Kilo meters, it has a total population of about 25 million. The annual growth rate of population, according to the 1993 census, is 2.63 percent.

Agriculture plays a central role in the Sudan economy it accounts for 37 percent of the country's national output, over 75 per cent of foreign exchange earnings (excluding remittances), 75 per cent of the productive sectors' value added, 60 percent of employment and over 90 per cent of the national food requirements. Crop production accounts for 52 percent of total agricultural output, livestock for 39 per cent and 9 per cent comes from forestry and fisheries[3]. Improving the productivity and efficiency of the agriculture sector is therefore central to any program of economic recovery.

Total arable land amounts to 180 million feddans[4], out of which only 31 million feddans are now under cultivation. The area under cultivation is divided into two sectors:

1- The rainfed area which consists of the traditional and the mechanized sub-sectors.

2- The irrigated area of the large Gezira scheme, established in 1925. This scheme is based on a gravity-operated canals which take water from the Sennar Dam to the southern environs of Khartoum, a distance of 200 km and serves an irrigated area 2.1 of million

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[3]The figures in this paragragh were taken from Hag Elamin (1992) study.

[4] One Hectare = 2.38 Feddan.

feddans (882,000 ha). The irrigated subsector covers 4.5 million Feddans of which Gezira scheme(2.1 million feddan) and New Hlfa scheme (0.33 million feddan), together constitute more than 61 percent of the total irrigated area. These schemes are irrigated by gravity. The remaining part of the subsector comprises pump irrigated schemes along the main Nile, the Blue and White Nile rivers, and flood irrigated schemes in Toker and Gash Delta[5].

The average shares of rainfed and irrigated areas of the total area under cultivation during 1974-83 is 85.6 and 14.4 respectively. Although the irrigated sub sector represented a small share of the total area under cultivation, its share in the agricultural output accounted for 53.2 per cent over the same period. Table 3 and 4 provide more details for each year.

Agricultural crops and livestock constitute most of the country's exports. The export crops are Cotton, the country's main export, followed by Oilseeds (sesame and groundnuts) and Gum Arabic. The share of each crop in the total exports fluctuated from year to year due to many factors. Cotton's share in 1980, 1981, 1990 and 1991 was 42.5, 19.2, 51.8 and 33 per cent respectively. Table 1 and 2 provide the percentage share of each crop during the periods 1980-84 and 1989-93.

[5]Source of information: Ministry of Agriculrure.

Table 3: Share of irrigated and Rainfed Agriculture in Total Acreage of Main Crops 1974 - 84 in (000) Feddan[6]

Season	Irrigat	%	Rainfed	%	Total	%
74/75	2410.7	16.7	12004.9	83.3	14415.6	100
75/76	2622.5	16.6	13213.8	83.4	15836.4	100
76/77	2452.7	15.8	13065.7	84.2	15518.3	100
77/78	**2449.0**	**14.3**	**14595.1**	**85.7**	**17044.1**	**100**
78/79	2364.4	14.5	13937.5	85.5	16301.9	100
79/80	2309.3	16.4	11739.6	83.6	14048.9	100
80/81	2092.1	13.5	13371.0	86.5	15463.1	100
81/82	2241.9	12.3	15958.0	87.7	18199.8	100
82/83	1890.2	12.6	13143.4	87.4	15033.7	100
83/84	2124.4	12.4	14956.2	87.6	17030.6	100
AVG	2295.7	14.4	13598.5	85.6	15894.2	100

Source: Yearbook of Agricultural Statistics (1987), Statistic Division, Ministry of Agriculture and Natural Resources, Khartoum,Sudan.

[6] One Hectare = 2.38 feddan.

Table 4: Share of Irrigated and Rainfed Agriculture in Total Production of Main Crops during 1974 - 1984 (000 M.Ton)

Season	Irrigat	%	Rainfed	%	Total	%
74/75	2846.1	50.7	22772.9	49.3	5618.9	100
75/76	2716.4	46.5	2999.4	53.5	5715.8	100
76/77	2862.1	51.6	2751.1	48.4	5663.2	100
77/78	**3136.7**	**48.9**	**3276.0**	51.1	**6412.7**	**100**
78/79	2187.7	39.2	3378.0	60.8	5556.7	100
79/80	2472.0	51.4	2339.7	48.6	4811.7	100
80/81	3281.6	50.2	3251.1	49.8	6532.7	100
81/82	3769.0	46.2	4381.0	53.8	8150.0	100
82/83	4794.0	66.7	2398.5	33.3	7192.5	100
83/84	5789.4	72.2	2227.8	27.8	8017.2	100
AVG	3384.5	53.2	2982.5	46.8	6367.1	100

Source: Yearbook of Agricultural statistics (1987). Statistic Division, Ministry of Agriculture and Natural Resources, Khartoum, Sudan.

Almost all the cotton production, wheat and sugar cane are produced in the irrigated subsector. In addition, the irrigated subsector accounts for about 20 per cent of sorghum production and 50 per cent of groundnut. More than 55 per cent of the country's foreign exchange earnings comes from the irrigated subsector.

All these crops are heavily dependent on inputs imports such as fertilizer, insecticides and agricultural machineries spare parts. However, despite the extensive agricultural research in this subsector and the relatively availability of inputs, yield levels are low. The yield obtained by farmers are low relative to the potential. The main reasons are the weak links between farmers and research and extension activities, poor infrastructural facilities and the inefficient marketing and pricing policies.

The traditional rainfed subsector is a major source of supply for sorghum, millet, sesame, groundnuts, sunflower and a number of other minor crops such as kerkadeh and water melon seeds. Together with the traditional livestock subsector, it accounts for the bulk of the agricultural labour force (about 80 per cent). The sub-sector is characterized by small-size subsistence farming, and the use of traditional hand tools and lack of high yielding inputs such as improved seeds, fertilizer and pesticides. The most alarming feature of this sub-sector is the low yield per feddan. The performance of this sub-sector deteriorated significantly over the last decade as a result of drought and severe natural disasters.

The mechanized rainfed farming sub-sector has an important contribution to Sudan's economy. It produces 65 per cent of the country's sorghum, 53 per cent of sesame, and 100 per cent of sunflower. At present its contribution to the GDP is significantly modest at 5 per cent, but this contribution is expected to increase substantially during the coming few years. The most important characteristics of the mechanized rainfed subsector which could increase its potential for future growth are availability of land, low investment costs, and quick return on capital.

Food security is central in government policies and decisions. The main food crops are sorghum, millet and wheat. All the requirements of sorghum and millet are produced in the country, while part of wheat consumption requirement is imported[7].

The export of sugar and some other agricultural crops and non-agricultural products such as gold was recently started. The share of these items on total export value is more than 13 per cent.

Sudan's economic growth has been hampered by a number of structural weaknesses. Its export base is highly dependent on primary commodities and is not reasonably diversified. Primary commodities are facing an increasing competition in the international market and unfavourable terms of trade. As the same times, the economy is vulnerable to exogenous shocks particulary drought, war and political instability.

3.2 Economic Development Plans

Since its independence in 1956, Sudan had adopted the long-and medium-terms development planning approaches as means to achieve social and economic development. These planning mostly concentrated on expansion of food and export crops to increase and achieve specific level of annual GDP growth rate. The development plans were:

1) The Ten Year Plan 1960 - 1970.

2) The Five Year Plan 1971 - 1975.

3) The Six Year Plan 1977 - 1983, and

[7] This part is based Economic Review, Ministry of Finance, different series.

4) The Economic Recovery program which is extended to Three Year investment Programs 1978 - 1985.

The implementation of each program was influenced by a number of factors such as the magnitude of the economic crisis which preceded each program, the extent to which the government actually implemented and sustained the program, the adjustment reforms, the effect of exogenous factors such as weather, civil war and/or changes in the terms of trade facing the country. Most of these plans and programs were either readjusted or terminated due to their failure or changes in governments.

The objectives of the Ten Year Plan (1960/61 - 1970) were;

i) expansion in food crops to attain food security.

ii) production of import-substitutes goods so as to increase on foreign exchange earnings in order to finance further development programs.

iii) production of agricultural raw materials to meet local manufacturing needs.

iv) expansion of exportable crops to increase the foreign exchange earnings.

Looking at these objectives we find that Sudan had adopted the import-substitute strategy which was the main strategy in developing countries during 1960s.

The main objectives of the Five Year Plan (1971- 1974/75) were to achieve an increase of 7.6 per cent annual growth rate in the GDP focusing on agriculture, increase the domestic saving rate, and improve the balance of payment through enhancing of exports. However, due the to shortage in investment resources from external sources, the plan was adjusted to a six-year-plan. The agricultural sector received only 37 percent, and total productive sectors investment received 77 percent from the planed investment.

Due to the shortage in investment resources from both foreign and local sources the plan failed to achieve its objectives. Only 4 to 4.5 percent of GDP growth rate had been achieved. Savings could finance only 7.8 percent of the public investment instead of 53 per cent of the target. The external finance covered 34 percent of the public sector investment and the government had to resort the deficit-financing which amounted to 22.7 percent. As such the balance of payment gap widened as imports increased and exports decreased.

The main objectives of the Six year Plan (1977/78 - 1982/83) were to achieve an annual growth rate of 7.5 percent in GDP through:-

i) modernization and development of the agriculture sector.

ii) development of the industrial sector particulary the agro-industrial.

iii) promoting exports and imports-substitutes so as to improve the balance of payments.

iv) development of the infrastructural capabilities: transport and communications, energy, storage, marketing and supply of social services and empower the societies movement to participate more effectively in the development process.

v) encouraging the public and private sectors participation in the development process.

The Three year investment program (1978/79 - 1980/81) was a replacement of the six year plan and was designed in collaboration with the World Bank as part of an economic and financial reform exercise.

The programs was supported by International Monetary Fund (IMF). The objectives of this program were to address the shortages in foreign financing and reforming the structural distortion in the economy. The main purpose was to restructure the incentives

pattern both within agriculture and between agriculture and industry by pursuing a more realistic exchange rate in stead of quantitative restrictions and removing export taxes to promote exports. The program also provided for concessionary loans and grants to finance infrastructural projects in transport and energy sectors, and financing other on-going schemes which need rehabilitation. Priority was given to agriculture, followed by the service sector. The second three year investment program (1982 - 1985) concentrated mainly on the irrigated agricultural sector. Nonetheless, the program failed to achieve its objectives due to some disagreements between the government and bilateral and multilateral donors over some aspects of the policy reforms, particulary the exchange rate adjustment and other issues such as the price liberalization and privatization policies strongly resisted by the government.

There is controversy over the causes of this failure and opponents of the liberalization policies claim that there were great doubts about the effectiveness of the policy adopted in Sudan, particulary the devaluation of Sudanese pound. The World Bank and IMF on the other hand, related the failure to poor implementation and weak government commitment to the programs. Other exogenous factors were said to be initial policy weaknesses, deteriorating terms of trade, weather and environmental conditions, and the civil war. All these unforeseen variables appear to have a contributed to the poor performance of agriculture and exports during the seventies and eighties.

The economic performance continued to deteriorate until November 1988 when the government adopted new policies and changed its export regulations. Exchange rate was adjusted by devaluation of Sudanese pound.

3.3 Stabilization and the agricultural price policy

Since 1978, Sudan has been pursuing a set of stabilization and adjustment policies in an attempt to stimulate agricultural production. Price support policies were introduced for oilseed crops (sesame and groundnuts) and gum arabic through floor prices. This policy was mainly aimed at protecting producers and promoting export crops. The minimum floor price was usually announced at wholesale markets location rather than the villages or farm gate level.

Prices of agricultural inputs were supported by the government through subsidies. Land, water charges, and petroleum products were subsidized. Custom duties were removed or reduced on most agricultural inputs and equipments.

This minimum price policy however, proved to be low and did not have any real positive effect on marketing. The announced floor prices had no effect on producers. In fact it benefited the traders rather than farmers since it was adopted at the wholesale markets. Wheat price is declared by the government according to delivery price based on Gezira yields and cost of production. The delivery price constituted a subsidy by the wheat producer to the urban consumers.

3.3.1 Cotton price policy

Cotton is the major export crop in Sudan and the main source of foreign exchange earnings. During the sixties and seventies cotton was produced according to production relationship called the "Joint Account". Cotton used to be collected from tenants by the Gezira scheme authorities, and transported to ginning plants and then to the markets. According to the joint account system, the revenues were distributed between the three

members - tenants, parastatal, and the government as follows:

- discount all expenditures on different crops in the irrigated scheme from cotton proceeds.

- distribute the net proceeds on cotton as follows;

1- Tenants	47 percent
2- Government (land rent, maintenance of dams, and irrigation canals)	36 percent
3- The management (Gezira board)	10 percent
4- Social services	3 percent
5- Local government	2 percent
6- Tenants reserved fund	2 percent

The Joint Account system had a number of problems. These were;

1- disincentive effect on producers which discouraged competition.

2- since costs were charged per quantity produced rather than per unit of area this meant subsidizing low yield producers at the expense of high yield producers, .

3- all the cost of other crops were deducted from cotton proceeds which caused cotton to be less attractive compared to other crops, and this resulted in misallocation of resources.

4- payments were made to farmers over a period of tow years and this created many problems to the farmers.

Because of these disincentives, changes on production relationships were introduced and the individual account was established in 1980. Accordingly, tenants were charged the cost of inputs of each crop separately.

3.4 Recent Economic Performance

Despite the structural weaknesses in the Sudan economy and the unfavourable social conditions, and inspite of the sharp contrast in the low growth rates of the 1980s, real GDP growth rate started to improve by the 1992 fiscal year. GDP grew at a rate of 11 percent compared with -1.7 and 1.2 percent in 1989/90 and 1990/91 respectively.

The high growth of GDP performance was mainly as a result of recovery in the agricultural sector which expanded by 34 percent, and the increase in the manufacturing sector by 14 percent. The recovery in agriculture was facilitated by the good weather conditions following a two-year drought. Growth in the agricultural sector was 13.8 and 9.5 percent in 1993 and 1994, respectively. This was largely due to the strong performance of the livestock sub-sector.

3.5 Export and Import taxes on the agricultural sector

The agricultural sector was subjected to heavy exports and import taxes. Export tax ranged between 5 to 25 percent of F.O.B price in all crops. Development tax was 5 percent of Port Sudan delivery price for all exports, and it increased to 10 and 20 percent in 1981 and 1989 respectively. According to the food security policy, sorghum export was prohibited in 1985,1990 and 1991.

Import tax included custom duties, consumption tax and defence tax. Import taxes on seeds, pesticides, farm machinery were abolished in 1976. And on fertilizers and sacks was 5 and 12 percent respectively. It ranged between 25 to 70 percent in all agricultural products during the period of the study[8].

[8] Information is collected from Custom Duties Department.

Chapter Four

4. LITERATURE REVIEW

4.1 Introduction

The role of price systems are not restricted to any particular form of political system. Prices are crucial to the operation of the economy, be it a free market economy, or a state owned and centrally planned economy.

Price distortion prevails when prices of goods and services, capital and labour do not correctly reflect their scarcity. For traded goods the scarcity price is indicated by the border prices, that is the price at which goods could be exported or imported. For non-traded goods, the scarcity (or efficiency) price can be measured by the opportunity cost of their scarcity value in displacing traded goods. Price distortion may be caused by monopolistic tendencies in the market economy or by government interventions.

The price distortion can be observed in the price of foreign exchange, capital, labour, and infrastructure services (particulary power) To measure distortions in price of foreign exchange, one should ideally measure the effective exchange rates of imports and exports as they deviate from the equilibrium rate. In practice, it is difficult to calculate equilibrium exchange rates, unless some specific assumptions are developed.

Under-pricing agriculture is a common phenomenon in the developing countries. Taxation of agriculture come through various instruments such as direct taxes on output and exports, compulsory procurement at low prices, and subsidization of the sale of agricultural products through government market channels to protect urban consumers.

These policies were generally associated with rationing, and would lead to distortions and inefficiencies. The under pricing of agriculture does slow down agricultural growth and, in turn this would adversely affect the overall growth and equity in developing countries which largely depend on agriculture.

4.2 Specific Country Studies

A study by Martin and Warr (1991) on the decline of agriculture in Indonesia concluded that an increase in relative prices of agricultural output led to an increase of agricultural share in Indonesian economy, and an increase in the capital/labour ratio tend to reduce the share of agriculture in the economy. Another study by Krueger, Schiff, and Valdes (1988) on 18 developing countries concluded that most direct and indirect policies are biased against agriculture. Direct effect on agriculture comes from agricultural trade policies. However, the direct effect was found to be relatively less than the indirect effects on agriculture in most developing countries.

The indirect effect according to Krueger, Schiff and Valdes (1988) includes both the effect of trade and macroeconomic policies on the real exchange rate and the extent of protection usually given to non-agricultural commodities. The impact of indirect intervention on producer incentives was even stronger than the direct ones, as it had been found in Argentina, Brazil, Chile, Colombia, Côte d'Ivoire, The Dominican Republic, Ghana and other developing countries. The total effect of the government interventions were simply the sum of the direct and indirect effects.

Government policies differ significantly between various agricultural commodities within the same country and between countries. For example in Brazil wheat is an imported

commodity, the direct effect NPR_D was found to be 35 percent and the indirect effect was -32 percent, the total effect was 3. In Chile the direct effect on wheat was 11 percent, the indirect was 22 percent, and the total effect was 33 percent. In Pakistan, they found that the direct effect on wheat was -13 percent, the indirect -48, and the total effect -61 percent. However, by definition, those policies which indirectly affect agriculture have the same impact on exportable commodities. In Argentina the direct effect on exported wheat -25, indirect -16, and the total effect was -41 percent, during the period 1975 - 79 and increased to - 50 percent during 1980 - 84. In Chile the direct effect on exported Grapes was 1 percent, the indirect was 22, and the total effect was 23 percent.

The same impact was attributed to non-food agricultural commodities export. For example, in Egypt the total effect on cotton was -54 percent during the seventies to -36 percent during the eighties. These are just a few experience of some countries.

4.3 Direct and Indirect Incentives in the Agriculture

The impact of policy-wide intervention and sector specific were studded by Hag Elamin N. for period 1978 - 85 on the aggregate sector at production level. Protection rate ranged between -29.1 and -.5 during the seventies, and between 1.2 and 7.7 during eighties on food crops. This means that food crops were subsidized during the eighties due to food security strategy.

Elbadawi (1992) estimated the effect of intervention policies on the agricultural sector. The indirect intervention in 1975 was 5 times the direct intervention. The direct intervention was less than 4 percent with an increasing trend of indirect effect. The study

did not explain the impact of policy intervention at disaggregate level on crops especially to export crops.

The industrial and trade policy framework in Sudan imposed a sizable implicit taxes on agricultural crops and harboured an overall incentive bias in favour of industry during 1970 - 75. During the 1970s Sudan was classified as a highly inward-oriented country with a substantial bias against agriculture and exports.

A number of studies Hag Elamin N.(1992), Ashraya(1979), Nashashibi (1980), Elbadawi (1987), D'Silva and Elbadawi (1987), and Hag Elamin and Elmack(1995) have shown that the Sudan export sub-sector has been subjected to sizable taxation.

A study by Hag Elamin N. (1992) found that the direct and total protection coefficients on Sudan's exports for the periods 1975-1977 were -25.8 and -43.1 percent respectively. And for the period 1983 - 1985 the indirect coefficient was -19.2 and the total -46 percent.

Another study by Hag Elamin N. and Elmack Sh. (1995), concluded that direct nominal protection rate on the agricultural sector during 1970 - 1978 was -44 percent on cereals and -39 percent on non-cereals. The total effect on cereals was -50 percent and non-cereals was -40 percent.

A study by Elbadawi (1992) on real overvaluation, terms of trade shocks, and the cost to agriculture in Sub-Saharan Africa (Sudan being the case study) showed that farmgate prices remain generally lower compared to their equivalent border prices. The real exchange rate tended to deviate from its equilibrium, causing overvaluation of the exchange rate in Sudan.

Chapter Five

5. THE IMPACT OF TRADE AND EXCHANGE RATE POLICY INTERVENTION ON INCENTIVES

5 Construction of Price Indices

5.1 Non-agricultural Price Index:

For the construction of non-agricultural price index, information and annual data on export and import is used. Price of non-agriculture is the sum of price of non-agricultural tradable with its share,α, and price of home goods with its share,$(1-\alpha)$[9].

$$P_{na} = \alpha P_{nat} + (1-\alpha)P_h$$

where,

P_{na} = non-agricultural price index.

P_{nat} = non-agricultural tradable price index.

p_h = home goods price index.

Price of non-agricultural tradable, P_{nat}, consists of non-agricultural export and non-agricultural import price index.

(A) Non-agricultural export price index:

The annual value of export is decomposed into (1) agricultural export value - which comes from the 5 major crops (Cotton, Sesame, Groundnut, Gum Arabic and Sorghum), and (2) non-agricultural export value, even though it contains some small value of agricultural commodities. The non-agricultural export value has been taken as a percentage from the total annual exports, then multiplied by export unit value index to yield a proxy for non-agricultural export price index. Hence,

where,

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[9]More details about these indices are given in chapter two.

$$P_{nax} = \frac{X_{na}}{X_t} X_u$$

X_{na} = non-agricultural export value.

X_t = total export value.

X_u = export unit value index.

(B) Import price index

Because wheat and wheat flour are the main agricultural imports in food items of Sudan's import bill, non-agricultural import price index is obtained through subtracting wheat value, as an agricultural import commodity, from the total value of imports. The remaining import value is considered as non-agricultural imports. It is also taken as a proportion from the total import value, and then multiplied by import unit value index to get a proxy for non-agricultural import price index. Hence,

$$P_{nam} = \frac{M_{na}}{M_t} M_u$$

where

M_{na} = non-agricultural import value.

M_t = total import value.

M_u = import unit value index.

The two indices - non-agricultural export price index and non-agricultural import price index - give price index for non-agricultural tradable, P_{nat}.

(C) Home goods price index

To obtain home price index, consumer price index (CPI) of the country is used. It is decomposed into tradable and non-tradable parts. Services and housing items are taken as non-traded goods. The weight of non-traded part into CPI is used to get a price index for tradable and non-tradable goods.

$$P_h = W * CPI$$

where, w = the weight of non-traded part in the CPI.

The share of each price index on the total non-agricultural price index is

α(X)- the share of non-agricultural export price index,

α(M)- the share of non-agricultural import price index, and

α(H)- the share of home goods price index (the nontradable).

The value of each share can be obtained as follows;

$$\alpha(X) = \frac{XNA}{MNA+XNA} \cdot \frac{IP}{NAPC}$$

$$\alpha(M) = \frac{MNA}{MNA+XNA} \cdot \frac{IP}{NAPC}$$

$$\alpha(H) = \frac{SP}{NAPC}$$

where,

MNA = non-agricultural imports in current values.

XNA = non-agricultural exports in current values.

IP = industrial product in current value (GDP of industry sector at current prices[10]).

NAPC = non-agricultural product in current price.

SP = service products in current value (GDP of the service sectors at current prices).

From the obtained price indices in points A, B, C and from the above obtained values of α, then non-agriculture price index is,

$$P_{na} = \alpha(X)P_{xna} + \alpha(M)P_{mna} + \alpha(H)P_{h} .$$

Table (5) shows the calculated values of $\alpha(X)$, $\alpha(M)$ and $\alpha(H)$. The sum of these values is simply equal to 1. Using these values in calculating price indices the obtained figures are presented in table (6), it shows the indices for non-agricultural import, P_{nam}, non-agricultural export, P_{nax}, home goods price index P_h, and the aggregate non-agricultural price index, P_{na}. From the calculated figures it is clear that non-traded good prices during the period of the sudy specially the 90s are very high, and it reflects that the price of non-traded goods are dominating the aggregate non-agricultural price index.

[10] Information on GDP at current prices by economic sectors for the period 1988 to 1995 is not available, it calculated from the aggregate GDP at current prices and the percentage share of each sector on aggregate GDP at fixed prices.

Table 5: Value of $\alpha(X)$, $\alpha(M)$ and $\alpha(H)$

Year	$\alpha(X)$	$\alpha(M)$	$\alpha(H)$	Year	$\alpha(X)$	$\alpha(M)$	$\alpha(H)$
1970	0.09	0.45	0.46	1983	0.02	0.39	0.59
1971	0.08	0.44	0.48	1984	0.03	0.36	0.61
1972	0.08	0.40	0.52	1985	0.02	0.38	0.60
1973	0.09	0.39	0.52	1986	0.03	0.36	0.61
1974	0.04	0.32	0.64	1987	0.06	0.32	0.62
1975	0.02	0.32	0.66	1988	0.01	0.23	0.76
1976	0.03	0.36	0.61	1989	0.02	0.22	0.76
1977	0.04	0.33	0.63	1990	0.01	0.22	0.77
1978	0.03	0.33	0.64	1991	0.02	0.22	0.76
1979	0.05	0.32	0.63	1992	0.03	0.23	0.74
1980	0.05	0.32	0.63	1993	0.03	0.25	0.72
1981	0.05	0.33	0.62	1994	0.04	0.24	0.72
1982	0.02	0.36	0.62	1995	0.04	0.24	0.72

Table 6: Price index of Non-agricultural goods

Years	Imp. Price Index	Exp. Price Index	Home Price Index	Non-agric. Index
1970	27.324	4.977	31.8	27.371
1971	24.384	4.989	32.4	26.680
1972	31.488	6.198	35.4	31.499
1973	38.88	9.696	41.4	37.563
1974	52.574	16.788	51.6	50.519
1975	58.212	12.757	63.3	60.66
1976	57.23	9.295	64.5	60.226
1977	64.386	12.984	75.6	69.394
1978	72.27	15.858	89.4	81.54
1979	83.594	24.967	119.7	103.409
1980	98.000	39.399	150.9	128.397
1981	92.344	30.699	185.1	149.77
1982	90.307	13.53	236.1	179.163
1983	86.815	10.063	309.6	216.723
1984	84.293	13.108	410.1	280.899
1985	51.648	11.65	600	389.859
1986	87.906	15.146	774.3	504.423
1987	86.541	18.171	967.8	628.819
1988	96.425	13.304	1444.5	1120.131
1989	101.184	17.281	2513.4	1932.79
1990	108.768	23.23	4812.5	3777.679
1991	107.476	30.756	10801.7	8233.552
1992	1087.065	30.847	23653.0	17528.77
1993	116.82	23.346	47565.7	34247.3
1994	67.9	36.703	100506	72364.32
1995	72.52	75.504	217896.7	156885.6

Note: Export and import unit value index for 1994 and 1995 is estimated.

5.2 Real and Equilibrium Real Exchange Rate Computations

For real exchange rate computation, the methodology used by Krueger, Schiff, and Valdés (1988) is followed. They assumed that real exchange rate in the case of large country is different from real exchange rate of small country.

The real exchange rate, RER, is defined as the relative price of tradable goods to non-tradable. In the case of large country the world price has an effect on the real exchange rate, as the share of the country will affect the world prices, and that effect should be taken into account. So the RER in the case of large country is: E_oP^*/P_h

where,

E_o = the nominal exchange rate.

P^* = world price.

P_h = price of home goods.

But in small country case the share of the country have no effect on the world price, so its RER is E_o/P_h. Because Sudan is a small country, the RER is simply E_o/P_h, that is the ratio between nominal exchange rate and non-tradable price. The official exchange rate in Sudan was fixed rate for long period. The rate during 1955 - 76 was fixed at 0.35 LS/US$[11]. It was fixed on the average, every two years after that, and then it became a flexible rate in 1992.

The nominal exchange rate on exports have been used to calculate the RER. The differential rates on the system during seventies and eighties create more than one real exchange rate. The official exchange rate on export sector was different from the rate that

[11] LS = Sudanese Pound currency

was used on imports and other transaction activities. Beside these rates the black market rate have an impact on domestic prices.

Total export and import values were used in equilibrium real exchange rate, (ERER), calculation.The methodology, discussed in chapter two, depends on the elasticity approach. Information on demand and supply elasticities for foreign exchange are not available, so 1 is used for elasticity of supply of foreign exchange, ϵ, and 2 for elasticity of demand for foreign exchange, η. These values were used by other researchers, for example, (Greene and Roe 1989) in the Dominican Republic and (Brandào and Carvalho 1991) in Brazil.

The equilibrium real exchange rate is,

$$e^* = \left(\frac{\Delta Q_o + \Delta Q_1}{\varepsilon_s Q_s + \eta_d Q_d} + 1 \right) e_o$$

where;

ΔQ_o is equal to the demand for foreign exchange minus supply of foreign exchange. The supply source of foreign exchange is the total export value, other sources of foreign exchange such as remittances from abroad are not available. The demand for foreign exchange was represented by imports value.

In computation of ΔQ_1, trade policy index on non-agricultural imports (t_{na}) is obtained from information provided by Elbadawi (1992) for the period 1970 to 1988. The period 1989 to 1995 is obtained from, department of custom duties in Sudan. Table (7) shows the calculated values of RER and ERER.

Table 7: Real and equilibrium real exchange rate

Year	RER	ERER	Year	RER	ERER
1970	0.01101	0.01317	1983	0.00354	0.00635
1971	0.01080	0.01311	1984	0.00417	0.00617
1972	0.00845	0.01166	1985	0.00323	0.00640
1973	0.00678	0.0099	1986	0.00336	0.00630
1974	0.00553	0.00970	1987	0.00308	0.00632
1975	0.00543	0.00785	1988	0.00259	0.00628
1976	0.00657	0.00745	1989	0.00623	0.00352
1977	0.00556	0.00951	1990	0.00278	0.00992
1978	0.00412	0.00816	1991	0.00380	0.00421
1979	0.00331	0.00595	1992	0.00300	0.00493
1980	0.00486	0.00493	1993	0.00213	0.00411
1981	0.00551	0.00707	1994	0.00161	0.00267
1982	0.00468	0.00756	1995	0.00160	0.00229

Figure (1) shows the RER and ERER. RER was overvalued in Sudan during the period under consideration. Its trend is also in the same direction as that of the equilibrium real exchange rate. The overvaluation decreased since the devaluation in 1989. The Sudanese pound was devalued from 4.5 to 12.5 and the rates were unified into one system instead of multiple system. This means that the devaluation and exchange rate regime during the last years specially from 1992 have reduced the overvaluation of real exchange rate. But still there is negative effect due to foreign exchange controls and large import tariffs on non-agricultural tradables.

Real and Equilibrium Real Exchange Rate

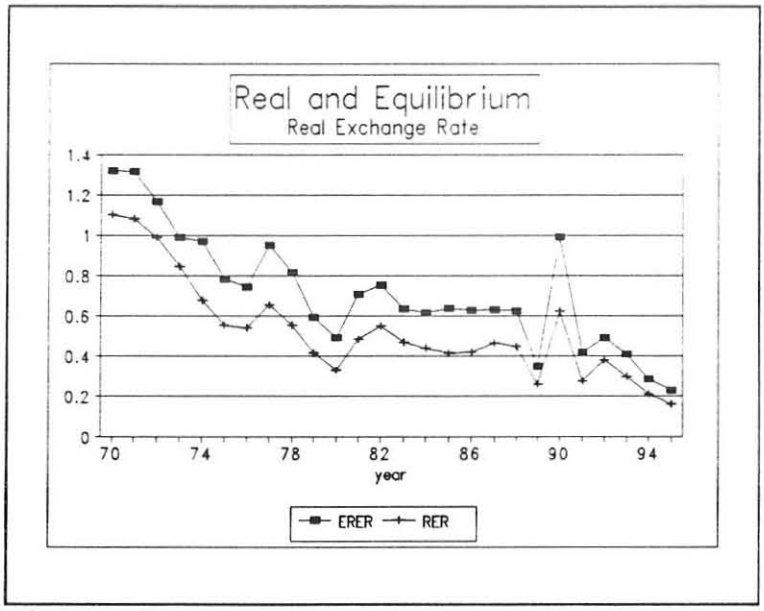

Figure 1

5.3 The Protection Rates

The impact is measured relative to prices that would have prevailed had there been no interventions, and a free trade regime. For export commodities the reference prices were the border price that would have prevailed under intervention. The direct nominal protection rate, npr_D, measures the proportional difference between the relative domestic producer price and the relative border price of agricultural tradables. So it measures the effect of price controls, export taxes or quotas, and other policies affecting producer price, P_i. All exports had the same tax rate and exchange rate during the period 1970 to 1977, which were fixed. Table (8) present export tax on agricultural crops.

Table 8: Export tax on agricultural crops

Years	Cotton	Sesame	Groundnu	Gum	Sorghum
1970	5	5	5	5	5
1971	5	5	5	5	5
1972	5	5	5	5	5
1973	5	5	5	5	5
1974	5	5	5	5	5
1975	5	5	5	5	5
1976	5	5	5	5	5
1977	5	5	5	5	5
1978	10	5	5	20	5
1979	10	5	5	20	5
1980	10	5	5	20	5
1981	10	5	5	20	5
1982	10	5	5	20	5
1983	10	5	5	20	5
1984	5	5	5	5	5
1985	5	5	5	5	5
1986	5	5	5	5	5
1987	5	17	17	5	17
1988	16	16	16	25	16
1989	16	16	16	25	16
1990	25	20	20	25	20
1991	25	20	20	25	20
1992	11	6	6	11	6
1993	11	6	6	11	6
1994	11	6	6	11	6
1995	11	6	6	11	6

The indirect effect must be the same for all products since producer price, P_i, does not included in its computation, but because there were different nominal exchange rates on export crops especially during eighties, the indirect NPR_i varies between crops during the

years of different rates. The sign of each rate gives an indication of the policy effect. If it is positive it means that the crop or the sector receives subsidies which means producer prices are higher than the world prices, and if negative it means taxation i.e producer prices are lower than the world prices taxation.

5.3.1 General findings

The results of direct intervention differ between crops. Direct protection rate was high in 1985 and 1991, the drought years, it was -14 and -11 percent respectively which means high taxation in exports. The rate was not very high compared to the direct nominal protection rates in other countries, table (9) shows direct, indirect and total nominal protection rates.

The indirect effect on the aggregate exports was ranged during the period of study between -12.73 and -39.51 percent, it indicates higher implicit taxation except in 1989 when it was positive reflecting the effect of devaluation. It was more higher on all crops than the direct effect, see table (9). The impact of indirect intervention on producer incentives was stronger than direct intervention. The strongness of indirect effect explains the unfavourable macroeconomic policies and foreign exchange controls. Real exchange rate deviation from its equilibrium is reflected by this measure. Expansion of fiscal policy, excess domestic credit, trade policy restrictions, and capital flights and increasing current account deficits companied with fixed exchange rate were the major reasons that had led to real exchange rate misalignment. The higher import tariffs on non-agricultural goods affected agricultural exports too.

Table 9: Average Direct, Indirect, and Total Nominal Protection

Rates on Agricultural Export Sub-sector

Years	npr_D	NPR_I	NPR_T
1970	-1.56	-16.79	-18.36
1971	-2.77	-17.91	-20.68
1972	-3.78	-15.44	-19.22
1973	-7.71	-14.59	-22.31
1974	-8.39	-30.08	-38.47
1975	-9.42	-29.50	-38.92
1976	-9.42	-27.14	-36.57
1977	-4.80	-34.99	-39.79
1978	-6.43	-31.88	-38.31
1979	-9.20	-29.81	-39.01
1980	-5.57	-24.78	-30.36
1981	-6.15	-31.26	-37.40
1982	-5.98	-27.10	-33.09
1983	-3.94	-26.24	-30.19
1984	-5.48	-34.36	-39.85
1985	-14.65	-27.90	-42.55
1986	-2.62	-39.51	-42.13
1987	4.42	-39.21	-34.79
1988	-4.96	-37.23	-42.19
1989	-4.76	12.73	7.97
1990	-7.06	-29.70	-36.77
1991	-11.47	-27.18	-38.66
1992	-3.96	-13.72	-17.69
1993	-2.49	-26.79	-29.29
1994	-2.62	-25.33	-27.95
1995	0.0	-30.04	0.0

From 1984 to 1989, cotton and gum arabic have the same indirect effect which is different from other crops due to differential exchange rate.

The total discrimination against agriculture was depressing incentives to the producers and so to the export subsector. The monopoly of exports by the government parastatals reduced the competition incentives and benefits. The total protection rate on exports is very high, about -42% during 1985 and 1986 and 7.97 in 1989 (it means subsidies), when all exports were valued at the free exchange rate (12.5 LS/US$ rather than official rate which was 4.5 LS/US$ except cotton). Figure (2) shows the plot of these rates.

Nominal Direct, Indirect and Total protection rates

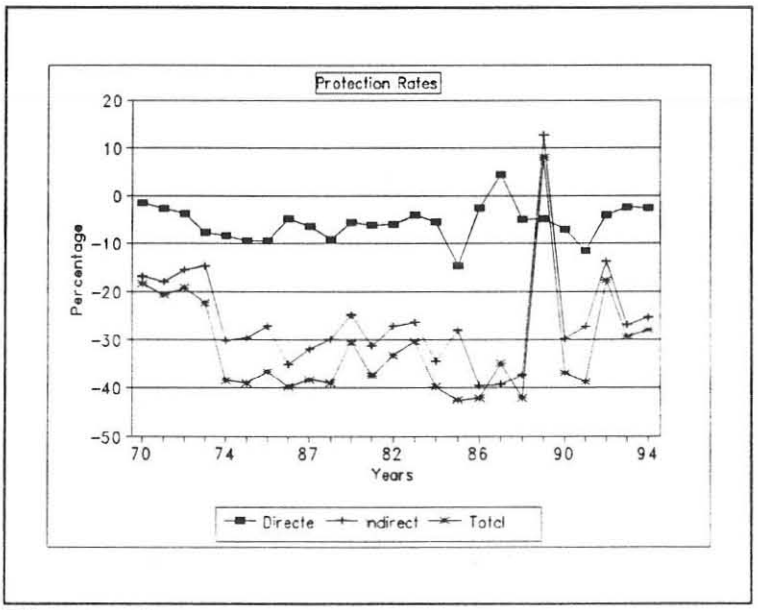

Figure 2

5.3.2 Crop level results

(a) Groundnuts

Export of groundnut and sesame has been monopolized by oilseed company since 1970. The direct nominal protection rate, npr_D, for groundnuts was low during the first half of the 70s, -7 percent (less taxation), and then increased to -44 percent (high taxation) by the end of the decade (appendix 5). At the beginning of the 80s it was reduced to less than -9 percent. This reduction was mainly because of privatization of oilseed company during

1981 - 1985, which reduced the impact of trade controls on oilseeds exports. It increased again in 1986 when the monopoly right was returned back to the oilseed company. It was relaxed in the next year due to the increase on producer prices from LS 476 to LS 1224 per ton (an increase of 157%) although export tax increased to 16%. More decrease was observed during the recent years after the adoption of the economic liberalization and the new policies in 1992.

The total effect was high, it is simply the sum of direct and indirect effects[12]. The higher taxation rate was observed in 1979 and 1980, it was -74.52 and -76.92 percent respectively. The average rate during the 70s, 80s and early 1990s was -43.63, -41.43 and -46.85 respectively. (Appendices 5 to 7) present the results of the three measure.

(b) Sesame

The direct nominal protection rate was low during the 70s. The suppression of producer prices during 1979, 1985 and 1989 was -35.16, -25.88 and -28.87 percent respectively. This was reduced to -4.61, -6.95, -4.85 and -3.35 in 1992, 1993, 1994 and 1995 respectively.

The Total effect on sesame during the 80s was higher than the 70s, but It was less compared with groundnuts. The average total effect in the 70s, 80s, and early 1990s was -36.19, -23.51 and --31.91 percent respectively. (See appendices 5 to 7).

[12] The indirect effect was explained in point 5.3.1 above so there is no need to repeat it again in each crop.

(c) Sorghum

Sorghum export have been influenced by food security policy since the beginning of the 80s. In 1985, 1990 and 1991 sorghum export was prohibited due to the drought factor.

The direct nominal protection rate was low during seventies and increased to -55 percent during the eighties. In 1983 and 1984, the direct nominal protection rate became positive, mainly due to higher producer prices which exceeded world prices during these years.

The total protection rate on sorghum was very high. It reached -80 percent in 1980 and 1981 reflecting high taxation level of unfavourable effect of all policies and controls on sorghum as a food crop to secure food requirements. The average total effect in the 70s, 80s, and early 1990s was -40.23, -42.62 and -21 percent respectively. (Appendices 5 - 7).

(d) Gum Arabic

Gum arabic had positive direct nominal protection rate at the beginning of seventies. It was around 8 percent indicates subsidies to producers, followed by low negative rate. The npr_D during 1980 - 1982 and 1987 - 1988 was about -30 percent. It then declined to -6.8 percent in 1984 as a result of reduction of export tax, which was relaxed from 20 to 5 percent. But this rate was still higher during the 1990s, because of the higher rate of export tax relative to other crops, and still the private sector does not participate in the export of gum.

The indirect nominal rate was higher on gum arabic than other the crops. This arises from unfavourable exchange rate policy and foreign exchange controls. The higher negative total nominal protection rate during the beginning of seventies was offset partially by the

positive direct rate. The average total effect in the 70s, 80, and early 1990s was -31.63, -58.09 and -56.45 percent respectively. (See appendices 5 - 7).

(e) Cotton

Cotton was produced under highly controlled system. The interventions and controls included determining cultivated area, producer prices and the share of tenants. The main problem in measuring the direct effect on cotton is the comparable prices. Producer prices are price for seed cotton (raw cotton) and the world prices are prices for lint cotton, after ginning process. This needs some adjustment to get the actual price for lint cotton that can be compared with producer prices.

Producers also received subsidies in all inputs used[13]. Prices during seventies were determined as percentage of cotton proceed. The share of producers in cotton proceed was 47 percent. The direct effect on cotton was found to be less than the direct effect on gum arabic. The average total effect for the 70s, 80s and early 1990s was -24.32, -42.22 and -34.48 percent respectively. (Appendices 5 - 7).

The results on all crops showed that the irrigated sub-sector received less direct and total effect as represented by cotton, while the traditional rainfed sub-sector received the highest direct and total protection rates as represented by gum arabic. Sorghum and sesame are represent the mechanized rainfed sub-sector but sesame has less protection rates than sorghum which may refer to the higher world price of sesame oil. The higher world price of sesame oil has been transmitted to producers and this decreased the protection effect compared with sorghum.

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[13]Fertilizers, seeds, pesticides, water and petroleum requirements were subsidized.

Chapter Six

6. THE COST OF POLICY INTERVENTIONS

Agricultural export revenue relative to the current GDP has been influenced by many factors in Sudan. Some of these factors are the relative price of agricultural export products to the non-agricultural, terms of trade, government investment on agriculture sector, labour force, direct and indirect effects of trade and exchange rate policies.

The analysis on the share of agricultural exports relative to the current GDP will be examined at the aggregate level of total agricultural exports and at crop level. Cotton represents irrigated sub-sector, Gum Arabic the traditional rainfed sub-sector. Sesame and sorghum together will represent the mechanized rainfed sub-sector. The effect of the various policy interventions will be examined through an econometric model using Ordinary Least Squares Estimates (OLS).

6.1 Variables of interest:

The study is based on time series data. The relative price series was obtained in the previous chapter. The economic and theoretical approach on relative price explains that the percentage share of agricultural exports in the current GDP will respond positively with the increase of export price relative to non-agriculture price.

An improvement in terms of trade can be expected to contribute positively to the share of agricultural exports. The data on terms of trade were obtained from UNCTAD annual reports.

Government expenditure on the agricultural sector is expected to have a positive effect on the percentage share of agricultural exports. This is because most of infrastructure and irrigation requirements in Sudan were provided by the government.

Labour force is expected to have a positive on the percentage share of exports. The data used on labour force were drawn from three census results: that of 1973, 1983, and 1993. The population growth rate per annum was used to calculate the labour force for the different years.

Direct and indirect nominal protection rates reflect the impact of trade, exchange rate policies, and market and price controls.

These protection rates create an excess tax on exports, and we expect negative relationship between them and the percentage share of exports.

Dummy variable is used to capture the effect of policy changes on the agricultural export revenue. And also time trend is used to predict the trend share of exports through time.

6.2 Stationary and non-stationary series

The model deals with time series data which may be a stationary or non-stationary series. As known most of economic time series data are non-stationary, in the sense that the mean of the variable concerned and variance of the error terms depend on time, and the values of the variable tend to depart further away from the mean as time goes on. For example, the series $X_t = \mu_t + e_t$ has mean μ_t which is a function of time (non-stationary) and e_t is a weakly stationary series. If the series are nonstationary then successive

differencing of the series is important to get a stationary series. Table (10) present definition of the considered variables.

Table 10: Definition of the Variables

(X_a/GDP)	Aggregate share of agricul. exports on current GDP
PRICE	Agricultural price index to non-agric. price
ToT	Terms of trade
GI	Government investment in agriculture sector
L	Labour force in agriculture sector
SCOTT	Share of cotton export on current GDP
COTTP	Relative price of cotton
$CNPR_D$	Cotton direct nominal protection rate
$CNPR_I$	Cotton indirect nominal protection rate
SSES	Share of sesame export on current GDP
SESP	Relative price of sesame
$SNPR_D$	Sesame direct nominal protection rate
$SNPR_I$	Sesame indirect nominal protection rate
SSORG	Share of sorghum export on current GDP
SORGP	Relative price of sorghum
$SORG_D$	Sorghum direct nominal protection rate
$SORG_I$	Sorghum indirect nominal protection rate
SGUM	Share of gum arabic export on current GDP
GUMP	Relative price of gum arabic
$GNPR_D$	Gum direct nominal protection rate
$GNPR_I$	Gum indirect nominal protection rate
SGNT	Share of groundnut export on current GDP
GNTP	Relative price of groundnut
GNTNPR	Groundnut direct nominal protection rate
$GNTNPR_I$	Groundnut indirect nominal protection rate

A test developed by Dickey and Fuller is used to test for stationarity. The Dickey - Fuller (DF) and augmented Dickey - Fuller (ADF) are the test statistics for testing the presence

of a unit root using annual data. The results of the tests on the concerned variables are presented in table (11). These results does not support the presence of unit root in all the series, except variables with superscript (star), and the variables have a trend-stationary processes (TSP). The test has also been applied at crop level and the same findings were observed. If individual variables in regression are non-stationary then estimation at level form gives misleading results. Such regression often referred to as spurious regression.

To solve the problem of trend-stationary processes, first difference is an appropriate procedure for trend elimination. Plosser and Schwert argue that with most economic time series it is always best to work with difference data rather than data in levels (Maddala 1992). The reason is that if the data is non-stationary the error term in level equation will have variances increasing over time and many of the properties of OLS estimates as well as tests of significance are invalid.

Table 11: Unit root test for variables at 5%

level of significant

Variable	DF	ADF
$\ln(X_a/GDP)$	- 2.7576	- 2.8440
lnToT	- 2.5554	- 2.4772
lnGI	- 0.8231	- 0.4585
lnL	- 0.0665	- 1.4027
$\ln NPR_D$	- 2.0859	- 2.7298
$\ln NPR_I$	- 3.7807*	- 2.7279
lnSCOTT	- 3.5820	- 3.7272*
$\ln CNPR_D$	- 2.1558	- 2.6994
$\ln CNPR_I$	- 2.5799	- 1.8119
lnSGUM	- 3.8513*	- 3.5683
lnGUMP	- 2.3937	- 3.8759*
$\ln GNPR_D$	- 2.2059	- 2.4089
$\ln GNPR_I$	- 3.8458*	- 2.5321
lnSSORG	- 3.2642	- 4.2065*
lnSORGP	- 3.3389	- 3.2694
$\ln SGNPR_D$	- 4.2591*	- 4.8262*
$\ln SGNPR_I$	- 3.8582*	- 3.7509*
lnSSES	- 3.8377*	- 2.4298
lnSESP	- 0.0410	- 0.6996
$\ln SNPR_D$	- 1.9011	- 1.6572
$\ln SNPR_I$	- 2.6218	- 2.6277
lnSGNT	- 4.0885*	- 3.7592*
lnGNTP	- 1.6107	- 1.2160
$\ln GNTNPR_D$	- 1.9010	- 1.6575
$\ln GNTNPR_I$	- 2.6218	- 2.6278
lnPRICE	1.7902	1.7171

Notes: Critical value DF (-3.6027), ADF (-3.6119).

(*) Significant at 5%.

6.3 Co-integration and the difference models

The procedure of differencing results in a loss of valuable "long run information" in the data. The concept of cointegrated series has been suggested as one solution to this problem. The variables must be integrated to the same degree. Suppose we regress Y_t on X_{ti} for i = 1,2,....n, such that Y_t is integrated to order one, or simply I(1), and some of the explanatory variables X_{ti} are also I(1) and if the resulting error terms $\hat{u}_t$ is integrated to order zero, I(0), then Y_t and X_{ti} are said to be cointegrated in the model. But if all the variables are integrated order one, I(1), and the error terms $\hat{u}_t$ also I(1), then Y_t and X_{ti} are not cointegrated in the model, and we can't reject the null hypotheses[14] of the presence of a unit root for the error term.

The first difference form regression of the short-run dynamics produces a consistent estimates of α's (the coefficients) that tends to the true values faster than the usual OLS estimates at level form.

Using the unit root tests (ADF), first a test for integration order of the series has been done. Most of the series were integrated to order on, I(1). After regressing the dependent variable on the explanatory variables, the residuals were tested for cointegration between the variables and long-run relationships. Error correction model (ECM) was used to supplement for the loss of long run information.

6.4 Empirical results

All the variables were transformed to logarithm form to eliminate the occurrence of heteroscedasticity problems.

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[14]The null hypothesis is: there is no cointegration between the variables.

6.4.1 Aggregate level

The test was done first at the aggregate level of exports share and then for each crop. The OLS model at levels form is;

$$\ln(X_a/GDP) = \alpha_0 + \alpha_1 \ln(P_a/P_{na}) + \alpha_2 \ln GI + \alpha_3 \ln L + \alpha_4 \ln ToT + \alpha_5 \ln NPR_D + \alpha_6 \ln NPR_I + \alpha_7 t + \alpha_8 D$$

Table 12: Long-run cointegration regression results

Dependent variable: $\ln(X_a/GDP)$[15]

Explanatory variables	Coefficients	T-ratios
constant	23.69	1.37
$\ln(P_a/P_{na})$	0.25	1.38
lnGI	0.09	0.49
lnL	- 1.89	-1.44
lnToT	- 0.27	-0.84
$\ln NPR_D$	- 0.24	-1.42
$\ln NPR_I$	- 0.43	-1.78***
t	0.05	0.72
D	0.09	0.56
R^2	0.77	
$\bar{R}^2$	0.66	
DW	1.78	
F	7.19	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial correlation: F = 0.0557

Functional Form : F = 0.6448

Normality : N χ^2 (2) = 0.9817

Heteroscedasticity: F = 5.4585

[15]The coefficients and T-ratios in all equations were rounded to two decimals.

In order to obtain a preliminary estimate of the parameters of interest, the OLS equation in level form is used. In this long-run regression all the variables have the expected sign except labour force, L, and terms of trade, ToT. And R^2 indicates that 77 percent of the variation in the dependent variable is explained by the explanatory variable. DW indicates no autocorrelation in the model. All the variables are insignificant except NPR_t.

Applying unit root test to the residuals from long-run equation, the following variables were obtained: DF = -4.3657 (-3.6027) and ADF = -4.0263 (-3.6119) - critical values in brackets. This explains the existence of cointegration between the variables i.e the residuals are stationary or integrated order zero, I(0). So OLS estimates in table (12) are misleading results. The first difference approach gives the short-run dynamic, but it does not explain the long- run information. hence lagged residuals of long run estimates have to be used with first difference variables to capture these information.

The results are presented in table (13). In this regression the values of R^2 and $\overline{R^2}$ increased. DW is closer to 2, indicating no autocorrelation in the model.

Table 13: Short-run dynamic effect

Dependent variables: $\Delta \ln(X_a/GDP)$

Explanatory variables	Coefficients	T-ratios
$\Delta \ln(P_a/P_{na})$	0.29	2.14**
$\Delta \ln L$	-4.43	-3.13*
$\Delta \ln ToT$	0.19	1.01
$\Delta \ln NPR_D$	- 0.33	-2.59**
$\Delta \ln NPR_I$	- 0.50	-3.99*
D	0.22	2.65**
$\Delta \ln(X_a/GDP)_{t-1}$	0.52	2.42**
ε_{t-1}	- 1.46	-5.66*
R^2	0.79	
$\overline{R}^2$	0.67	
DW	2.15	
F	6.895	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial correlation : F = 0.2594

Functional Form : F = 3.0823

Normality : N χ^2 (2) = 0.0239

Heteroscedasticity : F = 0.1230

The serial correlation test (based on lagrange multiplier test of residual serial correlation) indicates no serial correlation in the error terms. Functional form test (based on Ramsey's RESET test using the square of the fitted values) shows no problem of functional form in the model. The normality test (based on a test of skewness and kurtosis of residuals)

indicates that the error term is normally distributed. Finally, heteroscedasticity test is based on the regression of squared residuals on squared fitted values which shows the error term is homoscedastic[16].

The CUSUM and CUSUM Square are used to show the regression stability and there was no parameter instability. The test was applied at crops level and the same finding was observed, i.e, there is no structural break.

The use of error correction model gave OLS estimates that are unbiased and consistent estimates. The variables are significant except ToT, and most of the variables have the expected sign. Government investment was insignificant with wrong sign, so it was subsequently dropped from the equation. Labour force, L, is very significant but it has wrong sign. This may be due to inconsistency of the estimated data. The elasticity of labour variable is very high which means that increases in labour force of the sector by 1 percent will result in 4.43 percent decrease in export share. The relative price elasticity is very low and it shows an increase in relative price by 1 percent results in an increase of export share by 0.29 percent on the average. An improvement in terms of trade by 1 percent increases the share of export by 0.19 percent on the average. As expected, the protection rates have a decreasing effect. The direct nominal protection rate decreases export share by 0.33 percent if it increases by 1 percent and the indirect rate will decrease it by 0.50 percent on the average.

The lagged residuals ε_{t-1} in Table (13) are significant with the expected sign.

[16]These tests are going to be used in all regression so there is no need to mention them at each.

From the above dynamic regression, the problem of functional form can be overcome by lagged relative prices to reflect the impact of previous period prices. As can be seen from table (14), the lagged price have a stronger significant effect. This means that in the previous period, an increase in relative prices in Sudan tend to shift resources from other uses to production of export crops.

The direct and indirect nominal protection rates, npr_D and $NPRI_I$, significant at 1 percent. The terms of trade, ToT, is significant only at 10%. Policy changes (D) have positive significant effect in the share of exports. The coefficient of the lagged residuals term (ε_{t-1}) indicate that the error are fully corrected within 1.79 period of time.

Table 14: Error correction model

Dependent variable: $\Delta \ln(X_a/GDP)$

Explanatory variables	Coefficients	T-ratios
$\Delta \ln(P_a/P_{na})_{t-1}$	0.43	3.38*
$\Delta \ln L$	- 5.58	-3.94*
$\Delta \ln ToT$	0.27	1.62***
$\Delta \ln NPR_D$	- 0.37	-3.25*
$\Delta \ln NPR_I$	- 0.51	-4.52*
D	0.26	3.35*
$\Delta \ln(X_a/GDP)_{t-1}$	0.65	3.66*
ε_{t-1}	- 1.79	-8.17*
R^2	0.81	
$\overline{R^2}$	0.73	
DW	1.89	
F	9.97	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial correlation : F = 0.0489

Functional Form : F = 1.8433

Normality : N χ^2 (2) = 0.6700

Heteroscedasticity : F = 0.0825

6:4:2 Crop Level Results

The same analysis is applied at crop level. Relative prices used at each crop is the producer price of each crop relative to non-agricultural price. The results are discussed below.

(a) Sesame

The analysis on sesame explains the impact of policies on the rainfed subsector. The results are given in table 14.

Table 15: Long-run cointegration regression results

Dependent variable: lnSSES

Explanatory variables	Coefficients	T-ratios
constant	8.15	0.50
lnSESP	0.63	1.73***
lnL	-1.53	-1.33
lnToT	0.71	1.37
$lnSNPR_D$	-0.08	-0.30
$lnSNPR_I$	-0.45	-0.97
t	0.04	1.33
D	0.42	1.99**
R^2	0.44	
$\overline{R^2}$	0.29	
DW	2.33	
F	2.4757	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation: = F = 0.6516

Functional Form : = F = 0.6003

Normality : = N χ^2 (2) = 1.8330

Heteroscedasticity: = F = 8.9741

lnSSES is the export share of sesame to the current GDP.

From the results R^2 and the adjusted R^2 are very low, implying exclusion of relevant variables. There is heteroscedasticity problem in the model. This may be arises from price variable, because it is a cross sectional data. White's adjusted heteroscedasticity-consistent estimation method is used to correct for heteroscedasticity the results are given in table (15.1).

Table 15.1: Long-run regression adjusted heteroscedasticity

Dependent variable: lnSSES

Explanatory variables	Coefficients	T-ratios
constant	8.15	0.63
lnSESP	0.63	1.66
lnL	-1.53	-1.73***
lnToT	0.71	1.26
$lnSNPR_D$	-0.08	-0.32
$lnSNPR_I$	-0.45	-1.11
T	0.04	1.64
D	0.42	1.24

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

The test resulted in the same elasticities but T-ratios were changed. After adjustment for heteroscedasticity only labour force is significant at 10 percent, and prices are significant at 12 percent.

As mentioned before the level equation gives misleading results. Therefore, after correcting for heteroscedasticity and using the first difference form to solve for non-stationarity, the results are given in table (16).

Table 16: Short-run corrected results

Dependent variable: ΔlnSSES

Explanatory variables	Coefficients	T-ratios
ΔlnSESP	0.408	1.00
ΔlnL	- 4.37	-1.08
ΔlnToT	0.99	2.04**
$\Delta \ln NPR_D$	- 0.35	-1.74***
$\Delta \ln NPR_I$	0.01	0.04
ε_{t-1}	- 1.28	-4.87*
t	- 0.01	-1.15
D	0.32	1.44
R^2	0.66	
$\overline{R^2}$	0.52	
DW	1.84	
F	4.683	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation : = F = 0.0418

Functional Form : = F = 0.1255

Normality : = N χ^2 (2) = 0.3749

Heteroscedasticity: = F = 0.7560

The relative producer price of sesame appeared to be insignificant with low price elasticity of 0.41. Labour force, L, still has a wrong sign. The terms of trade, ToT, is significant implying that the external factors are stronger than internal factors on sesame export. And the direct rate of protection, NPR_D, has a more significant influence than the indirect rate, NPR_I.

The residuals are very significant with the expected sign and it explains that the adjustment mechanism needs 1.28 period of time to adjust. The dummy variable (D) of policy change has no significant effect on sesame export share. From this, we conclude that producer prices do not have strong effect since the export of sesame is monopolized by a public company. The most important is the terms of trade. Time indicates a decreasing share of sesame export.

(b) Sorghum

The long-run regression estimates for this crop were presented in table (17). The relative price was found to be statistically significant with expected sign, and also the indirect protection rate was significant but with wrong sign. Labour force has a positive sign. Government investment is not used in case of sorghum on the assumption that the crop is rainfed and most of government investment is directed towards the irrigated sector.

Table 17: Long-run cointegrated regression results

Dependent variable: lnSSORG

Explanatory variables	Coefficients	T-ratios
constant	-96.44	-2.50**
lnSORGP	0.91	4.01*
lnL	5.23	1.96***
$lnSGNPR_D$	0.71	1.45
$lnSGNPR_I$	1.29	2.47**
T	- 0.40	-3.43*
D	0.61	1.12
R^2	0.95	
$\overline{R^2}$	0.94	
DW	2.007	
F	64.48	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation : F = 0.0164

Functional Form : F = 4.0560

Normality : N χ^2 (2) = 0.7053

Heteroscedasticity : F = 1.5444

The unit root test of residuals is, DF = -4.9234 (-2.985) without trend and = -4.8033(-3.6027) with trend. ADF = -3.2163 (-2.9907) without trend and = -3.1378 (-3.6119) with trend which in this last case supports the presence of cointegration. For this reason OLS estimates in table (17) are not adequate estimates, and the first difference short-run dynamic with ECM is given in table (18).

Table 18: Shor-run dynamic with error correction results

Dependent variable: ΔlnSSORG

Explanatory variables	Coefficients	T-ratios
ΔlnSORGP	0.72	2.66**
ΔlnL	3.37	0.55
ΔlnSGNPR$_D$	0.64	1.53
ΔlnSGNPR$_I$	1.54	3.02*
T	- 0.02	-0.99
ε_{t-1}	- 0.86	-3.21*
R^2	0.96	
$\overline{R^2}$	0.95	
DW	1.76	
F	86.6043	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation : F = 1.1313

Functional Form : F = 0.3991

Normality : N χ^2 (2) = 0.3621

Heteroscedasticity : F = 0.5681

In Table (18) we found that the relative price and indirect protection rate are statistically significant at 5 and 1 percent respectively, but indirect nominal protection rate has a wrong sign. The lagged residuals are significant with expected sign and it explains the adjustment mechanism is less than 100 percent that is 86 percent. Labour force has statistically insignificant coefficient this is may be due to the use of mechanization in the production of sorghum. The direct protection rate is insignificant with a wrong sign.

However, if we compare sorghum with sesame (both rainfed crops) relative prices are more significant in the case of sorghum than sesame, although the latter is a cash crop and the former mostly a food crop. This means for sorghum to be exported beside food requirements relative producer prices are important, and the domestic demand have an influence effect on producer prices. The direct protection rate, which reflects export tax and trade controls effects is found to be insignificant in both crops. This may be due to the low export tax imposed on them.

(c) Gum Arabic

The wholesale prices which were used in this crop are the price of gum arabic at Elobied market, the biggest market of gum arabic in the Sudan. Hence heteroscedasticity is expected to be very low. The long-run estimates in table (19) produced R^2 equal to .50, and DW indicating no first order autocorrelation. Relative price of gum arabic is used in lagged form, because it is more significant than the relative price in time t.

Table 19: Long-run cointegration regression results

Dependent variable: lnSGUM

Explanatory variables	Coefficients	T-ratios
constant	- 8.19	-0.77
$lnGUMP_{t-1}$	0.36	2.13**
lnL	-0.37	-0.12
lnToT	-0.09	-1.08
$lnGNPR_D$	-0.07	-0.46
$lnGNPR_I$	-0.19	-0.89
t	-0.05	-0.23
D	-0.32	-1.47
R^2	0.50	
$\overline{R^2}$	0.29	
DW	2.21	
F	2.4523	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation : F = 0.2862

Functional Form : F = 0.1802

Normality : N χ^2 (2) = 0.7471

Heteroscedasticity : F = 0.1316

All the variables are insignificant and T-ratios are less than one except lagged relative prices, $Gump_{t-1}$. Since most variables have t-ratios less than 1 and F-statistics is greater than 1, multicollinearity problem is suspected. To solve for the problem we need to drop one or more variable from the model. Hence the labour force variable (which seems to

be insignificant with wrong sign) was dropped. All the variables change their t-ratios to more than one except $\ln GNPR_D$ after dropping of labour force from the model.

The unit root test of residuals results are DF = -2.7647 (-3.6119), and ADF = -3.4299 (-3.6219). So first difference form is applied, but it can't explain the long-run information. Lagged residuals of level form are used to capture this information the regression result is given in table 20.

Table 20: Short-run dynamic with error correction

Dependent variable: ΔlnSGUM

Explanatory variables	Coefficients	T-ratios
$\Delta \ln GUMP_{t-1}$	0.51	3.60*
ΔlnToT	- 0.29	-1.28
$\Delta \ln GNPR_D$	- 0.11	-1.21
D	- 0.10	-1.37
ε_{t-1}	- 1.20	-5.48*
R^2	0.68	
$\overline{R}^2$	0.61	
DW	1.94	
F	9.9355	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation : F = 0.0265

Functional Form : F = 0.1109

Normality : N χ^2 (2) = 1.0009

heteroscedasticity : F = 1.1478

The lagged relative price $\Delta \ln GUMP_{t-1}$ is the most significant variable with the expected sign. Gum arabic is produced by small farmers. Price incentives must be very important in the trade off between leisure and gum arabic production.

The terms of trade, ToT, was insignificant and it has a wrong sign. The direct nominal protection rate, $GNPR_D$, is insignificant with expected sign and low elasticity. The impact of direct export tax and trade controls on gum is more significant than exchange rate policy as the indirect protection rate, $GNPR_I$, is insignificant with elasticity of - 0.04 percent. For this reason it has been dropped from the model. The policy change impact is found to be insignificant, the negative sign indicates unfavourable policy on gum arabic.

Previous period is assumed to be important in case of gum arabic so in table (21) all the variables are used in lagged form and they are significant except direct nominal protection rate.

Table 21: Short-run in lagged form with error correction

Dependent variable: ΔlnSGUM

Explanatory variables	Coefficients	T-ratios
$\Delta \ln GUMP_{t-1}$	0.63	3.821*
$\Delta \ln ToT_{t-1}$	- 0.43	-1.783***
$\Delta \ln GNPR_{Dt-1}$	0.13	1.259
$\Delta \ln GNPR_{ft-1}$	- 0.29	-2.528**
ε_{t-1}	- 1.26	-4.919*
R^2	0.66	
$\overline{R^2}$	0.59	
DW	1.99	
F	9.3355	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation : F = 0.0776

Functional Form : F = 0.0674

Normality : N χ^2 (2) = 1.2142

Heteroscedasticity : F = 0.0149

(d) Groundnuts

In providing a preliminary estimates of the parameters of interest, the OLS equation in level form was used and all the variables were statistically insignificant. T-ratios were less

than one where the F-statistic was greater than one (8.064) indicating multicollinearity problem. Lagged relative price, direct and indirect protection rate are used to solve the problem. Hence the long-run relationships are given in table (22).

Table 22: Long-run cointegrating results

Dependent variable: lnSGNT

Explanatory variables	Coefficients	T-ratios
constant	-114.09	-1.71***
$lnGNTP_{t-1}$	1.02	1.69
lnGI	0.32	0.50
lnL	6.39	1.55
lnToT	0.87	0.93
$lnGNTNPR_{Dt-1}$	0.19	0.32
$lnGNTNPR_{It-1}$	- 0.26	-0.27
T	- 0.74	-2.47**
D	- 0.39	-0.85
R^2	0.84	
$\overline{R^2}$	0.75	
DW	2.003	
F	10.2233	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation : F = 0.1252

Functional Form : F = 2.5093

Normality : N χ^2 (2) = 0.5052

Heteroscedasticity : F = 0.2522

All the variables have the expected sign except direct nominal protection rate. The time trend, T, is significant at 5 percent but indicates decreasing share of groundnut. The OLS regression estimates of long-run clearly are not an adequate representation. The Engle-Granger estimator indicates that the dynamic representation provided by the first-order ECM can adequately represent the dynamic of the system, table (23) shows this model.

The lagged relative price, $\ln GNTP_{t-1}$, labour, lnL, dummy, D, and lagged residuals are significant. The response of share of groundnut, SGNT, to previous relative price and labour force is positive. Lagged residuals have expected sign. The dummy variable has a negative sign indicates policy changes are unfavourable. The index of direct protection $\ln GNTNPR_{Dt-1}$ whic is insignificant subsequently dropped from the equation. Also the change in ToT, the index of indirect protection rate, and the change in lagged dependent variable $\ln SGNT_{t-1}$ are insignificant.

Table 23: short-run dynamic with error correction

Dependent variable: ΔlnSGNT

Explanatory variables	Coefficients	T-ratios
$\Delta \ln GNTP_{t-1}$	0.98	2.71**
ΔlnL	12.84	2.30**
ΔlnToT	0.80	1.17
$\Delta \ln GNTNPR_{It-1}$	- 0.92	-1.22
D	- 0.88	-3.21*
$\Delta \ln SGNT_{t-1}$	- 0.16	0.84
ε_{t-1}	- 1.29	-3.98*
R^2	0.66	
$\overline{R^2}$	0.54	
DW	1.75	
F	5.4364	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial correlation : F = 0.4671

Functional Form : F = 0.2873

Normality : N χ^2 (2) = 1.0318

Heteroscedasticity : F = 0.1601E-3

(e) Cotton

Producer prices can't be used in the equations as explanatory variable, because it has no influence and it determined endogenously. The terms of trade, government investment and labour force were expected to have positive impact on cotton's export share. Direct and indirect protection rates were expected to have negative effect.

Applying the OLS estimates at level form and after testing for integration in the variables, DF and ADF fail to reject the null hypothesis[17] of integration. The OLS estimates of long-run are given in table 24.

[17] The existence of integration in the variables.

Table 24: Long-run cointegration regression results

Dependent variable : lnSCOTT

Explanatory variables	Coefficients	T-ratios
constant	- 20.30	-1.00
lnToT	0.16	0.44
lnGI	0.16	0.80
lnL_{t-1}	1.15	0.94
$lnCNPR_{Dt-1}$	- 0.15	-0.78
$lnCNPR_I$	- 0.43	-1.14
D	0.05	1.74***
T	- 0.10	-1.178
R^2	0.86	
$\overline{R^2}$	0.79	
DW	1.89	
F	0.4526	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation : F = 0.4526

Functional Form : F = 1.0213

Normality : N $\chi^2(2)$ = 0.2602

Heteroscedasticity : F = 0.8972

All the variables have the expected sing but are insignificant except dummy variable at 10 percent. Time trend, T, shows decreasing share of cotton export. As it was mentioned before OLS estimates in the level form are not an adequate estimates due to non-stationarity. The short-run dynamics and first difference with ECM are presented in table (25). However, R^2 and adjusted R^2 decreased.

Table 25: Short-run dynamic with error correction

Dependent variable: ΔlnSCOTT

Explanatory variables	Coefficients	T-ratios
ΔlnToT	0.94	2.58**
ΔlnGI	0.20	1.02
ΔlnL	- 5.78	-2.36**
ΔlnCNPRd$_{t-1}$	0.21	1.04
ΔlnCNPR$_I$	- 0.42	-1.61
D	0.42	2.85**
T	- 0.02	-2.10**
ΔlnSCOTT$_{t-1}$	0.47	1.97***
ε_{t-1}	- 1.31	-3.86*
R^2	0.62	
$\overline{R^2}$	0.42	
DW	2.002	
F	3.1227	

Note: (*), (**), (***) significant at 1, 5 and 10% respectively.

Serial Correlation : F = 0.4136

Functional Form : F = 0.3635

Normality : N χ^2 (2) = 0.7213

Heteroscedasticity : F = 0.8845

The variables ToT and the dummy for policy changes are significant with positive sign. But labour force is statistically significant with unexpected sign. Direct and indirect protection rates are insignificant both in the long and short run. As cotton is the main source of foreign exchange earnings in the Sudan we found that the terms of trade and

policy changes were the most important variables in the case of cotton. The time trend explains decreasing share of cotton export.

6.4.3 Summary of the regression results

Relative prices are significant at the aggregate as well as at individual crop level, except for sesame and it is positive. The terms of trade was significant in all cases except groundnut and it is positive except gum arabic. Labour force is not significant in the case of gum arabic, sesame and sorghum. It is positive and significant in the case of groundnut, but negative and significant in the case of cotton. Direct nominal protection rate is insignificant in all cases, except at aggregate level and sesame. The indirect rate is insignificant in all cases except aggregate level and sorghum. It is negative in all cases except sesame and sorghum. Government investment does not show any significance effect in all cases, which is unexpected. And finally the time trend has a negative coefficient in all cases, implying a decreasing trend with time.

Table 26: Summary of variables in the regression analysis results

	aggreg	Cotto	Sesame	Ground	Gum	Sorghu
Price	+ sig	*	+ insig	+ sig	+ sig	+ sig
ToT	+ sig	+ sig	+ sig	+ insig	- sig	*
Labour	- sig	- sig	- insig	+ sig	- insig	+insig
G.Invest	- insig	+ insig	- insig	insig	+ insig	*
npr_D	- sig	+ insig	- sig	+ insig	- insig	+insig
NPR_I	- sig	- insig	+ insig	- insig	- insig	+ sig
D	+ sig	+ sig	+ insig	- sig	- insig	+insig

Notes: (sig) significant, (insig) insignificant, (*) not applied in the model, (+) positive sign and (-) negative.

Chapter Seven

7. CONCLUSION

The economic development and the process of structural transformation induced by government intervention, especially in the agricultural sector of Sudan is addressed in this paper.

The motivation of government policy intervention is to encourage economic growth by improving the incentive structure. The effect of intervention on agricultural export is measured using a model developed by Krueger, Schiff, and Valdés (1988). Price indices and equilibrium real exchange rate was generated in order to measure the effect of sector specific and macroeconomic policy on agricultural exports. The derivation of equilibrium real exchange rate supported the literature of real exchange rate overvaluation in developing countries.

The induced intervention created distortion in the export sub-sector directly through price and market controls, trade policy, export regulations and monopolistic parastatals. The monopolistic parastatals in the export market reduced the benefits that would have been obtained had there been free market competition. The negative effect was found to be significant both of the aggregate (total export) and at individual crop level. Farmers were selling export crops to public marketing corporations which set producer prices at low levels. The surplus earnings from these corporations have been used to finance government expenditure rather than reinvest in the agricultural sector. Producer prices have been kept low even when world commodity prices have risen.

Equilibrium real exchange rate is used in measuring the indirect effect. It has the same effect on all crops because it measure the trade policy on imports of non-agricultural goods as well as agricultural exports. The negative effect of the overvalued exchange rate was found to be higher than the direct effect which yielded an implicit tax on exports.

The derived direct and indirect protection rates, in combination with relative prices, government investment in agriculture, the agricultural sector labour force and the terms of trade were used in the regression analysis in which the share of agricultural export (in GDP) was treated as dependent variable.

Price interventions are typically the most important policy measures, but the Sudanese government is also heavily involved in the development and dissemination of technological innovations and infrastructural development. Government investment in agriculture is intended to capture such intervention.

The share of agricultural export responded significantly to changes in relative prices, implying that farmers in Sudan are price responsive. The argument that African farmers have backward bending supply curve is not supported.

The relative price elasticity of aggregate export sector is lower than the elasticity for individual crops. Indeed farmers can often switch land and other resources between different crops more easily than switching resources from or to the agricultural sector.

The export sector responded negatively to the terms of trade in the long run. In the short run however, the response was positive. That means the economy adjusted to the

exogenous shocks in the short run, but the inefficient policies caused the economy to be vulnerable to terms of trade shocks in the long run.

For gum arabic, the current relative prices are insignificant. Only previous lagged prices are important in determining the trade off between farmers leisure and production of gum arabic.

Cotton producer prices are not used in the econometric analysis as it was set by the government in case of percentage share from cotton proceeds during seventies or as it is controlled and determined during eighties and nineties.

In general, agricultural export is highly affected by relative prices and exchange rate policies. The positive effect of relative prices was offset by the negative direct and indirect effect of trade and exchange rate policies, and this explains the decline or stagnation of the share of the agricultural export in Sudan.

Exchange rate overvaluation greatly hurts exports, and if it exists for a long period of time, it can generate irreversible costs by wiping out the agricultural infrastructure. Real exchange rate misalignment are also conducive to speculation, and usually generate massive capital flights out of the country.

To conclude, government policies have been the major problems for the poor performance of the agricultural sector in general and the export sector in particular. The observed decline of agricultural exports and the general worsening of economic conditions in Sudan are linked to economic policy distortions.

APPENDICES

Appendix 1:

Agricultural and Cotton Export Share on GDP

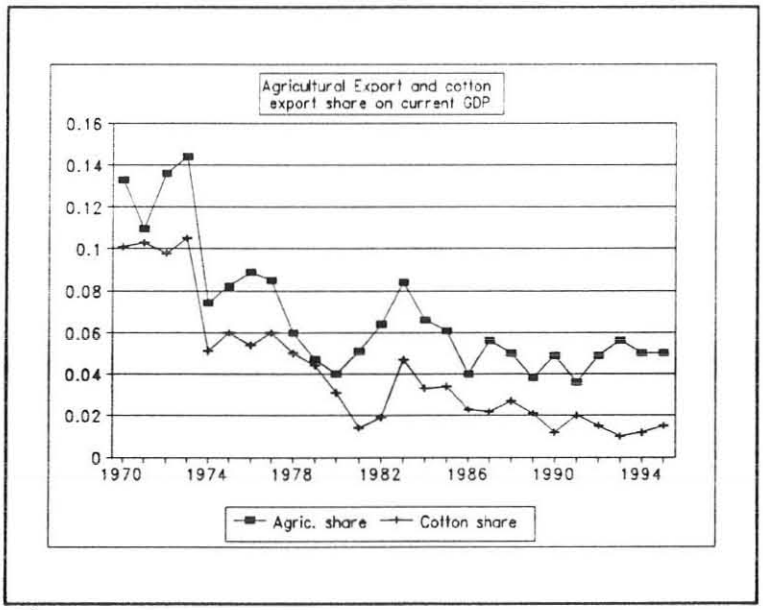

Figure 3

GDP and Agricultural GDP at Fixed Prices

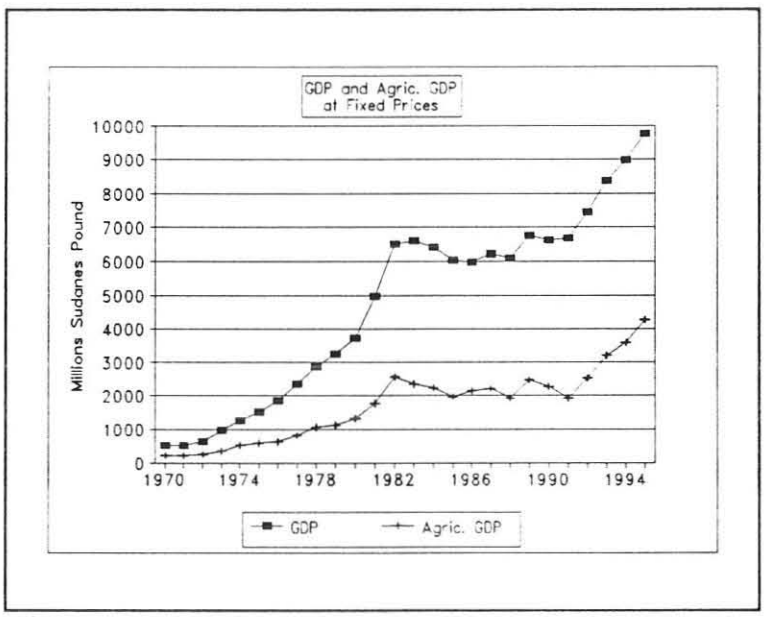

Figure 4

Appendix 2:

Imports and Exports

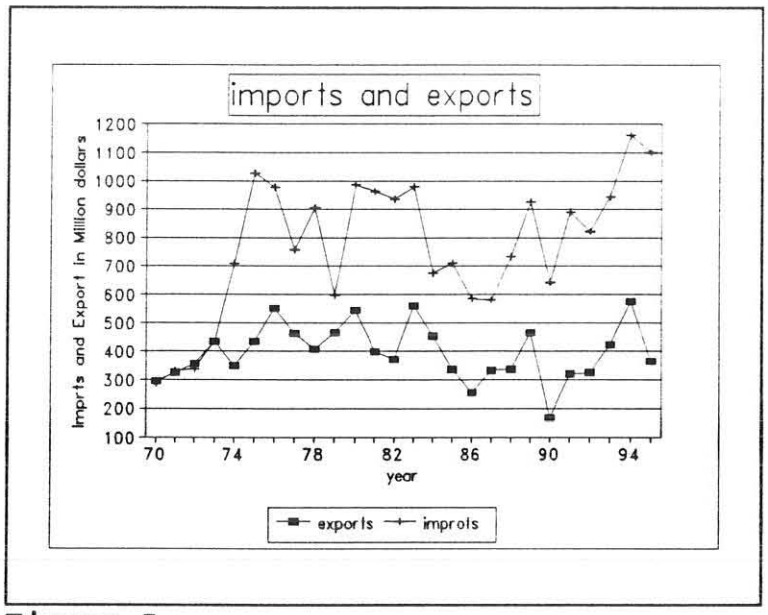

Figure 5

Agricultural GDP in Percent

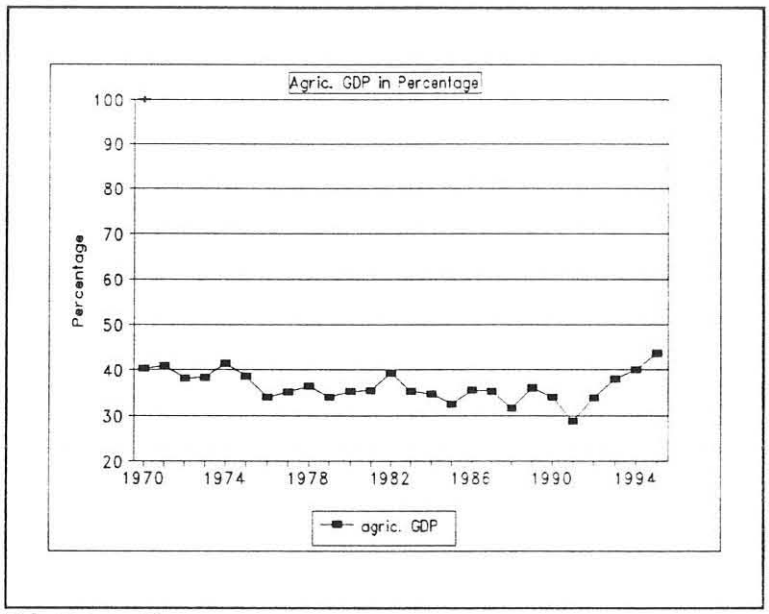

Figure 6

Appendix 3:

Table 27: Aggregate GDP and Agriculture GDP at fixed prices LS/million.

Years	GDP	Agric. GDP	Agric. GDP%
1970	516.6	207.6	40.2
1971	513.7	217.3	40.8
1972	632.4	241.4	38.2
1973	896.8	344.6	38.4
1974	1246.2	516.4	41.4
1975	1510.8	585.3	38.7
1976	1848	628.2	34
1977	2339.7	824.3	35.2
1978	2882.7	1051.9	36.5
1979	3253.8	1111	34.1
1980	3722.8	1381.2	35.4
1981	4971.3	1770	35.6
1982	6513	2566.5	39.4
1983	6612	2338.9	35.4
1984	6416	2231.1	34.8
1985	6041	1958.4	32.4
1986	5976	2135.3	35.7
1987	6207	2196.3	35.4
1988	6098	1926.5	31.6
1989	6774	2452.1	36.2
1990	6625	2254.2	34
1991	6691	1918	28.7
1992	7447	2522	33.9
1993	8364	3188	38.1
1994	8990	3592	40
1995*	9756.7	4254	43.6

Source: The Economic Review, Ministry of Finance and Planning, different series.

* estimated.

Appendix 4:

Table 28: Official and Free exchange rates

Years	Official	Free Rate
1970	0.35	0.35
1971	0.35	0.35
1972	0.35	0.35
1973	0.35	0.35
1974	0.35	0.35
1975	0.35	0.35
1976	0.35	0.35
1977	0.497	0.497
1978	0.497	0.497
1979	0.5	0.8
1980	0.5	0.8
1981	0.9	0.8
1982	0.9	0.9
1983	1.3	1.8
1984	1.3	2.1
1985	2.5	3
1986	2.5	4.1
1987	2.5	4.15
1988	4.5	12.3
1989	4.5	12.3
1990	4.5	30
1991	4.5	30
1992	15.2	90
1993	90	217
1994	217	367.5
1995	367.5	478

Source: Bank of Sudan.

Appendix 5:

Table 29: The Direct Nominal Protection Rate

Year	Cotton	Sesame	Groundnut	Gum	Sorghum
1970	-1.75	-0.48	-7.77	7.51	-9.38
1971	-1.91	-4.17	-9.73	8.21	-7.77
1972	-2.15	-5.66	-10.58	8.52	-10.85
1973	-2.49	-5.03	-12.45	-5.43	-15.21
1974	-2.88	-9.66	-14.96	-5.77	-10.87
1975	-3.74	-7.67	-17.35	-10.62	-11.13
1976	-3.74	-6.28	-15.55	-10.62	-14.78
1977	-4.38	-19.23	-26.76	-19.41	-6.34
1978	-6.45	-24.58	-32.36	-18.31	-19.17
1979	-9.32	-35.16	-44.71	-25.92	-32.36
1980	-11.31	-13.83	-44.11	-30.0	-47.33
1981	-8.8	-4.71	-7.05	-29.0	-54.94
1982	-5.07	-4.02	-7.01	-30.0	-7.84
1983	-12.8	17.16	-9.3	-32.0	6.27
1984	-15.04	14.36	-12.54	-6.8	2.22
1985	-35.69	-25.88	-23.26	-15.8	0.0
1986	20.4	13.19	-31.78	-11.76	-45.21
1987	30.25	10.76	-6.73	-12.8	0.0
1988	-6.44	14.06	-21.8	35.33	-55.75
1989	-10.63	-28.87	-20.36	-33.02	-40.6
1990	-5.87	-8.56	-20.78	-24.63	0.0
1991	-12.0	13.25	-37.36	-32.61	0.0
1992	-4.26	-4.61	-11.03	-27.28	-10.15
1993	-3.58	-6.95	-2.44	-20.37	-24.19
1994	0.0	-4.85	-4.00	-20.77	-17.72
1995	0.0	-3.35	0.0	0.0	-15.24

Appendix 6:

Table 30: The Indirect Nominal Protection Rate

Year	Cotton	Sesame	Groundnut	Gum A.	Sorghum
1970	-16.79	-16.79	-16.79	-16.79	-16.79
1971	-17.91	-17.91	-17.91	-17.91	-17.91
1972	-15.44	-15.44	-15.44	-15.44	-15.44
1973	-14.59	-14.59	-14.59	-14.59	-14.59
1974	-30.08	-30.08	-30.08	-30.08	-30.08
1975	-29.50	-29.50	-29.50	-29.50	-29.50
1976	-27.14	-27.14	-27.14	-27.14	-27.14
1977	-30.92	-30.92	-30.92	-30.92	-51.26
1978	-31.88	-31.88	-31.88	-31.88	-31.88
1979	-29.81	-29.81	-29.81	-29.81	-29.81
1980	-32.81	-32.81	-32.81	-7.33	-32.81
1981	-31.26	-31.26	-31.26	-31.26	-31.26
1982	-27.10	-27.10	-27.10	-27.10	-27.10
1983	-26.24	-26.24	-26.24	-26.24	-26.24
1984	-42.65	-28.83	-28.83	-42.65	-28.83
1985	-34.87	-34.87	-34.87	-34.87	0.0
1986	-48.73	-33.36	-33.36	-48.73	-33.36
1987	-46.89	-26.47	-26.47	-49.34	0.0
1988	-50.91	-28.30	-28.30	-50.35	-28.30
1989	-26.57	38.94	38.94	-26.57	38.94
1990	-37.15	-37.12	-37.12	-37.12	0.0
1991	-33.98	-33.98	-33.98	-33.98	0.0
1992	-22.88	-22.88	-22.88	-22.88	-22.88
1993	-26.79	-26.79	-26.79	-26.79	-26.79
1994	-25.33	-25.33	-25.33	-25.33	-25.33
1995	-30.04	-30.04	-30.04	-30.04	-30.04

Appendix 7:

Table 31: The Total Nominal Protection Rate

Year	Cotton	Sesame	Groundnut	Gum A.	Sorghum
1970	-18.54	-17.27	-24.56	-9.28	-26.17
1971	-19.82	-22.08	-27.64	-9.70	-25.68
1972	-17.59	-21.10	-26.02	-6.92	-26.29
1973	-17.08	-19.62	-27.04	-20.02	-29.80
1974	-32.96	-39.74	-45.04	-35.85	-40.95
1975	-33.24	-37.17	-46.85	-40.12	-40.63
1976	-30.88	-33.42	-42.69	-37.78	-41.92
1977	-35.30	-50.15	-57.68	-50.33	-57.60
1978	-38.33	-56.46	-64.24	-50.19	-51.05
1979	-39.13	-64.97	-74.52	-55.73	-62.17
1980	-44.12	-46.64	-76.92	-37.33	-80.14
1981	-40.06	-35.97	-38.31	-60.26	-86.20
1982	-32.17	-28.12	-34.11	-57.1	-34.04
1983	-39.04	-9.08	-35.45	-58.24	-19.97
1984	-57.69	-14.47	-41.37	-49.45	-26.61
1985	-70.56	-60.75	-58.13	-50.67	0.0
1986	-28.33	-20.17	-65.14	-60.49	-78.57
1987	-16.64	-15.71	-33.20	-62.14	0.0
1988	-56.35	-14.24	-50.210	-85.68	-84.05
1989	-37.20	10.07	18.58	-59.59	-16.6
1990	-43.02	-45.68	-57.90	-61.75	0.0
1991	-45.9	-20.73	-71.34	-66.75	0.0
1992	-27.14	-27.49	-33.91	-50.16	-33.03
1993	-30.37	-33.74	-24.23	-47.16	-50.98
1994	0.0	-30.18	-29.33	-46.10	-43.05
1995	0.0	-33.39	0.0	0.0	-45.28
AVG. 70s	-24.32	-36.20	-43.63	-31.59	-40.23
AVG 80s	-42.22	-23.51	-41.43	-58.10	-42.62
AVG 90s	-34.48	-31.91	-46.85	-56.46	-21.00

Appendix: 8

Table:32 Main Crops Producer Prices LS/M Ton, Cotton LS/LP

Years	Cotton	Sesame	Groundnut	Gum Arabic	Sorghum
1970	0.0201	57.336	31.151	100.17	21.01
1971	0.0661	53.597	33.609	100.17	13.75
1972	0.0652	57.648	37.171	102.53	9.46
1973	0.0906	61.298	68.109	184.645	6.45
1974	0.1284	89.387	73.673	340.022	21.56
1975	0.1056	120.637	68.554	200.34	25.41
1976	0.1339	118.723	741.893	200.34	17.93
1977	0.2278	99.715	75.009	200.34	27.94
1978	0.2552	117.232	101.941	250.425	35.86
1979	0.2688	178.174	111.512	278.25	41.47
1980	0.2817	271.924	263.087	356.16	44.66
1981	0.683	315.259	226.584	422.94	82.94
1982	0.849	412.704	380.608	613.263	111.54
1983	0.867	717.258	533.074	890.4	224.52
1984	1.056	816.305	397.189	1157.52	363.44
1985	1.321	749.554	476.316	2047.92	1107.92
1986	2.075	1357.72	1224.179	6678	538.45
1987	2.688	1927.14	1408.251	8904	
1988	2.905	3711.37	2052.837	8904	797.5
1989	5.641	7136.36	4466.473	8904	957
1990	7.047	15796.3	13666.29	9571.8	2111
1991	9.311	35986.9	20563.98	29383.2	17704.5
1992	20.614	41626.9	24817.45	178080	11438.13
1993	54.622	45942.3	37594.94	389550	90009
1994		88592.2		779100	56087.8
1995		117827.			

Source: Ministry of Agriculture.

Appendix: 9

Table: 33 Main Crops F.O.B Prices $US/M Ton, Cotton Cent/LP

Years	Cotton	Sesame	Groundnut	Gum Arabic	Sorghum
1970	49.434	222	240	253	97
1971	162.078	273	233	255	97
1972	159.684	317	238	275	87
1973	222.096	304	270	938	89
1974	314.286	564	527	1625	142
1975	258.72	601	481	1250	142
1976	328.146	558	395	1250	123
1977	392.952	563	578	1250	133
1978	355.74	723	613	1250	163
1979	369.117	1091	748	1380	219
1980	390.117	873	539	1450	301
1981	363.982	886	1049	1450	263
1982	283.92	582	347	1450	242
1983	302.788	595	514	1450	146
1984	321.604	563	572	1600	136
1985	224.416	1304	427	1900	0
1986	161.795	467	428	4950	107
1987	197.62	540	302	4950	105
1988	293.779	598	276	2800	99
1989	359.698	429	407	2300	87
1990	302.263	1000	482	2300	0
1991	304.983	1278	960	2550	0
1992	248.934	753	580	3200	102
1993	220.08	537	580	4000	99
1994	279.699	540	375	4200	97
1995	279.699	540		4000	

Source: Bank of Sudan, Oilseed Company, Sudan Cotton Corporation and Economic Review Different Series.

Appendix: 10

Table: 34 Consumer price Index, Sudan 1970 - 1995

Base January 1970 = 100

Years	Higher Income	Lower Income
1970	105.5	106.7
1971	106.8	108.2
1972	115.5	120.9
1973	133.7	141.6
1974	165.9	178.6
1975	200.9	221.4
1976	204.9	225.1
1977	240.8	262.8
1978	288.9	306.7
1979	385.9	412.2
1980	488.3	517.9
1981	595.8	637.3
1982	765.2	809.0
1983	1007.5	1055.9
1984	1317.3	1417.2
1985	1938.7	2060.6
1986	2488.4	2673.1
1987	3086.8	3365.7
1988	4527.4	5102.6
1989	7936.6	8819.6
1990	13119.4	14377.9
1991	28738.2	32984.8
1992	64766.2	70392.8
1993	130055.6	141748.3
1994	281830.5	307452.1
1995	*	*

Source: Ministry of Finance, Central Bereau of Statistics

* Not available

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DECLARATION

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

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