STABILIZATION POLICY: AN ECONOMIC ANALYSIS AND EVALUATION OF ITS IMPLICATIONS FOR NIGERIAN COCOA PRODUCERS

By

SYLVANUS OBI ABANG

Bachelor of Arts
Central State University
Edmond, Oklahoma
1978

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1980

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF PHILOSOPHY
May, 1984

STABILIZATION POLICY: AN ECONOMIC ANALYSIS AND EVALUATION OF ITS IMPLICATIONS FOR NIGERIAN COCOA PRODUCERS

Thesis Approved:

Leo V. Shelley
Thesis Adviser

Joseph E. Williams

Joseph M. Jadlow

Daniel D. Badger

Norman N. Durham
Dean of the Graduate College

PREFACE

I seize this opportunity to thank those who have been of great assistance to me in this study and throughout my Doctor of Philosophy program. Special appreciation and debt is owed to Dr. Leo V. Blakley, my thesis adviser, for his guidance, understanding and the useful suggestions and encouragements. In him is the epitome of professionalism and individual humanistic gifts, all in one. Others of no less crucial importance include Dr. Dan Badger, Dr. Joseph Jadlow and Dr. Joseph Williams for their various suggestions and recommendations during the initial phase of this study and the final draft.

I am equally grateful to Dr. Glenn Knowles, Dr. Dean Schreiner and Elton Li for helpful suggestions and programming. Thanks are also extended to Ms. Cade Wilcoxson for her patience and skillful typing of the initial draft and to Ms. Marsha Speer for the final manuscript.

Outside the Department, I wish to extend special thanks to the Cross River State Scholarship Board which made it possible for me to attend graduate school. Without this initial backing, perhaps this study would have been completed with greater difficulty. A debt of gratitude is owed also to the members of the Research Staff Department at the Central Bank of Nigeria and my personal friend, Obasse Bichene Okongor, who personally saw to it that all the necessary data series are received by me.

Finally, one cannot close without paying homage to other members of my family in Nigeria whom I have been separated from for many years and my immediate family here, who had to sacrifice a great deal in order for me to accomplish the present work. Thanks to all of you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Background

One of the major restraints to development in most developing nations is the short run gyrations in export earnings. The gyrations arise because of widely fluctuating producer prices from year to year, large production changes from season to season, fluctuating incomes, or perhaps combinations of some of the above factors. Many of the commodities exported by these nations are consumed primarily in the advanced industrialized nations. For example, between the period 1961-1975, the European community, United States of America, United Soviet Socialist Republic and Japan accounted for about 79 percent of the total world imports of cocoa bean (Okorie and Blandford, 1979).

The geographical distribution of the major exporters and importers of some of the primary commodities in international trade is presented in Table I. The major exporters are developing nations and include Ghana, Nigeria, Brazil, Cameroun and the Ivory Coast. The major exporters of coffee and the other commodities in the table are also primarily the developing nations of the third world except for the United States and France which export maize. The major importers of the commodities listed in the table are regarded as developed industrial nations except in the case of rice. These nations rank very high in terms of income per capita.

TABLE I

MAJOR EXPORTING AND IMPORTING COUNTRIES OF SELECTED PRIMARY COMMODITIES (1978)

Cocoa	Coffee	Rice	Maize	Bananas
Major Exporters				
Ghana	Colombia	United States	United States	Ecuador
Nigeria	Brazil	Thailand	Argentina	Costa Rica
Brazil	Ivory Coast	China	France	Honduras
Cameroun	Angola	Burma	S. Africa	Panama
Ivory Coast	Uganda	Italy	Thailand	Guatamala
Major Importers				
France	United States	India	Japan	United States
USSR	FR Germany	Indonesia	Italy	Japan
Netherlands	France	Bangladesh	FR Germany	FR Germany
United States	Italy	Vietnam	United Kingdom	France
United Kingdom	Netherlands	Korea	Netherlands	Italy
FR Germany				
Japan				

Source: Adams, Gerard F., Stabilizing World Commodity Markets, p. 8, 1978. Also computed from F.A.O. Commodity Year Book, 1981, p. 105.

The market behavior of export commodities is reflected in the magnitude of fluctuations experienced in international markets. A classification of the commodities into various groups according to the magnitude of the relative degree of price fluctuations is shown in Table II. The group with more than 40 percent in price fluctuation experiences the greatest variation in the prices. Coffee has the highest fluctuation of 68 percent while cocoa has only a 35 percent gyration in the prices.

As a consequence of fluctuations in export prices of primary commodities, many policy economists have been able to foster and buttress the argument that the instability of export proceeds has had adverse effects on economic development for the developing nations. On the strength of this argument many of the policy makers have recommended policies of price stabilization for developing countries such as Ghana, Nigeria, Ivory Coast and to some extent Brazil.

Realistically, these developing countries would prefer an international stabilization scheme which would stabilize prices at the international level as is the case with coffee (Adams and Klein, 1978), if they felt that the source of instability was due to shifts in their domestic supply. On the other hand, they would prefer an alternative policy of non-intervention in market prices if they thought that the instability resulted from shifts in the demand for these commodities abroad (Heuth and Schmitz, 1972). With lack of adequate knowledge on the source of instability and the lack of a comprehensive international agreement for most of the primary commodities that will reduce the fluctuations in prices, many of the developing countries have rather taken "mid-term" corrections. These

TABLE II

SELECTED COMMODITIES BY DEGREE OF PRICE FLUCTUATION IN WORLD MARKETS (1978)

Percentage Variation					
Over 40%		26-39%		25% or less	
Coffee	68%	Copper	36%	Abaca	25%
Sugar	63%	Beef	35%	Palm Oil	24%
Zinc	61%	Cocoa	35%	Groundnut Oil	24%
Tungsten	54%	Sunflower Oil	31%	Tin	22%
Wheat	49%	Corn	31%	Pepper	20%
Linseed Oil	46%	Lead	29%	Jute	20%
Wool	45%	Cotton	29%	Rice	19%
Sisal	42%	Rubber	28%	Tea	15%
		Coconut Oil	27%	Maganese	14%
		Soybean Oil	27%	Iron	14%
		Palm Kernel Oil	26%	Bananas	13%
				Aluminuma	8%

Source: Adams Gerard F., Stabilizing World Commodity Markets, p. 10, 1978.

corrections have involved stabilization of prices of these commodities by fixing prices for a whole season at a time, thus shielding the producers from the world market price fluctuations of these commodities. Nigeria, which produces many of the primary commodities such as cocoa, palm kernels, groundnuts (peanuts) and rubber, is an example of a nation which has established a pricing stabilization scheme to handle the purchase and sale of the varied commodities, and at the same time, fix prices for a whole season at a time. This scheme effectively severs the link between domestic prices and world prices.

Since the introduction of the Nigerian commodity board to oversee the above pricing arrangement, actual production of many of the commodities has been on the decline. The data in Appendix E, show that production of cocoa, palm-kernel, groundnut and rubber, which provide foreign exchange to support the needed importation of both capital and consumer goods, in many of the years, was not enough to meet even the domestic demand. Even with the increased importance of oil as the major export earner of Nigeria, the raw material agricultural commodities in the Nigerian economy remain important to export earnings. However, their earnings have been declining as shown in Table III. Within the group, however, the trend in exports of cocoa as a percentage of total agricultural exports has been upward even though the increases have been variable. The percentage was 47 in 1967 and had risen to 81 percent by 1975.

The declining role agriculture is playing relative to the overall gross domestic product of Nigeria is portrayed in Table IV. Agriculture contributed 68.4 percent of gross domestic product in

TABLE III

VALUE OF EXPORTS AND CONTRIBUTIONS OF AGRICULTURE[a]
TO NIGERIAN ECONOMY, 1967-1975

YEAR	EXPORTS (MILL)		SHARE OF EXPORTS	
	TOTAL	AGRICULTURE	AGRICULTURE	COCOA
1967	201.75	115.56	57.30	27.10
1968	164.44	113.15	68.80	25.60
1969	267.40	116.83	43.70	19.70
1970*	390.63	118.16	30.20	17.00
1971	1,204.51	226.22	18.80	11.90
1972	1,327.63	150.47	11.30	7.60
1973	2,122.51	212.61	10.00	5.30
1974	5,572.76	258.23	4.60	2.90
1975	4,296.49	227.95	5.30	4.30

Source: Value of Export figures computed from FOS Economic Indicators, Vol. 7, No. 8, and Vol. 12, Nos. 1, 2, 3, 1967-1975.

[a]Agricultural products includes exports of livestock, forestry and fishing.

*The eastern states were excluded from estimates.

TABLE IV

NIGERIAN GROSS DOMESTIC PRODUCT BY TYPE OF ECONOMIC ACTIVITY
(Percentage Distribution)

	1958/59	1962/63	1966/67	1970/71	1973/74
Agriculture	68.4	61.5	54.4	50.0	34.0
Mining (Including Petroleum)	.8	2.1	4.0	11.6	18.0
Manufacturing	4.4	5.8	7.3	8.0	8.0
Power Transport and Construction	7.3	9.6	9.8	8.3	14.2
Services	19.1	21.0	23.5	22.1	15.4

Source: Wonter Tims, Nigeria: Options for Long-Term Development Findings of Economic Mission Mission by World Bank Team, p. 13: FOS, Digest of Statistics, Vol. 25, 1976 and FOS, The Index of Economic Indicators, Vol. 12, Nos. 1, 2, 3 March 1976.

1958/59 as compared with 34 percent in 1973/74. The other sectors have increased their relative importance to the gross domestic product (GDP) while agriculture's share declined. Based on data in Table V, only agriculture has a sectorial growth rate which is downward. The other sectors of the economy seem to be growing at relatively rapid rates.

As a result of the declines in production and in agricultural growth rates, the policies of the Nigerian commodity boards have become the subject of many debates. The first progress report of the 1970/74 development plan noted that the "indications show that the marketing board system as presently operated discourages increased efforts and production of farmers" (Olatunbosun, 1972). The implication is that the pricing strategies have eventually caused agricultural production to decline. The main functions and operations of the commodity boards will be described in Chapter III.

Research Problem

Despite the abolition of export taxes on cocoa in the 1973/74 production season, prices actually received by the farmers is still relatively low. In fact, even the claim that the commodity boards have on the average succeeded in stabilizing domestic producer prices of many of these primary commodities is still questionable and unsettled (Bauer, 1967), when one compares the degree of internal domestic instability for most of these commodities in Nigeria and their instabilities in the world market. For example, the world degree of instability in cocoa prices is 35 percent while the degree of domestic instability stands at about 27 percent (Johnson, 1971).

TABLE V

SECTORIAL GROWTH RATE (In Percentages)

Average Annual Growth Over Period In Real Terms
For 1950/57 To 1975/76

	1950-1957	1958/59 - 1962/63	1962/63 - 1966/67	1966/67 - 1970/71	1970/71 - 1971/72	1974/75 - 1975/76
Gross Domestic Product	4.1	6.4	5.5	5.5	2.5	17.6
Agriculture	2.9	4.6	2.0	.8	1.8	1.0
Mining (Including Petro)	3.1	27.0	44.0	26.5	88.0	63.0
Power, Transport and Construction	15.1	12.1	5.5	3.8	40.0	20.0
Services	3.4	6.8	7.0	6.2	14.0*	14.0*

Source: Wonter Tims, Nigeria: Options for Long-Term Development - Findings of Economic Mission By World Bank Team, p. 12; FOS, Digest of Statistics, Vol. 25, 1976; FOS. The Index of Economic Indicators, Vol. 12, Nos. 1, 2, 3, March 1976.

*Approximates

The problem becomes more complicated with the realization that producer prices in general have been kept well below the world competitive prices since World War II (Helleiner, 1966) and have continued in that pattern after 1966 to the present. The differences between the deflated world prices for cocoa and the deflated cocoa prices received by cocoa producers from 1967 to 1980 are presented in Figure 1. The world competitive prices are those prices the producers would have received were they allowed to face the world market, whereas the actual prices received by the producers are those that are paid to them by the Cocoa Board.

It was alleged by Helleiner (1966), that between the production seasons 1947/48 and 1961/62, the Cocoa Board withheld, on the average, 31 percent of the producers' prices via export duties, marketing board trading surpluses and produce purchase tax that is normally imposed by the government on cocoa producers. For the periods after 1962/63 production season, Essang (1972) asserts that about 35 percent of the world prices was still being withheld from the producers - an increase over the previous period of 4 percentage points. As a result of these findings, Essang further hypothesized that if data on other forms of taxation such as the poll tax, income tax and several other levies borne by the cocoa producers were ascertainable, perhaps the transfers of the cocoa producer proceeds may be in the range of 40 to 50 percent of the world prices.

The level of taxation may be a contributing factor to the declines in agricultural production in Nigeria. The peasant producers account for more than 90 percent of Nigerian cocoa production, which are planted mainly on small acreages ranging from

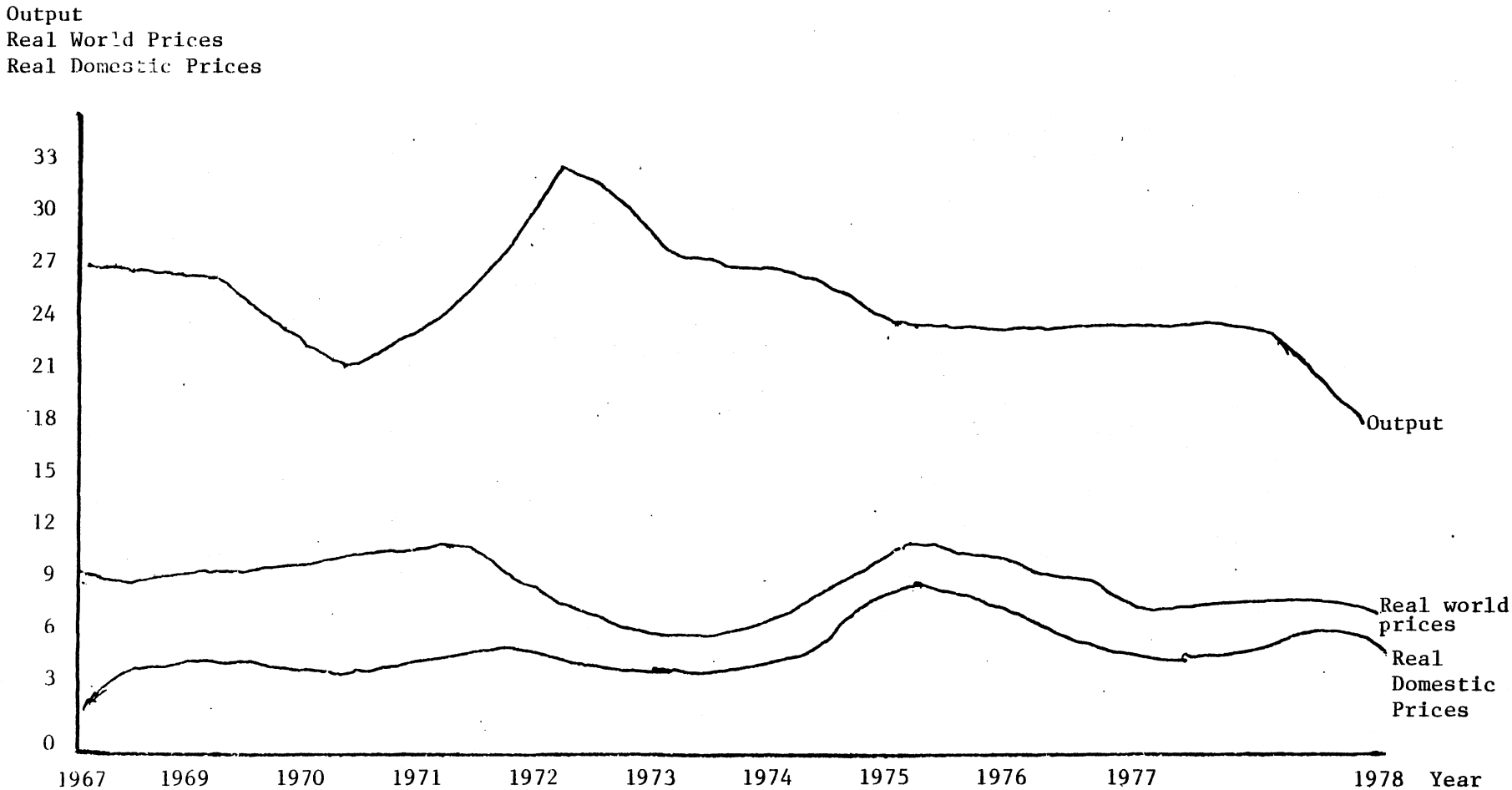


Figure 1. Nigerian Cocoa Production and Real Prices, 1967-1978.

3.2 acres in the western area and 6.4 acres in the eastern area of the country (FAO, 1966). These small acreages, even under the best conditions, may be unable to fetch average Nigerian incomes for the cocoa producers. On the whole, the taxation feature and the stabilization scheme can be hypothesized to play a major role in the flight of labor out of agriculture, and especially the cocoa industry. As a result, a decrease in production in the cocoa sector and the agricultural sector as a whole would occur.

Recent studies on price stabilization issues have tended to conclude that stabilization could be harmful or beneficial to either the producers or consumers or to both, depending on the source of instability (Turnovsky, 1976). Consequently, the mere fact that prices are fixed at the beginning of each production season may not guarantee that the appropriate planning strategies are followed which would increase cocoa production. Turnovsky (1974), asserted that accurate knowledge about the manner in which the stochastic disturbances enter and about the price elasticities of supply and demand are crucial elements in the formation of appropriate policies on stabilization.

One proposal to ameliorate the declines in cocoa production is to increase the farm price. This could come from paying the farmers prices obtainable in the world market.

Objectives

The primary objective of this study is to develop and investigate appropriate models which will help in determining the implications

of increasing cocoa producers' prices to reflect the competitive market world prices.

Specifically the research will be geared towards:

(1) determining changes in Nigerian cocoa production and its share of world output.

(2) determining the relationships between world and Nigerian producer prices of cocoa.

(3) estimating the response of Nigerian cocoa production to producer prices of cocoa.

(4) evaluating the effects of past pricing policies on (a) Nigerian world production shares, (b) cocoa producers' income.

(5) evaluating the effects of increasing producer prices toward the world prices of cocoa.

Hypotheses To Be Tested

The hypotheses to be investigated in the study include the following:

(1) that there will not be any differences in sales volume as a result of changing the announced cocoa producer prices,

(2) that farm income will not change by a proportional amount as a result of reducing the divergencies between producer prices and world prices,

(3) that real income from cocoa would not have changed over the years without a price policy, and

(4) that there would not have been any changes in output without stabilization.

Organization Of The Thesis

Chapter II of this study will include reviews of important studies on price stabilization policies and their benefits to various segments of society. Also, studies dealing with modeling supply and demand functions for cocoa will be reviewed in this chapter.

Chapter III will include a description of the general production and consumption patterns of cocoa and further determine if the larger producers (countries) of cocoa have maintained, lost, or gained production shares over the years. The direction is important as it may relate to the effect of Nigerian commodity board policies on Nigeria's position as a large supplier of cocoa. Various theoretical ramifications of the past and present stabilization pricing schemes are also explored in the chapter. Finally, the chapter will discuss synophically, the development of the Nigerian commodity board and its structure.

Chapter IV will include the theoretical underpinnings for the study, including model specification and the limitations of the available data series. Chapter V will re-specify models of Chapter IV in estimable form and analyze the general results developed therefrom. Chapter VI will summarize the results and limitations of the study and make suggestions for further research.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The major literature relating to both the aggregate supply and demand models for cocoa are presented in this chapter. Aggregate supply and demand analysis are useful for predictive as well as for policy decisions in general. They are also important for evaluating the impacts of various agricultural pricing schemes aimed at affecting one or all of the market participants.

Specifically, the aggregate supply response will enable this study to ascertain the response of the producers to the price stabilization policies of the Nigerian commodity board since its establishment in 1948. The demand (consumption) function will be pertinent in Chapter IV in predicting and analyzing the response of consumers of Nigerian cocoa under the current pricing scheme. However, since cocoa is mainly produced for export, the studies to be reviewed will be based on the external demand for Nigerian cocoa rather than the domestic demand. Rather than presenting an exhaustive analysis of all the previous studies, the attention of this chapter will be directed towards the major theoretical and methodological contributions that are useful in estimating aggregate supply and demand response for cocoa. In addition, the focus will also be directed towards the major studies that have used linear and

non-linear supply and demand functions in estimating the benefits of price stabilization to various market groups.

Modeling Cocoa Demand Response

While considerable attention was devoted in the 1950's and 1960's to estimating demand functions for cocoa, it is a well recognized fact that real prices, money income of consumers, taste and preferences of consumers, prices of related products or complements and the number of persons who consume a particular commodity are considered as important variables in estimating ordinary demand functions (Ferguson and Gold, 1975). This is also true for cocoa. However, since many studies have already been done in this area in the 1950's and 1960's, this section will primarily consider models that were developed by three major studies; Behrman (1965), Oni (1967) and Okorie and Blandford (1979).

Behrman (1965) estimated demand for cocoa elasticities for five leading cocoa consuming countries. The study covered the period from 1961 to 1965. The five countries investigated included the United States, United Kingdom, the Federal Republic of Germany, Netherland and France. The combined cocoa consumption in these countries over the period accounted for about 65 percent of the world's final cocoa consumption (Behrman, 1965).

Cocoa consumption by these countries was represented by the aggregate per capita grindings (AG_t). It was considered to be a function of real annual domestic price of cocoa, (Pc_t), annual average real domestic price of sugar (PS_t), average annual

$$AG_t = \beta_0 + \beta_1 Y_t + \beta_2 PC_t + \beta_3 PS_t + W_t \quad (1)$$

Equation 1 provided the specific linear form that was utilized in estimating the demand for world cocoa, in each of the countries under investigation. The β's were the structural parameters estimated while W_t was the disturbance term. Estimates of several variants of the demand for net additions to per capita stock function were made but not reported. The reason for not reporting the results of the net capital stock function was because they did not provide any useful results (Behrman, 1965). However, the demand for net additions to stock involved some form of the Nerlove partial adjustment model. The relationship stipulated was that the optimal net addition to stock, (J_t^*), was a function of annual per capita grindings of cocoa, (G_t) in quantity terms, price speculatory activity denoted by $\frac{\Delta PC_{t+1}}{PC_t}$ where PC_{t+1} was the difference in cocoa price of cocoa between periods and PC_t, the real domestic price of cocoa and G_t as the differences in grindings between periods. This relationship is specified algebraically as follows:

$$J_t^* = \beta\xi_0 + \xi_1 \Delta G_t + \xi_3 \frac{\Delta PC_{t+1}}{PC_t} + U_t \quad (2)$$

and

$$J_t - J_{t-1} = \ell (J_t^* - J_{t-1}) + E_t \quad (3)$$

Where

ℓ = coefficient of adjustment

and E_t and U_t were the error terms.

However, due to data limitations on the quantity of stocks available, the study constructed a series denoted by (ΔJ_t) for the stock variable and equation (3) was then manipulated to obtain

equation (4) in which ΔJ_t appeared. Substitution of the first difference equation of (2) into (4) led to equation (5) which gave the form actually estimated.

$$J_t = \lambda\Delta J_t + (1-\lambda)\Delta J_{t-1} + \Delta E_t \quad (4)$$

$$\Delta J_t = \theta_1 \Delta G_t + \theta_2 \Delta G_{t-1} + \theta_3 f(PC) + \theta_4 \Delta J_{t-1} + V_t \quad (5)$$

Where

$$f(PC) = \frac{\Delta PC_{t+1}}{PC_t} - \frac{\Delta PC_t}{PC_{t-1}}$$

$$V_t = \Delta E_t + \lambda\Delta V_t$$

and

θ's = algebraic combinations of λ and ξ's .

The study then based on equations (1) through (5), utilized a prototype simultaneous equation which necessitated the completion of the system of the above equations to enable the system to be estimated. Ten equations were finally estimated. One demand function for per capita grinding function, one for each country and one demand for net additions to the average per capita stock function, five of them for each country under analysis. The remaining equations were presented as follows:

$$AG_t = AG^r(Y^r, PC^r, PS^r) \quad (6)$$

$$\Delta J^r = \Delta J^r(\Delta G^r, \Delta G^r_{t-1}, f(PC)^r, \Delta J^r \quad (7)$$

$$D^t = D^{t5}, (AG^r, \Delta J^r, AG^c, \eta^r, \eta^c) \quad (8)$$

$$S^t = S^t(PC^t, W, P_d \ldots) \quad (9)$$

$$PC^t = PC^t(D^t) = PC^t(S^t) \quad (10)$$

The variables AG, Y , PC , PS ΔJ_t are as previously defined and represented population of the various countries. The superscripts represented in equations (6) through (10) represent the various

geographic regions of the world. For example, t represents the total world, r the rest of the world except the five countries of interest, while c represents the combined areas of the countries under investigation. The barred quantities are the equilibrium magnitudes and the parentheses in equation (9) represents the non-specified functional form of the equations.

Equations (6) and (7) are similar to (1) through (5) except that the earlier set of equations represented the rest of the world. Equation (8) represented the total world demand function. Equation (9) was the cocoa supply response which was composed of the following variables: weather (W), plant disease (Pd) and other non-specified factors. The final equation, (10), was nothing more than the equilibrium clearing equation.

In the system of equations estimated, all the variables were considered to be generated within the system except for the price of sugar and the per capita income of the various countries under analysis. As a result, the ordinary least square multiple regression technique, if applied directly, would have provided biased and inconsistent estimates since there was interdependence between the dependent variables and the explanatory variables. The order condition of identification was applied to determine if numerical estimates of the parameters of the structural equations could be obtained from the reduced form coefficients. The study found that the equations in the system were over identified using the order condition of identification with an inequality by exclusion restrictions.

The procedure finally applied involved the use of the instrumental variable technique to obtain consistent estimates. However, the conditions necessary to obtain consistent estimators in a system of simultaneous equations when instrumental variables are utilized are that:

(1) plim $\hat{\Theta} = \Theta^*$

Where

θ^* is some point which may equal 0.

This statement should hold for every $\varepsilon > 0$.

Lim $\{|\hat{\Theta}_n - \Theta^*| >) = 0$ or for every $\varepsilon > 0$ and $\int > 0$.

There must exist an Θ^* such that for Θ_n

$$P|\hat{\Theta}_n - \Theta^*| > \varepsilon$$

(2) The large sample size property must be satisfied.

(3) The instruments used in deriving the parameters must be related to the variable in question in such a manner that it will not have any relationship to the other variables in the system of interest. Even if the instrumental variable in question satisfies all of the above rules, its only desirable property is that it will only yield consistent estimates (Pindyck and Rubinfield, 1981).

Behrman (1965) also estimated the models presented previously by ordinary least square multiple regression technique (OLS). The results he obtained through this approach were presented rather than the earlier approach. The study did not find any significant difference between the approaches. However, the application of OLS procedure in the study would have led to significant flaws. There is

the possibility of the violation of the large sample size property of OLS, which would have resulted in inconsistent estimates. Other problems with the study which make it questionable include, for example, the price series of cocoa and sugar, which did not adequately represent the value of the derived variables. This could have affected the response coefficients of the study. The trend variable utilized to represent taste and preferences could not be interpreted as either representing a shift in demand, population growth or even growth in per capita income and/or perhaps other factors. It is possible that because of the significance of the trend variable, the income variable became insignificant. The assumption that world prices were exogeneous is also refutable. Finally, the non-inclusion of possible substitutes or complementary commodities variables and the absence of lagged prices of cocoa in the supply response also could have affected the parameters of the supply response in the simultaneous equation system. The elasticity coefficients from this study are presented in Chapter V, with those of other studies.

Oni (1970) conducted a similar study on the demand for cocoa. The study determined the structure of the market demand parameters for Nigerian cocoa. Data of cocoa imports for five major countries were collected from 1947 to 1968. These countries included the United States, Netherlands, Western Germany, Canada and Japan. These countries were responsible for the purchase of most of the Nigerian cocoa (Oni, 1970). Prior to this study, there was no known study on the demand for Nigerian cocoa and as such little was known about the elasticities of demand for Nigerian cocoa in these markets.

Broadly, the model asserted that the demand (consumption) of Nigerian cocoa, by each of the countries under analysis, was a function of the world market price of cocoa, the world market price of sugar, the total cocoa grinding of each of the countries, the aggregate disposable income of the various countries and changes in populations, taste and preferences in each of the countries.

The OLS procedure was used to estimate three types of demand functions; the linear, exponential and power form. This procedure was used for each of the five cocoa consuming nations mentioned previously. The semi-log form was determined to be appropriate for the United States while the linear static models were used for the other countries.

Annual time series data were employed in estimating the models which ran from 1947 to 1968. But because estimates for some countries for 1968 could not be obtained the study terminated in 1967. For the United Kingdom, West Germany, Netherlands and Canada, the static linear form provided the necessary estimates for the parameters. The results from the study indicated highly inelastic demand response for Nigerian cocoa (Oni, 1967).

Since OLS procedure was used in estimating the above equations, the major problem from the study may be due to the inadequate data. Time series data for the periods under observation may not have been large enough so as to provide unbiased and consistent estimates of the structural parameters (Pindyck and Rubinfeld, 1981). The use of the trend variable to represent taste and preferences of the consumers may also have resulted in a downward bias for the income variable. However, the interpretations of the trend variable remains suspect as indicated in the previous section.

While Behrman's 1965 study utilized both the instrumental variable technique and the application of OLS procedure directly to estimate the various equations, his study found no significant differences between the two approaches. The study estimated cocoa consumption elasticities in the countries investigated, as stated previously. The study encompassed and estimated demand macro parameters for cocoa. However, Oni's 1970 study estimated elasticities of demand for Nigerian cocoa only. Only the OLS technique was applied to the models developed in the study. Essentially, Oni's study was more interested in estimating specifically the elasticities of demand for Nigerian cocoa while Behrman's study concerned itself with estimating demand elasticities for all the cocoa producing countries. Since the studies involved different levels of interest and almost the same techniques were applied to estimate the models, the only major contributions of these studies are that one provided an insight into the macro demand parameters for cocoa while the other provided the estimates of the parameters at the micro level. However, both studies found that the price elasticities of cocoa were relatively low at both levels.

Okorie and Blandford (1979) estimated cocoa demand functions for the United States, European Community, Japan and the Union of Soviet Socialist Republic. Time series data were collected from 1952 to 1975. The contention that the conduct or behavior of commodity demand functions in many instances can be more appropriately represented or described dynamically (Labys, 1973) influenced the study to focus attention on estimating the Nerlove type of partial adjustment demand model.

Behrman (1965) had used a similar approach to estimate the capital stock adjustment model presented in the previous sections. Okorie and Blandford (1979) however, applied the technique directly to estimate demand functions for the countries under analysis. In the final analysis, the study utilized the above technique to estimate the demand function for the union of the Soviet Socialist Republic while applying the double-log static model to the equations of the United States and European Community and the linear static form for Japan.

The partial adjustment model utilized in estimating the demand equation for the USSR, which was first popularized by Nerlove (1958), is difficult to estimate directly. This is because the desired level of the independent variable is always unknown. On the whole, when compared with the adaptive and other forms of the Koyck distributed lag structures, ordinary least squares estimators of the parameters of the partial adjustment model will provide consistent estimators of its parameters.

The general form of the partial adjustment model used in the study to estimate the dynamic model for cocoa was:

$$YC_t^* = \alpha_0 + \alpha_1 CP_t + \alpha_2 PS_t + \alpha_3 I_t \qquad (1)$$

and

$$YC_t - YC_{t-1} = \partial (YC_t^* - YC_{t-1}): \quad 0 < \alpha \leq 1 \qquad (2)$$

$$YC_t = YC_{t-1} + (YC_t^* - YC_{t-1}): \quad 0 < \alpha \leq 1 \qquad (3)$$

Where

YC_t^* = optimal or desired level of cocoa consumption

∂ = coefficient of adjustment, sometimes known also as the rate of adjustment.

If $\partial = 1$, this will imply that the full adjustment of cocoa

consumption occurred in the first time period. If $\alpha=0$ this will be indicative that the desired cocoa consumption level and that of the first initial period was the same. The coefficient of adjustment had boundaries between zero and one.

Substituting for YC_t^* in equation (1) and re-arranging the terms, the following equation was derived;

$$YC_t = \partial\alpha_0 + \alpha_1 CP_t + \alpha_2 PS_t + \alpha_3 I + (1-\partial) YC_{t-1} + U_t^* \quad (4)$$

Where

CP_t = Price of cocoa,

PS_t = Price of sugar,

I = Income

YC_t = One year lag on cocoa consumption

and

U_t^* = error term.

It was assumed that $\partial U_t^* = U_t^*$ and that U_t^* is $NID(0, \sigma^2 U_t^*)$

The premise surrounding the Nerlove adjustment model itself is that actual consumption (YC_t) is a function of observable cocoa prices (CP_t), sugar prices (PS_t) and income (1_t) and that consumption in one single period adjusts only partially by a fraction ∂ already shown above, towards long-run equilibrium consumption (YC_t^*).

The study used ordinary least square procedure in estimating the parameters in equation (4). But using OLS to estimate equation (4) assumed that the independent variables were uncorrelated with the disturbance term. This means;

$$EX^1 u = 0$$

and

$Eu_t = 0$. The expected value of the disturbance term was zero accompanied by the following other assumptions:

$$E(u_t u_s) = 0, \text{ for all } t \neq s$$
$$= \partial^2_{It}, \text{ for all } t = s$$
$$t = 1, 2 \ldots T$$

Should the equation estimated in their study meet the above specifications, then it is imperative that the equation fitted in the study would have no serially correlated disturbances. If, on the other hand the disturbances were autoregressive, the assumption of independence of the explanatory variables and the disturbance term would have been violated, and hence how "good" their estimated demand function would have been would have depended upon the degree of serial correlation.

However, several restrictive assumptions implicit in estimating the adjustment model were noted (Okorie and Blandford, 1979).

(1) The contention that the consumer is prevented from adjusting to a new situation due to the inflexibilities in demand which could have arisen because of ignorance, initia, contractual obligations and other related consequences was not underscored.

(2) The the same coefficient of adjustment was applied to all the explanatory variables. As a result of this restrictive proposition, it would seem the estimated coefficient of adjustment and those others associated with the explanatory variables would be sensitive to any omission of relevant explanatory variable.

(3) The optimal consumption depended solely on current prices and incomes.

The results of these studies show that the static demand model is one way of handling the demand for cocoa in countries where cocoa consumption has become a regular feature of the household's basket of purchases. The partial adjustment model is applicable for countries where cocoa consumption is relatively new and the demand for cocoa is hampered by the non-existence of the free market. Despite this feature in the models some, theoretical problems regarding the construction of the variables for analysis still remain to be solved.

Modeling Cocoa Supply Response

Many studies attempting to estimate the supply response of cocoa have been conducted. The first major attempt to estimate a cocoa production response model was done by Bateman (1965). In the study, an econometric model to explain both the aggregate and regional cocoa supply response for Ghana was specified. A combination of both the Nerlove partial adjustment model presented previously and the adaptive expectation formulation to be presented presently were used to specify the relationship between actual and potential production on one hand and actual prices and producers' expectations about future prices, on the other hand.

The Nerlove (1956) adaptive expectation model is based on the concept that each year producers revise the price they expect to receive in the following year in proportion to the error they made in predicting price the previous year. This implies that producers revise their expectations according to their most recent experiences.

the model discussed above can be presented algebraically as follows:

$$CP^*_t - CP^*_{t-1} = \beta(CP^*_{t-1} - CP_{t-1}) \quad 0 < \beta \leq 1;$$

Where

CP_t is the expected price for period t at period t-1,

CP^*_{t-1} is the expected price for period t-1 at period t-2,

CP_{t-1} is the price actually received by the producers at period t-1 and

β is the coefficient of expectation, which has ranges from 0 to 1, with similar interpretations as those explained in the partial adjustment model presented above.

It can also be shown that the expected price for period t at period t-1 could be represented by an infinite sum of past prices with geometric weights as follows:

$$CP^*_t = \sum_{j=0}^{\infty} \beta(1-\beta)^j P_{t-j-1}$$

Just (1974), also using a decision theoretic approach, showed that the subjective mean of the expectation variable is identical to Cagans adaptive expectation model. However, Bateman (1965) study assumed that all the future prices were the same as those expected now;

$$CP_{t+k+i} = CP_{t+k} = CP_t; \quad k=1$$

Using the partial adjustment model that was presented earlier, he also established the relationship between potential output of cocoa and actual output. Specification of aggregate supply response models is usually based on acreage response. But due to the lack of data on acreages planted, the study proposed the use of cocoa price lags as

the appropriate proxies for the missing acreage data. In fact, this was the first study to propose the use of lagged prices for the missing acreage data on cocoa supply response. In the study, the eight and twelve year lags on cocoa prices were determined to be the relevant lags for the specification of both the Ghanaian aggregate and regional cocoa responses. However, the study did not find any significant relationship between current prices and cocoa production.

OLS procedures were applied in the estimation of the aggregate and regional cocoa supply response models that were specified. The major criticisms of the study are:

(1) The process in which the expectations on prices were generated (Behrman, 1968).

(2) The cocoa price expectation hypothesis would have led to the introduction of the element of autocorrelated residuals in the error term.

(3) The lack of inclusion of data on the cocoa disease and the various disease control measures being carried out (Wehner, 1968).

Generally, models involving the adaptive expectation hypothesis suffer from significant shortcomings which can lead to the questioning of the validity of the modelling process. (Nerlove, 1979; Grossman, 1975). The critics of the above process direct their attention towards:

(1) The economic explanation of the lag structure.

(2) The assumption that expectations are formed in a particular manner. Lack of flexibility of the geometric lag

structure, also ad hoc but more flexible such as the polynomial lag (Lin, 1977).

(3) The assertion that producers base their expectations only on past realized prices may be questionable.

(4) The estimated coefficient of expectation and the coefficient attached to the price variable have been shown to be particularly sensitive to the omission of relevant explanatory variables in the models (Nerlove, 1979).

(5) The introduction into a supply response model of expected normal prices as a distributed lag of past prices with geometric weight may lead to a reduced form supply response which could be identical to results obtained by a Koyck reduction process. This could lead to a problem of separating changes resulting from the lagged adjustment to those attributed to the expectation formation.

Behrman (1968), basing his model formulation on the Bateman (1965) study presented above, also estimated cocoa supply response models for Ghana, Nigeria, Brazil, Ivory Coast, Cameroun, Ecuador, Dominican Republic and Venezuela. The major difference between the two studies was centered around the assumptions surrounding the various expectation hypothesis. Whereas Bateman's price expectation hypothesis was focused on a one price variable, Behrman's 1968 study formulated a two price variable expectation hypothesis involving both the cocoa and coffee prices. In the final analysis, however, the two models were basically the same involving some combination of the partial and adaptive expectation formulation, Ady (1968), following the same direction, also estimated various supply response models for

cocoa but with a slightly different price expectation formulation. The adaptive price expectation model formulation was used to postulate that the producers of cocoa face a lagged response in prices between the world and domestic stabilized prices. Based on this formulation, the study found the current price of cocoa to be significant even though it had a negative coefficient effect in the case of the Ghanaian cocoa supply response model. Olayide (1972) also developed a similar model but included an index of cocoa disease.

All the models discussed in this chapter utilized the OLS technique to estimate their models. The major differences lie in the appropriate variables for estimation and the number of relevant lags to be used in estimating the supply responses. For example, Ady (1968), did not find the specification of a coffee variable as the relevant alternative commodity to cocoa, while Bateman (1965) and Behrman (1968) specified coffee as relevant in the estimation process. Bateman (1965) had only one expectation price formulation while Behrman (1968) had two; one involving cocoa and the other coffee. On the whole, it is possible that with the limited time series data available to them, their models may have had biased estimates. The error structures in the model may also have resulted in autocorrelated residuals in the models.

The omission of relevant variables can bias the included variable parameters (Huang, 1980). For instance, if we assume that Y is the number of included variables and Y the number of total variables necessary and sufficient to estimate the model, then the matrix form of the variables can be represented as follows:

$$\bar{Y} = | Y_1 \ldots Y_h, Y_{h-1} \ldots Y_k |$$

But the matrix form of the included variables in the models would have been of the form;

$$\bar{Y} = |\bar{Y}_1 \; \bar{Y} \; . \; . \; . \; Y_h \; |$$

and

$$M = |m_1 \; . \; . \; . \; M_{h2-1} \; . \; . \; . \; M_k \; |$$

Where

$M = (Y^1Y)^{-1}Y^1Y$. The M matrix is in effect the matrix of the regression coefficients of the columns of any variables excluded in the model, $\bar{Y}$.

$M_1 \; . \; . \; . \; M_{hj}$ is an M x M identity matrix and M_{h+1} an h_{xl} vector of the regression coefficients of Y_{h+1} on $\bar{Y}$.

M_k a hxl vector of the regression coefficients of Y_k on Y. The general matrix form can be presented essentially as

$$\begin{bmatrix} 1 & 0 & 0 \; . \; . \; . \; 0 & M_{h+1} \; . \; . \; . \; . \; M_{1k} \\ 0 & 1 & 0 \; . \; . \; . \; 0 & ML_{2h+1} \; . \; . \; . \; M_2 \\ \cdot & & & \\ \cdot & & & \\ \cdot & & & \\ 0 & 0 \; . \; . \; . \; . \; . & 1 & M_{h1h+1} \; . \; . \; . \; M_{hk} \end{bmatrix}$$

and

$\Lambda = |m|$ the parameter estimators. As a result, the relationship between the estimated coefficients using y rather than y would have been

$$\xi(\overset{\Lambda}{\xi}_1) = \xi_1 + m_{1h+1} + \; . \; . \; . \; m_k \xi_k$$

The estimated coefficients would have not only been biased but inconsistent in the limit. The extent of the inconsistency in the parameters, however would have depended on two things.

(1) The degree of correlation between the included and excluded variables.

(2) The sign of the coefficients of the excluded variables.

In the final analysis, inclusion of irrelevant variables may not bias the included variable parameters (Pindyck and Rubinfield, 1981). Consequently, if coffee prices are relevant in explaining cocoa producers' response but were omitted by any of the studies presented in this chapter, such an omission will result in biased estimates. If not relevant, their inclusion will not bias the other included variables.

Price Stabilization Benefits

As stated previously, both supply and demand models can be used in analyzing various programs designed to alleviate agricultural adjustment problems. The present section is designed to review studies which utilized the above tools in determining the effects of price stabilization policies on the market participants. This is important for Chapter V, because that chapter is designed to assess the implications from the conclusions of the Nigerian Commodity Board price stabilization effect on the Nigerian peasant cocoa producers.

Waugh (1944) estimated linear demand functions to ascertain the implications and effects of price stabilization on consumers. From the study, he concluded that if consumers face a negatively sloping demand function with random fluctuations in prices due to the stochastic variations in supply, they will be better off with unstable prices than with a stabilized price policy that fixes its prices at

their arithmetic mean. The assumption surrounding the process in which the error terms were derived was additive, and the conclusion was arrived at only by assuming that the supply response function was constant. Because of this weakness, Oi (1961) conducted a similar study to assess the desirability of price stabilization policy on the producers. He found that producers rather than the consumers will stand to benefit from price stability if price instability is the result of random fluctuations in the selling prices which in turn is a consequence of stochastic shifts in demand. This study also assumed that the demand function is ceteris paribus. The studies did not consider the effects on both supply and demand functions simultaneously. However, when Tisdel (1968) assumed that production in any one period was inflexibly planned before hand, the opposite result of Oi was found. The studies considered the cases of price variability not the cases where price uncertainty was involved. Massell (1969), recognizing one of the major flaws of the Waugh (1944) study and Oi (1961) indicated above, attempted to integrate simultaneously their results.

Massell (1969) used a partial equilibrium analysis for the study. From the assumptions in the study, he examined the effects of eliminating the stochastic disturbances in the demand functions and the implications of rotating the demand curves in order to alter their elasticities. The major conclusions of the study were:

(1) It is crucial to consider the long run implications of price stabilization schemes on production especially where the stabilization schemes involve agricultural commodities.

(2) Producers may lose or gain from price stabilization depending on the source of instability.

(3) When both supply and demand are random, the gains to each group may be indeterminate and will depend on the relative sizes of the variances and the slopes of the demand and supply functions.

(4) Provided the supply and/or demand functions are not perfectly elastic, the total gains from stabilization will always be positive with gainers in theory compensating the losers.

The major criticisms directed towards the above study are:

(1) The assumption of linear supply and demand functions.

(2) The study did not take into consideration the effect of price stabilization on the variance of producers' and consumers' incomes (Turnovsky, 1974).

(3) The conclusions are applicable only to situations of price variability and not to price uncertainty.

(4) Actual compensation is usually not made (Hueth and Schmitz, 1972).

Hueth and Schmitz (1972) estimated the benefits to be gained from price stabilization but focused attention on internationally traded commodities. The main results are similar to those of Massell's study presented above. Whether or not an individual country benefits from price instability will be dependent on the source of instability (Hueth and Schmitz, 1972). Price stabilization brought about by a buffer stock policy will lead to gains for the consumers and producers. However, the validity of the above conclusion is based on the proposition that losers are compensated by the gainers. But, since actual compensation is not actually made, consumers may not gain

or lose from price stability. That is, consumers will be indifferent to the established prices. On this bases, Hueth and Schmitz (1972) asserted that instability is actually superior to price stability.

Turnovsky (1974) extended the analysis to include cases where the gains from price stabilization were based on supply decisions that are made prior to any knowledge of the actual market price, i.e. uncertainty in the prices. In the study, two types of expectation generating hypothesis were examined: adaptive and rational. In both cases, the study found that price stabilization will provide an overall welfare gain that is far greater than when supply depended on actual prices. It was also shown in the study that the expectations regarding the sources of instability and the autoregressive properties of the random fluctuations are crucial to assess the nature of the gains and losses for each group.

Non-linear supply and demand response studies also have been conducted to determine the benefits to the market participants from price stabilization. Inclusion of risk variables was also been done in these studies.

Hazell and Scandizzo (1975) estimated the benefits from price stabilization when risk is asserted to be multiplicative instead of additive. The major findings of the study were:

(1) Any price stabilization policy which will leave the expected value of any stabilized commodity unchanged will result in gains of total welfare to the market participants, but the consumers will stand to lose slightly from price stabilization.

(2) If the expected price anticipated by the producers were to be less than the natural margin by an averge cost, the stabilizing agencies will stand to benefit from excess profits.

Finally, Turnovsky (1976), also with the assumption of multiplicative disturbances, conducted another study on the same subject. The main thrust of his study, however, was the consideration of rpice stabilization policies in which the slopes rather than the positions of the demand and supply functions are random. The main findings were:

(1) There was significant difference in the results of the additive cases presented earlier.

(2) The multiplicative results indicated that the desirability of price stabilization for either the producers or consumers is not dependent on the source of price instability. It is rather dependent on the slopes of the deterministic components of the demand and supply functions (Turnovsky, 1976).

(3) The nature of the stochastic disturbances will be important only in assessing the distributional effects of price stabilization.

Chapter Summary

A review of the major aggregate demand and supply response analysis was presented. The adaptive and partial adjustment models were also presented. All the studies reviewed utilized a combination

of both the partial and adaptive adjustment models in specifying the various models supply response models while the demand models were basically of the static linear nature. Lag prices of cocoa were also determined to be appropriate in estimating supply response models but the length of lags necessary for their relevant specification is still indeterminate.

The importance of adequately having knowledge on the source of instability and the assumptions surrounding the stochastic disturbance term in order to accurately assess the effect of price stabilization policies on the market participants was also reviewed. Many of the estimated supply and/or demand functions to determine the effect of price stabilization were linear which resulted in different sets of conclusions from those using the non-linear and multiplicative assumptions. Even the case where risk was explicity added to the supply and demand responses, it was discovered that, consumers will be indifferent to price stabilization in terms of their welfare implications. It was further determined that if the expected prices of the producers are less than their natural margin on average cost, the stabilizing agencies will stand to benefit form the excess profits (Hazell and Scandizzo, 1975).

CHAPTER III

WORLD COCOA PRODUCTION, CONSUMPTION AND HISTORICAL DEVELOPMENT OF NIGERIAN COMMODITY BOARD

Introduction

Primary export commodities of the developing countries are important to the overall economic development of their economies. As a consequence, any attempt to review the economic performances and future prospects of these countries should take into account the role these primary commodities play in the world trade. For instance, cocoa is purchased mainly by firms in the developed countries which in turn, use it as an input in the production of other goods. It is produced in developing countries where the crop is important to export earnings.

The present chapter will center on four areas related to production and consumption as follows:

(1) Production trends in five leading cocoa producing countries which account for more than 80 percent of total world cocoa production.

(2) Consumption trends in four major cocoa consuming blocs which accounted for about 65 percent of total world consumption of cocoa (Okorie and Blandford, 1979).

(3) Cocoa production share changes for the five leading producing countries from 1933 to 1980.

(4) The historical development of the Nigerian Commodity Boards, its functions and structure with respect to the purchase and sale of Nigerian cocoa.

World Cocoa Production and Consumption

Production

Originally, the cocoa tree originated in South America, probably somewhere in the tropical rain forest climatic zones of Brazil, or perhaps in a wider region, encompassing valleys of the Amazon in Brazil and of the Orinoco area in Venezuela (Wickizer, 1951). It was then taken to other continents of the world by either (1) the missionaries interested in both bringing the Bible to the people of that part of the world and also in providing an economically profitable commodity to the regions under their hegemony, or (2) the colonial governments interested in providing raw materials for their home industries. For the African countries, like Nigeria, Ghana and some parts of Cameroun, which were under the direct jurisdiction of the British, its introduction was in consonance with Joseph Chamberlains' doctrine of Dual Mandate (Sarah, 1967). For instance, in Nigeria the British administrative policies were geared essentially to be conservative and towards seeking the introduction of cautious development within the framework of well-preserved traditional institutions and practices (Sarah, 1967). As a consequence, most of the cocoa was produced by peasant (native) farmers on small acres of land with sizes varying from region to region.

By the beginning of the 20th century, cocoa production was extensive not only in the original continents where production had first existed, but also in Africa and other parts of the world where production had started much later. For example, by about 1892, all of the land suitable for cocoa in Ghana (then Gold Coast) in the neighborhood of the Akwapin ridge had already been planted and other farmers seeking to grow the commodity had to move to lands either north or west (Bateman, 1965). Viton (1965) writes that the periods of greatest expansion of Ghanaian and Nigerian planting in cocoa corresponded very closely to the periods of high world prices and that planting was intense particularly in Ghana between 1895 and 1915.

At the end of the 19th century, the American continent was contributing about 85 percent of total world production. Its contribution was down to 30 percent of world total output by 1926 (Bateman 1965). Ghana alone accounted for more than 49 percent of the total world production with shipments averaging 235,000 tons in the mid 1920's (Amoa, 1965). Production in Nigeria and other parts of Africa was also on the increase during these periods. As a result, by the end of the 1930 decade, the African continent as a whole accounted for well over two thirds of total world production.

The declines in production in Latin America and the Carribeans were due to the price declines that followed from the large African production which led to production exceeding consumption. By 1934, the Ghanaian production had exceeded the 30,000 ton mark and was to reach the highest peak of the decade in 1936, with an output of 360,000 tons (Amoa, 1965). Despite the comparative advantage in cost, the low prices that existed in this period resulted in the

discouragement of new plantings and the neglect of the bearing trees which led to increases in diseases and pests during the years prior to and during World War II. As a consequence, shortages in world production of cocoa occurred.

Actual world production of cocoa from 1948 to 1980 has been somewhat oscillatory (Figure 2). Starting with 1948/49 as the base year production season, production had a fairly slow increase initially, then major troughs in 1951, 1957, 1962, 1968 and 1976, followed by peaks in 1956, 1960, 1971, 1974, and 1979 (Figure 3). The average duration of periods between troughs or between peaks is 5 years with some minor modifications and adjustments after the 1965 and 1967 production seasons.

Production during the 1951/52 season was about 652 thousand metric tons with Africa accounting for about 63 percent, America about 29 percent, West Indies about 7 percent while Asia and the Oceanic were accountable for only 1 percent of total world production. During the decade of the 1950's, world production of cocoa varied between 813,000 metric tons and 923,000 metric tons then rose to 1,053,000 metric tons at the close of the decade (Figure 2).

In 1964/65, production season world total production peaked to an all time high of 1,508,000 metric tons, only to be surpassed slightly a few years later in 1971/72 production season and to gradually stabilize with minor troughs and peaks throughout the remaining period under analysis. The upsurge in production in 1964/65 has been attributed by Okorie and Blandford (1979) to exceptionally favorable (good) weather conditions during that year.

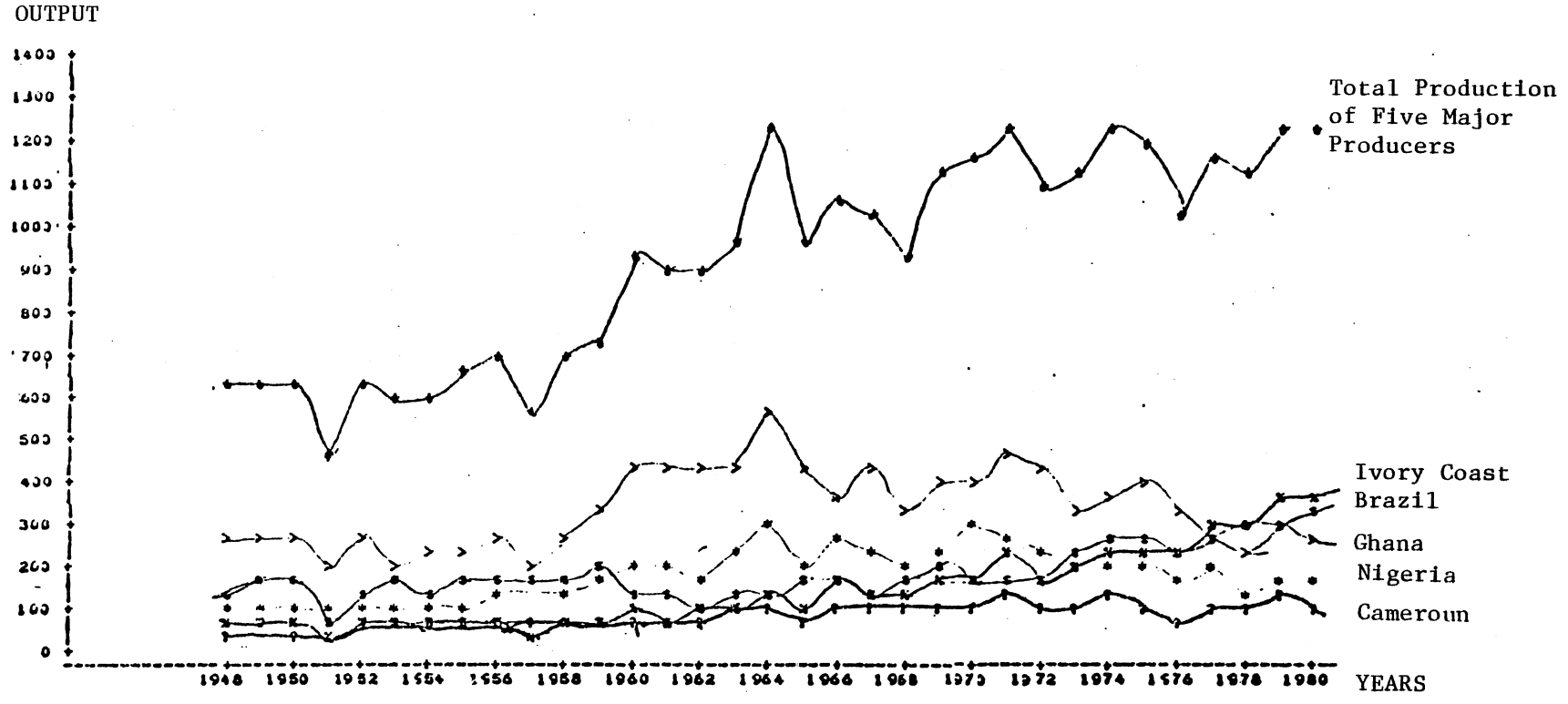


Figure 2. Cocoa Production by Five Major Producers (1948-1980)

The major African cocoa producers' share declined from 63 percent in the 1930's to approximately 55 percent in 1980, while the Americas had increased their percentages from 29 percent to 34 percent. The remainder was produced in the West Indies and Oceania.

Country by country analysis of production of the five leading producers indicate that Ghana, which had an overwhelming lead in production prior to the second world war and had continually maintained and in some cases solidified her lead up to the later half of the 1970 decade, had slumped into third place, while the Ivory Coast, last at the beginning of the period under review, had been able to climb and take over the lead from Ghana. Brazil, which has always been a major producer, had lower production in a few of the years but held the second place in terms of world production in 1980. Nigeria which had the second place finish during the later half of the 1960's and early 1970's fell to 4th place at the end of the period.

For Nigeria, the advent of internal political squabbles which later culminated in a civil war disrupted production minimally. The reason for this is the internal strikes did not affect the major cocoa producing regions of the country. In contrast, Ghana has had a lot of political turmoil but no civil war, which may be related to declines in production. Okorie and Blandford (1979) assert that countries such as Brazil, Ivory Coast and Cameroun whose governments had maintained relatively consistent policies on the cocoa industry had been able to increase their production shares at the expense of the others who do not have consistent policies on cocoa production. However, consistent policies may be possible only under a stable political system. The lack of a stable political system may be responsible for part of the declines in production in Nigeria and Ghana.

Consumption

Cocoa was used first primarily by the Toltecs and the Aztecs in Mexico and the Incas of Peru (FAO, 1954). Later it was used as a medium of exchange and as a food-drink in the middle Americas (Wickizer, 1951). Roasted and ground cocoa beans were normally mixed with small quantities of powdered corn meal, vanilla, herbs and some honey for food. At the present the cocoa bean is now a source of beverages, chocolate, raw materials for a great variety of chocolate flavored products used in food industries, cocoa powder, chocolate products and cocoa butter, which at times is used as a base for cosmetics and various other pharmaceutical preparations (Wickizer, 1951).

Significant and steady increases in cocoa consumption occurred during the period prior to World War II. The control measures imposed during World War II restricted consumption. The control measures were essentially promulgated to punish the enemies and to reward the allies by making provisions to ensure adequate supplies (Hoos, 1979). But even after the war many countries, including the United Kingdom, were still major advocates for the continuation of war time control policies. The main reasons for advocating the continuation of the war time control measures were to prevent price increases in many of the internationally traded commodities and to ensure availability of supplies to members from the smaller world cocoa production, caused by diseases and pests which resulted from prolonged neglect during the war. The United States alone among the importing nations opposed the continuation of the war time control policies.

The trend in world consumption has been upward with much smaller fluctuations as compared with production (Figure 3). Relative lows occurred in 1952, 1955, 1970 and 1975, with some correspondence to recessions in the developed countries. Regional analysis of consumption shows that the European community (EC) is the largest consumer with only a slight upward trend in consumption (Figure 4). Consumption increased gradually following the World War II and reached a peak in 1973. Consumption declined sharply in 1974 but rose gradually again after that date. United States consumption, on the other hand, decreased after 1949 then gradually increased back to the 1949 level by 1963. Consumption was relatively constant from 1963 through 1973 then began to decrease. By 1980, consumption was down to 250,000 metric tons as compared with 370,000 metric tons in 1973. It was this decline in consumption which resulted in research that was initiated by C. A. Kwami (1965) to determine the reason for the declines in per capita cocoa consumption in the United States.

The Soviet Union consumption of cocoa increased gradually from 1948 to 1976 (Figure 3). Consumption decreased sharply in 1977 but had recovered somewhat by 1980. Japanese consumption shown in Figure 3 is still small. Moreover, there is no trend.

Total consumption for the four major marketing blocs shown in Figure 3 has followed the pattern of the individual blocs but the gap between world cocoa consumption and the four major markets is widening. Since the U. S. is the only bloc registering lower consumption, the gap between the world consumption and that of the four major blocs could be the result of either the cocoa producing nations utilizing more cocoa for internal domestic use or increasing consumption in other countries of the world.

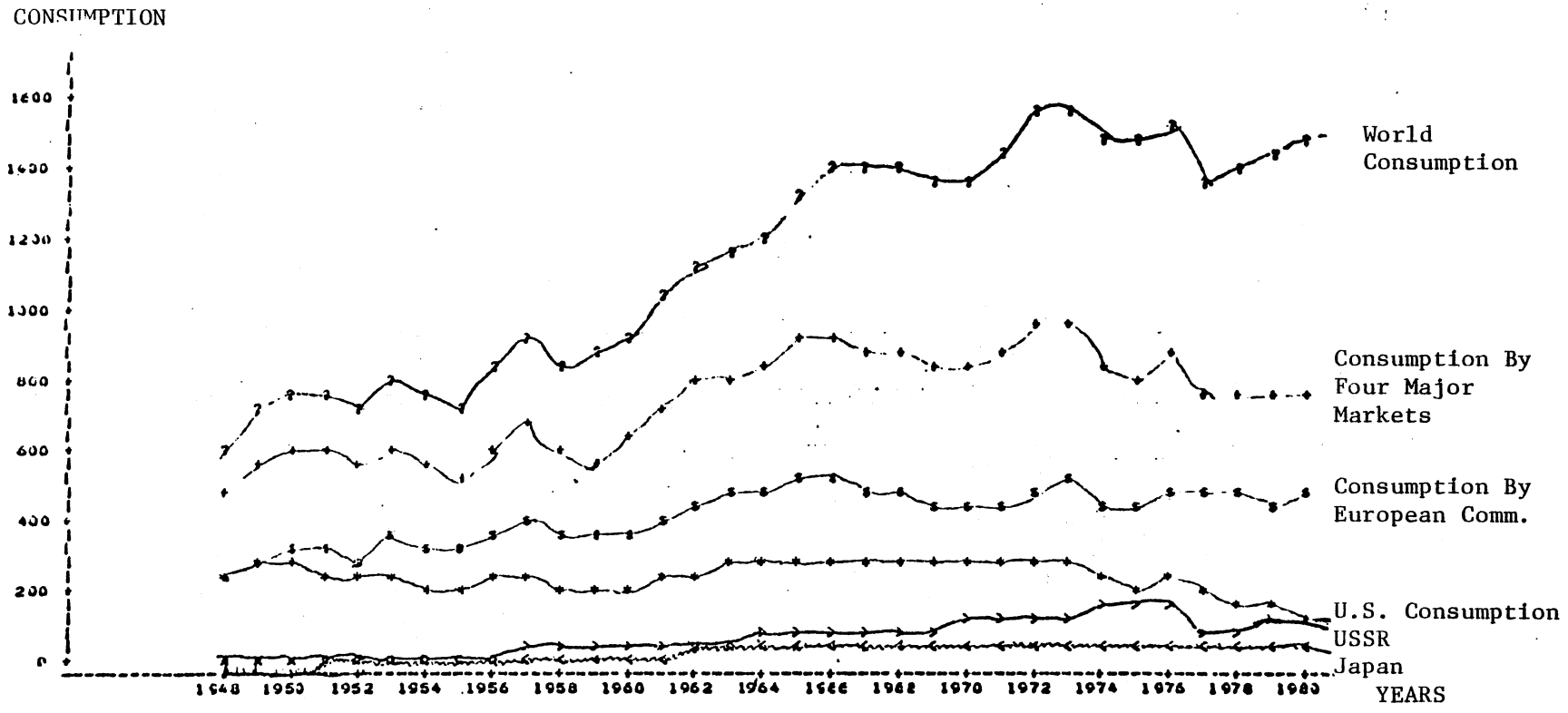


Figure 3. Cocoa Consumption in Four Major Markets (1948-1980)

Production Shares

The cocoa production shares are shown in Figure 4. They exhibit patterns similar to those for actual production. Ghana had a commanding lead in cocoa production during the 1948/49 production season with 37 percent of world total production. Ghana's share had declined to only 16 percent of the total world production by 1980. A similar trend is shown for Nigeria with a share of 19.8 percent in 1966 dropping drastically to approximately 10 percent of the total world production by 1980. Of the five leading producers, only Ghana and Nigeria have lower production shares.

Ivory Coast, with a production share of 6.8 percent in 1948, had increased its share to 22 percent by 1980. Brazil also increased its share going from 16.6 percent in 1948 to approximately 22 percent in 1980. The only major producing nation with a relatively constant production share was Cameroun (Figure 4). Of the major cocoa producers, four are West African producers.

Overall, the five major producers command a significant portion of the world cocoa producing market even though their combined total production share has gradually dropped from 81.8 percent in 1948 to 78 percent during the period. The decline in production shares involve both permanent and transitory components. The transitory components such as lower yields tend to affect production shares over only one or two seasons while the permanent components such as decreasing acreage tend to affect shares over decades. One method of analyzing market share changes is to use Herfindahl indexes of market concentration (Scherer, 1980). Grossack (1969 and 1972) provided an alternative

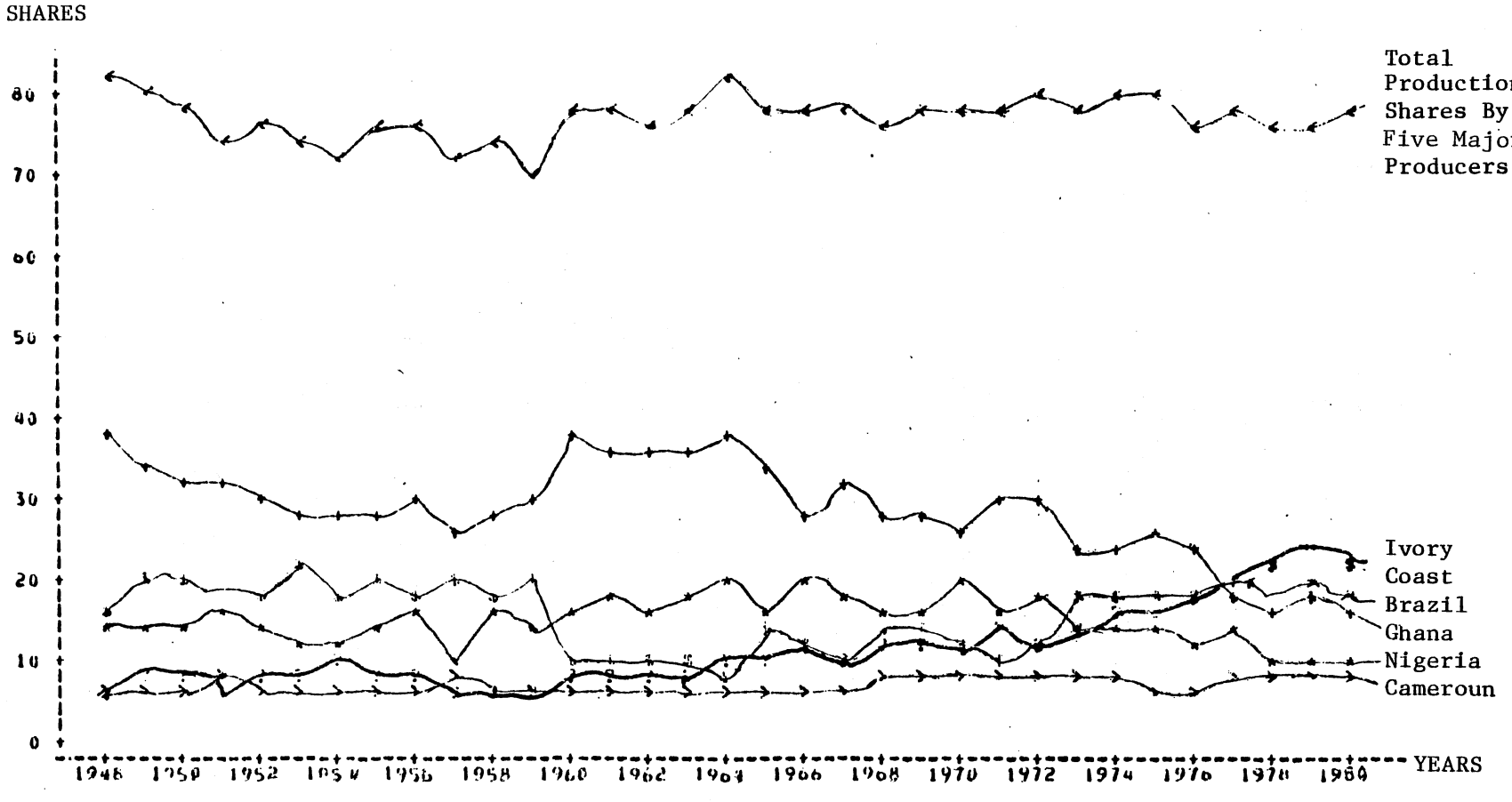


Figure 4. World Cocoa Production Shares of Five Major Producers (1948-1980)

approach. He adapted the analysis of market share distributions to some of Freidman's and Kuznet's concepts of permanent and transitory income and made assumptions concerning the nature of the permanent and transitory component shares. Grossack (1972) then regressed the terminal year permanent market share on the initial year permanent market share in order to analyze the degree of industry concentration. If the regression coefficient (b) of the terminal on the initial year share was found to be less than one, the large firms of the initial years had lost market share. If b were greater than one, the large firms had gained market share.

To ascertain whether the change had been from the large to the small firms, or vice-versa, the regression coefficients were decomposed into two parts (1) the correlation coefficient and (2) the ratio of the standard deviation of the terminal year market shares and that of the standard deviation of the initial year market shares for all the firms in the industry.

That is, $b = \ell \frac{Y_{tp}}{Y_{Op}}$

Where

Y_{tp} = standard deviations of the permanent component production shares in the terminal year

Y_{op} is the standard deviations of the permanent production shares in the initial year and

ℓ, is the simple correlation coefficient between the terminal and initial year production shares.

Three cases are compared. First, if the coefficient of correlation between the periods is low while the ratio of the standard deviations from the mean of the initial and terminal year market shares were

approximately one, the inference is that the large firms lost market shares to each other. Second, if the coefficient of correlation is high and the ratios of the standard deviations of the respective means is low, the inference is that the large firms did not lose shares to each other but rather tended to lose them as a group to small or to new firms. Third, if the correlation coefficient and the ratio of the standard deviations from their respective means were both low, the large firms not only lost shares to each other but also to small and/or new entrants to the market.

Based on similar concepts but applied to countries, the periods from 1933 to 1980 were divided into five time periods which involved different marketing strategies in each of the cocoa producing countries. For instance, the periods 1933 to 1939 was used to reflect a market situation in which there were no institutional arrangements in existence to handle, purchase and sell cocoa in the majority of the countries. The period from 1948 to 1973, was selected to represent a market with various institutions and arrangements to handle sales of cocoa for the interest of producers. The period from 1974 to 1980 was selected to represent the period when export taxes on cocoa in Nigeria were eliminated. The last regression was for the complete period of 1933 to 1980, and was done for comparative purposes to determine how the large producers have fared on the average without taking into consideration the different institutional and market strategies of various countries.

From Table VI the estimates of b for 1933-39 indicate that the larger cocoa producers, primarily made up of Nigeria, Ghana and

TABLE VI

DYNAMIC COCOA PRODUCTION CONCENTRATION COEFFICIENTS
(1933-1980)

Years	Intercept	Regression Coefficients	Correlation Coefficients	$\frac{y_{it}P_i}{y_{i0}P_i}$
1933-39	.077 (.99)	.93 (17.76)	.99	.95
1933-73	.144 (1.86)	.81 (14.70)	.98	.82
1933-80	.009 .34	.77 (3.52)	.76	1.0
1933-80	.054 (2.02)	.38 (2.01)	.56	.68

Values in Parenthesis are the t values of the estimates

Brazil who were in command of over 72 percent of the total world cocoa production retained their permanent production shares up to the end of 1939.

In the 1948 to 1973 period, the correlation coefficient was .98 while the ratio of the standard deviations of the various respective series was .82. The relatively high correlation coefficient and the lower ratio of the standard deviations indicated that large cocoa producers tended to lose market shares to other smaller or newer cocoa producers. The pattern exemplified by regression coefficients for the 1974 to 1980 period indicate loss of market share for some large producers to other large producers but no loss to small producers. Over the period 1933 to 1980, the correlation coefficient was .56 and the ratio of the standard deviations of the terminal year means on the initial year was .68. These values indicate that some larger producers of cocoa had lost market shares to both other producers and to smaller cocoa producing countries. These estimates confirm the previous observations that Ghana and Nigeria have been losing production shares to the Ivory Coast and Brazil and to some of the other countries.

Nigerian Commodity Board

Historical Background

Cocoa, palm oil and palm kernel were introduced into Nigeria in the late 19th century. The trade in these export commodities was handled from then until 1939 by mostly British foreign expatriates including John Holt and the United African Company. The produce was

purchased directly from the farmers by various middlemen who were financed by the large companies. During this era, prices fluctuated from day to day depending mainly on the existing marketing conditions. The companies in some instances possessed a lot of oligopolistic power and in many occasions actually utilized these powers through making price colusive arrangement that were designed to depress the prices paid the farmers (Sarah, 1967).

In 1937, the cocoa growers in Ghana (then Gold Coast) boycotted and refused selling their commodities for a period of five months due to the dissatisfaction that was generated through the alleged colusive arrangements and other perceived illegal deals that the producers suspected the buying agents of practicing (Hoos, 1979). Ghana and Nigeria were under the British colonial administration so the British government set up a Commission of Inquiry to investigate the grievances of the disgruntled producers. The results of the Commission of Inquiry agreed that grievances of the producers were valid and blamed the problem on the existence of a large number of middlemen. The commission's recommendation with respect to the possibility of restructuring the export trade in cocoa was to institutionalize the market process (Hellinear, 1966). Because of the advent of World War II, the implementation of the commissions' report was not undertaken by the British government.

With the Second World War in progress and with no organized channels for handling the export of cocoa to various destinations, the British government assigned to the ministry of food, the primary responsibility of purchasing the entire West African produce (Hellinear, 1966). However, some authors notably Blandford (1977)

assert that the war time control boards were formed to:

(1) deny supplies of essential primary products to the enemy and to secure them for the allies;

(2) maintain or increase exports of these commodities, and;

(3) prevent a collapse in the world prices for primary commodities.

After the end of the 1939/40 production season, controls were extended and strengthened especially with the inauguration of the West African Control Board in 1942. The board evolved later into the first permanent institutional arrangement in West Africa in 1946. The West African produce control board established minimum buying prices and at the same time controlled and reduced the various marketing costs associated with the commodities. Purchases were carried out through Licensed Buying Agents (LBA) on the basis of a quota system relating to the pre-war market shares. Essentially, the West African produce control board continued functioning with the techniques employed earlier by the Ministry of Food.

World War II resulted in a disruption in the markets for cocoa. First, shipping was tightened which led to changes in the system of control. Second, large quantities of cocoa including some of the intermediate commodities were destroyed. Third, prices that were usually advanced to the cocoa producers were further reduced. During this period as well, the board severed the link between world prices of cocoa and the prices received by the producers.

Before the official pronouncements of the end of hostilities, the British government had begun to consider long-term plans for a more permanent control of the marketing of West African Cocoa. The

United States criticized the attempt to institutionalize the market for cocoa because it would impede the development of a free market for cocoa (Industrial Series, 1947). On the basis of this belief, the United States levied the charge that the British government was attempting to operate and assume full monopoly control over cocoa production in the West African Colonies (Wickizer, 1951).

However, following the war, the various 1946 white papers and the previous conclusions of the Nowells' commission were then advanced as the main reasons for not returning to the prewar arrangements in export trade of primary commodities in the British territories. The main advantage claimed for a statutory systems was its potential to stabilize prices paid the producers and hence income (Hoos, 1979). This assertion has been criticized by many researchers. Bauer (1968) contended that the boards had destabilizing effects on income and prices over the long run, though they may have been successful in seasonal price stabilization.

The statutory marketing agency to be set up was envisaged to be an organization operating through the decision-making body of the government and acting on behalf of the producers. The establishment of such an agency began immediately after 1947 with the establishment of two national commodity boards in Nigeria and Ghana to market cocoa. The West African Produce Control Board (WAPCB) continued to function until 1949 when the marketing of the remaining commodities within its control was finally adopted by the various individual commodity boards in the various respective West African nations that had begun to emerge as independent states. The wreckage of the WAPCB was due to: (1) its inability to control world market prices; (2) the low prices

paid the producers; (3) the surplus profits accumulated over the short span of its life; (4) the storage of these surplus profits in British securities with no interest accruing to the producers (Wickizer, 1961) (indirectly the peasant producers were getting the British devalued currencies at extremely inflationary prices); and (5) the desire of the emerging nations to become more independent and self-reliant.

Between 1947 and 1949, different boards were formed in Nigeria to purchase palm oil, palm-kernel, groundnuts and cocoa. These boards together were known as the central produce marketing board. Later they were charged with the duty of handling a variety of other export crops. By 1954 a major reorganization effort of the central produce marketing board, was undertaken. The central produce marketing board was divided into regional produce marketing boards; the northern region marketing board with the sole responsibility for handling the sale and purchase of groundnuts (peanut) and cotton; the eastern region marketing board to deal with palm-oil products; the western state board, to control the purchase and sale of cocoa; and finally the creation of the midwest region in 1964, led also to the creation of a fourth regional board to handle the purchase and sale of rubber.

In 1966, the country was restructured into twelve states. In the same year the central produce marketing board was reorganized into state boards. The state boards were responsible to the main board, the central produce marketing boards whose name at this time was changed to Nigerian Produce Marketing Board. The Nigerian Produce Marketing Board was responsible for the sale of purchases of the state boards in the external market. The country was again restructured into 19 states in 1975.

Even before 1975, there had been some dissatisfaction with the performance of the boards which was unrelated to the number of the boards. The dissatisfaction was the result of production decreases and the low levels of prices paid the farmers. Based on the progress report of the 1970/74 development plan, the discussion was made to appoint an inter-ministerial committee to look at all the possibilities of improving the functioning of the boards. The committee recommended the formation of seven commodity boards. The seven commodity boards were formed in 1980 and the name of the Nigerian Produce Marketing Board was changed to the Nigerian Commodity Board from the West African Produce Control Board. Subsequent name changes were to the Central Produce Marketing Board to the Nigerian Produce Marketing Company and finally to the Nigerian Commodity Board.

Structure and Functions

The Nigerian Commodity Board oversees the activities of seven separate boards which are in turn made of state boards; (1) the Cocoa Board to handle coffee and tea; (2) the Grain Board; (3) the Cotton Board to handle other similar fibers; (4) the Groundnut (peanut) Board; (5) the Palm Produce Board; (6) the Rubber Board; and (7) the Root Crops Board.

The seven boards are charged with the responsibility of carrying out the functions such as: (a) purchasing, selling and stabilizing the markets for commodities under their control, (b) maintaining and controlling an efficient organization for the purchase of produce through the appointment of licensed buying agents (LBA) who in turn undertake the handling of produce under the boards' direction from the

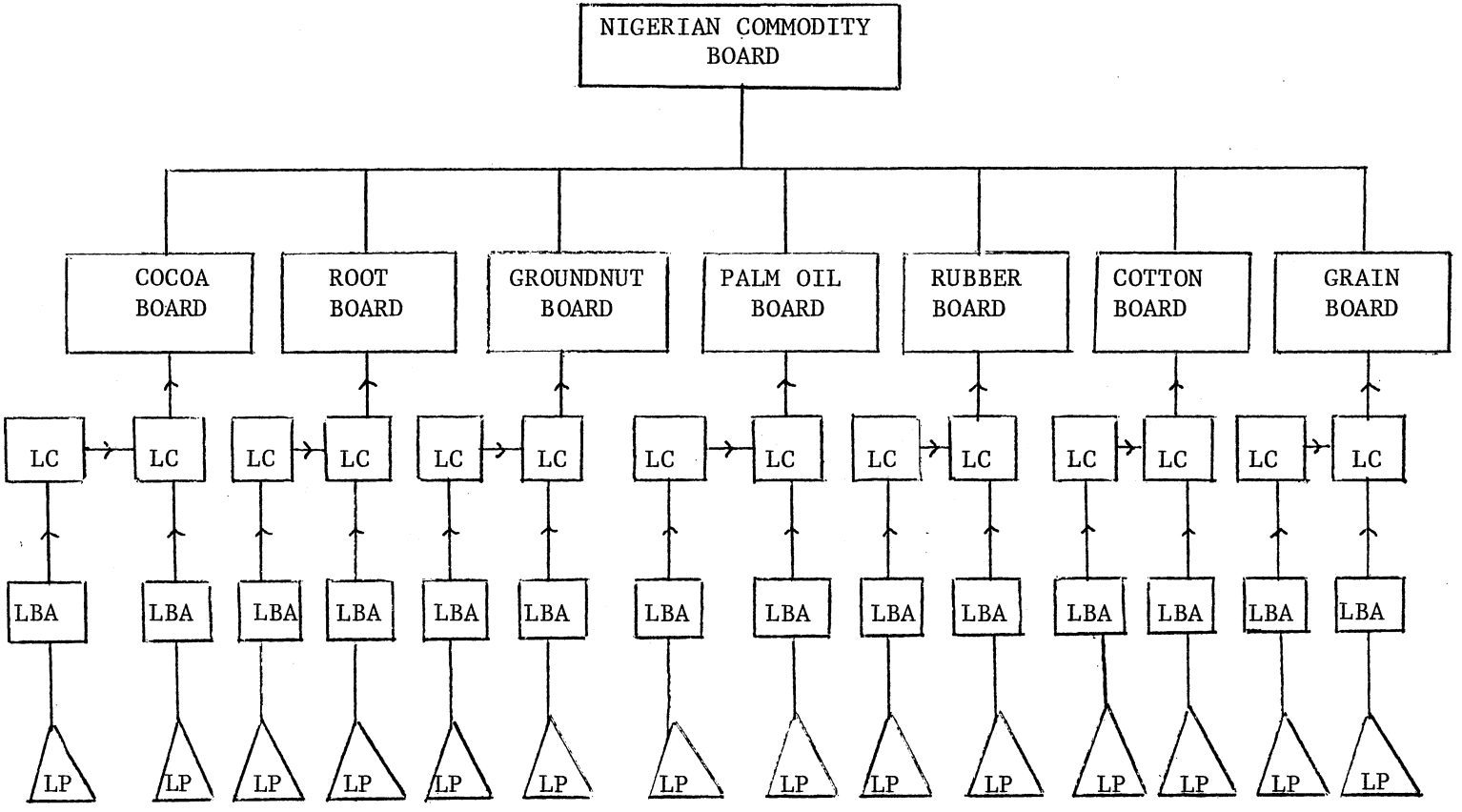
source of produce to that of delivery at the port of shipment, (c) allocating funds to appropriate authorities through the issuance of grants, loans, investments and other endowments for the purpose of economic development and research, (d) supplying produce to the local processors for processing in the domestic factories and (e) maintaining a legally prescribed grading standard and/or quality of all export.

The Cocoa Board continues to face and experience fluctuations in the quantity of cocoa beans purchased. It also continues to hold down producer prices below world prices levels. For instance, during the 1980/81 production season, the board purchased only 149 metric tons of cocoa which is a decrease from 172 metric tons purchased during the 1979/80 production season.

At present, the board has embarked on various rehabilitation programs. Such programs include the spraying and provision of chemicals to farmers of infested farms and the provision of other essential inputs with emphasis on areas which had experienced the greatest declines in production previously recorded (Ebony, 1980). The government has abolished export taxes on cocoa beginning with the 1973/74 production season.

A schematic representation of the organizational structure of the Nigerian Commodity Board is presented in Figure 5.

In summary, the political events in Nigeria had a significant effect on the current organizational structure of the Nigerian Commodity Board in terms of both commodities covered and the number of boards. However, despite the various important structural and organizational changes in the Nigerian Commodity Board that had taken



LC = State Boards
LBA = Licensed Buying Agents. Farmers could group together and form cooperatives and are allowed to register with the State Boards and to sell produce directly to the State Boards.
LP = Local Producers

Figure 5. Schematic Structure of Nigerian Commodity Board

place during the annals of Nigerian history, the functions of the board have remained unchanged. In general the stabilization pricing strategy of the boards has maintained export prices for cocoa far above prices received by farmers. This price differential could have been one major cause of decreasing cocoa production.

In the next Section, the ramifications from maintaining prices received by the cocoa producers at lower than world levels will be considered. Also the implications of increasing producers' prices to reflect more adequately the competitive world prices will be considered.

Implications of Differential World and Domestic Prices

Four assumptions are used for the analysis of the implications of maintaining stabilized prices below prices obtainable in the world market. They are:

(1) Nigerian peasant (local) producers are rational and attempt to maximize net profits from an additional acre of cocoa planted. Also, there are alternative uses of resources in production alternatives which eliminates the possibility of a backward bending supply response, sometimes enunciated by researchers interested in African production response (Dean, 1965). The basic tenet made to justify a backward bending supply response is that producers of cash commodities have a fixed set of objectives with limited production and consumption alternatives. For example, if producers could be said to be interested in getting a fixed sum of money, a price increase would make it easier for them to meet their

desired income objectives whereas a price decline would force them to work harder to meet the same set of objectives. If increased cocoa production were needed, then a backward bending supply schedule would imply that prices should be depressed from high levels down to the level at which maximum production would be forthcoming (assuming that the schedule is not backward bending all the way down to the "X" axis origin).

(2) The marginal cost curve is upward sloping and linear. This is indicative of the fact that higher additional cost are incurred to bring additional plots or acreages into production. As a result, if prices were stabilized below the natural equilibrium level, marginal producers who would have been producing cocoa under higher actual market prices would be forced to leave cocoa production in search of alternative economic activities. This may result in shifts among agricultural commodities or perhaps a total abandonment of agriculture for those who have alternative economic skills that are utilized in the rural or urban industrial sector. Such a result would fuel the rural urban migration trend in Nigeria.

(3) The demand curve for cocoa is negatively sloped and linear, that is, higher prices will induce less purchases of cocoa and vice-versa, unless cocoa is assumed to be a non-normal good.

(4) The natural equilibrium price for cocoa, $\overline{CP}$, shown in Figure 6, includes the transportation cost of shipping from the source of production to the point of delivery at the port of shipment.

With no stabilization, CP is the price obtainable in the domestic market for cocoa, and quantity X_t is purchased by the cocoa board. At this price and output there are no surplus profits. Only the normal profits attributable to taking risk in purchasing in the case of the cocoa boards, and the risk of planting in the case of peasant producers.

With price stabilization at CP_s, given adjustments, output OX_{ts} would be produced and purchased by the cocoa board but the boards would have been willing to purchase output OX_{td}, because there would be a demand for this quantity. However, cocoa producers will be willing to sell only output OX_{ts}. In the short-run, if prices were cut from $\overline{CP}$ to CP_s, alternative markets would be needed to sell the excess output $X_{ts}X_t$.

Two alternatives readily available to the producers to sell the excess output are:

(1) to destroy the extra output $X_{ts}X_t$, either by leaving it unharvested or by neglect of cultivation of the newly planted acreages.

(2) Sell the extra output to a neighboring country whose pricing strategy involved higher producer prices. This alternative may lead to smuggling, a form of black marketing. However for smuggling to be successful, two prerequisites must be met:

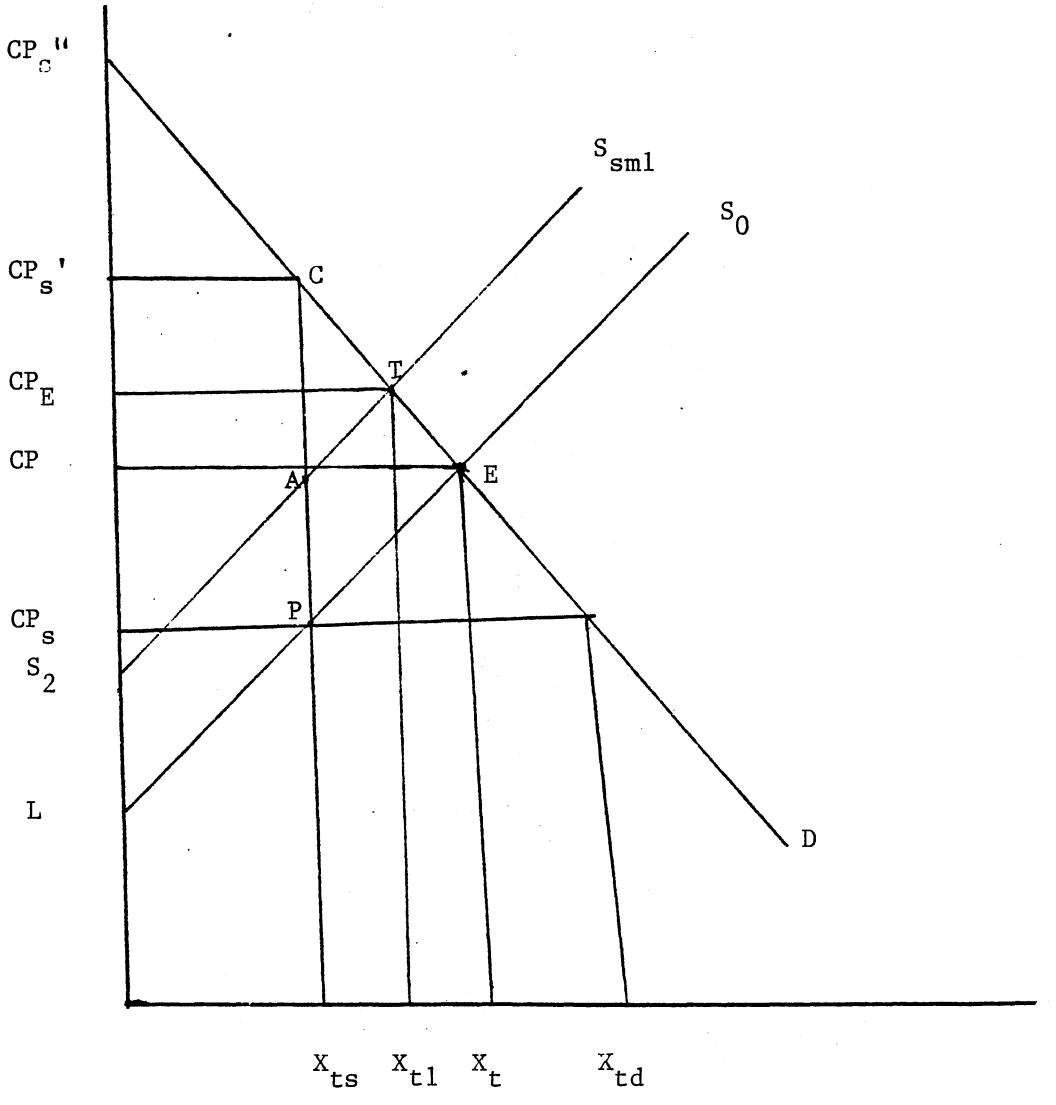


Figure 6. Effect Of Differential World And Domestic Prices

(a) The extra transportation cost involved must be small enough to have a black market price greater than the price CP_s plus a margin for the transportation cost, and

(b) The penalty imposed on the smugglers must be small enough to enable the efforts to be lucrative and worthwhile.

High transportation costs or stiff penalties on the producers, would make the supply curve LS_0 indicated in Figure 6, to be more inelastic if we assume that the transportation cost/and or other penalties are imposed on a per unit basis. The upper part of LS_0 curve will rotate inwards. With a stabilized price at CP_s and the curve S_0, producer surplus $LPCP_s$ which is less than LECP, the area without stabilization. The Commodity Board retains area $CP_sPCCP'_s$ while the producers receive $LPCP_s$. Consumer surplus will be area $CP_sCCP''_s$. Maximum net loss to society will be PEC assuming the resources were destroyed. However, if the penalties on smuggling are not too stiff and resources are not destroyed, producers will attempt to seel some of the extra resources to neighboring countries that have higher prices. This will reduce the domestic cocoa supply. The consequence of this will results in the supply response moving towards S_2S_{sml}. This movement will results in a decrease of societal welfare loss provided the total quantity sold is the same, the stabilized price plus extra costs are unchanged and all sales are made in the black markets. Societal welfare loss would then be area ATC.

Marginal producers who would have remained in production under a free market will be prevented from doing so under the pricing scheme.

Prices stabilized below their natural equilibrium levels may also prevent the rural peasant producers from attracting capital investments in their rural communities through the development of social overhead capital.

It can be demonstrated also that the peasant cocoa producers may in many circumstances attempt to substitute cheaper inputs in their production processes when there is a perceived price variance between two cash commodities that are controlled by the boards and perceived profits to be made from having prices unstabilized. In theory, the cocoa producers will be willing to compensate the cocoa board a sum of money up to the difference in their prices and that of the world price in order to improve welfare if compensation were allowed. By compensating the cocoa board, the producers would prevent distortions in factor utilization. However, with no compensation in practice, the producers will be forced to substitute in their input uses, from the more efficient to the less efficient inputs in the cocoa production process.

Assume two inputs are used in cocoa production, Q and X as shown in Figure 7. Q_1 and X_1 are the number of skilled and unskilled labor needed to produce cocoa output R, on the Isoquant C^*. The ratio of the output price for skilled labor, Q_1 to that of the input price for unskilled labor can be represented by the slope LL^*. If the price of skilled labor increased and unskilled labor decreased, the ratio of marginal cost of input for unskilled labor to the output price of skilled labor usable in cocoa or corn production is ZZ^* indicated in Figure 7. However, ZZ* hs a steeper slope than LL*, implying that a re-ordering of the two ratios is essential if

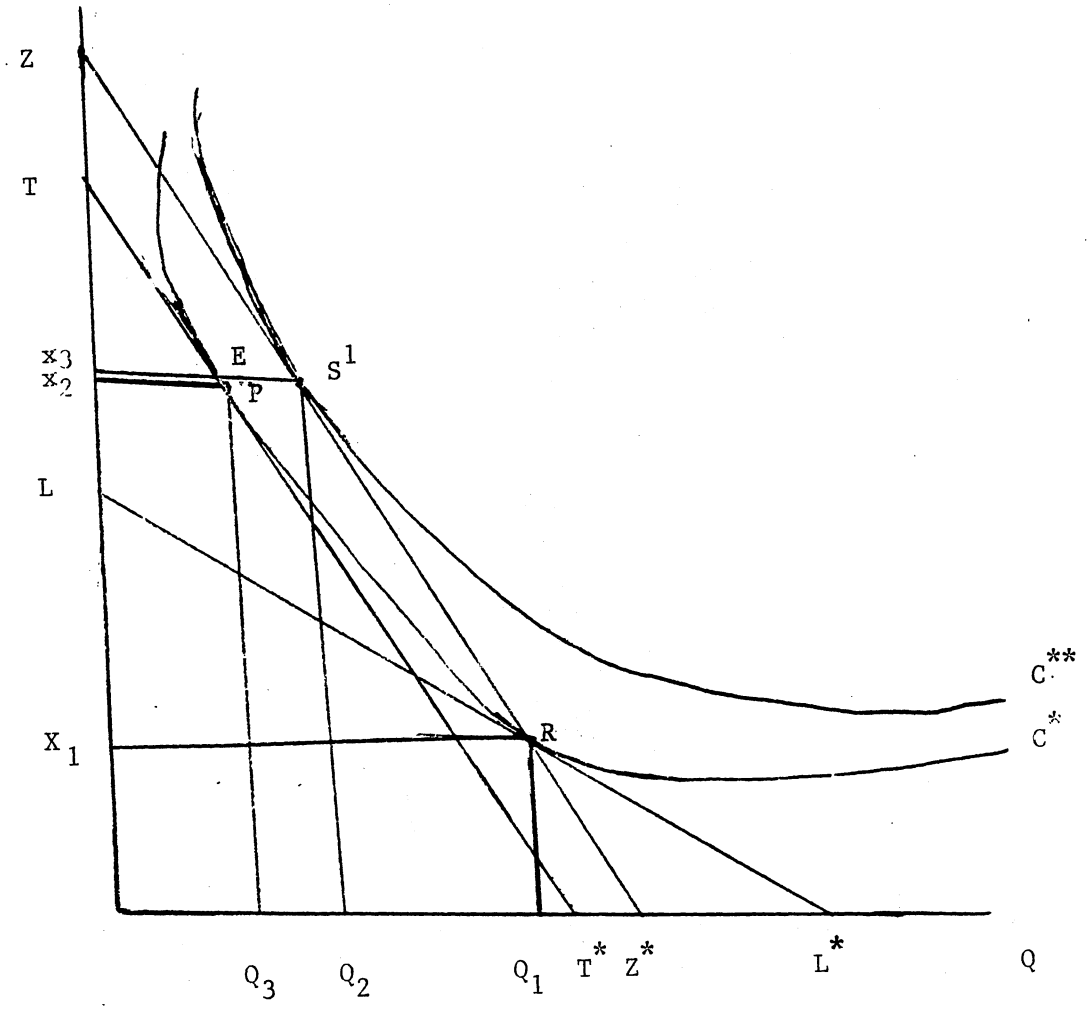


Figure 7. Input Substitution In The Presence Of A Perceived Variance In Profits From Different Commodities

producers are to produce efficiently. The line ZZ* lies in a higher isoquant curve C**. Producers therefore, to produce S^1 which is on a higher isoquant, will increase the quantity of unskilled labor from $0X_1$ to $0X_2$ while at the same time, reducing the quantity of skilled labor from $0Q_1$ to $0Q_2$.

But, if we assume that the increased skilled labor cost is not to affect cocoa production, i.e., producers remain on the same isoquant curve C*, TT*, which has the same slope like ZZ* must cut the lower portion of isoquant C*. By holding cocoa production constant at C*, cocoa producers will further increase the use of unskilled labor from $0X_1$, the natural equilibrium combination to $0X_3$ and reducing the use of skilled labor further to $0Q_3$.

(1) There is a general reduction in the producers overall marginal cost curve of producing cocoa. It is possible but cannot be shown graphically that output may deteriorate as a result of the substitution.

(2) There is a shift in input use shifting and relying more on unskilled labor. This is the movement from R to P on the Isoquant C^*. The skilled labor can be gainfully employed in the production of corn or other agricultural commodities that have a greater perceived profit margin.

(3) The producers would have preferred to produce outputs that are on a higher isocost and isoquant curves ZZ^* and C^{**}, but they are prevented from doing so because of the nature of the pricing arrangements.

The alternative open to the farmers to reduce the use of the more skilled inputs, i.e. to remain on isoquant C^* and produce output P,

is to substitute efficient inputs for inferior ones. This may lead to an inefficient allocation of resources. Essang (1972) showed that

(a) The operations of the marketing board had resulted in income transfers from the relatively poorer rural farmers to the more affluent urban dwellers,

(b) The licensed buying agent (LBA) have received a substantial proportion of the amount transferred to the cocoa farmers because of the internal organizational structure of the commodity board,

(c) The distribution of income received by LBA's and the cocoa farmers was unequal and

(d) The inequality of income has led to the abandonment of cocoa production activities.

Implications Of Equalizing World And Domestic Prices

The last section indicated that price depressing policies distort agricultural allocative efficiencies and affect producers' income in the long run. The present section will pursue the alternative proposition of a price stabilization strategy that is designed to increase actual prices received by the farmers. The following assumptions are made in addition to those enumerated in the previous section (1) the interest of the cocoa board is only to represent cocoa producers' interest in the world market; and (2) the world market for cocoa is competitive.

The Nigerian Commodity Board is still assumed to be the only purchaser of all domestic cocoa produced in Nigeria, i.e. they are monopsonist. But the board is only a monopsonist internally and faces

competitive markets externally. Domestically, changes in the volume of purchases from season to season will affect the price it will pay cocoa producers while intra seasonal variations in purchases will not affect price level changes. In theory as a monopsonist, as the board expands cocoa purchases, the input prices of purchases will rise. However, this rise in input prices will not be allowed to affect intra-seasonal purchases of cocoa, since the board had already fixed producer prices at the beginning of the production seasons. The only influences in variable cost of purchases are others which include additional manpower for cocoa grading, higher administrative cost and storage facilities are assumed for simplification of analysis to be constant.

In the world market illustrated in the section of Figure 8A, the equilibrium price is P_w. In Nigeria, this rice is P_w less transportation cost or P_b. At price P_b, the Nigerian Commodity Board is paying farmers the price P_c, illustrated in section B of Figure 8 and is making margin of $\overline{P}_c P_b$. This exists if the cocoa board is assumed to be a monopsonist. Internally however, the cocoa board faces a positive supply response curve (S_{dl}) and marginal expense for cocoa at each additional purchase of a tonnage of cocoa over the seasonal. Intra-seasonally, the marginal expense curve can be assumed to be constant because of the boards price fixing powers. Prices over time periods, however, change and as a result, their expense curve changes as well for each additional tonnage purchased. It is this characteristic that causes the input price purchase to rise. Consequently, the cocoa board in making their buying decisions will take into account the marginal expense of purchasing an additional tonnage of cocoa over time.

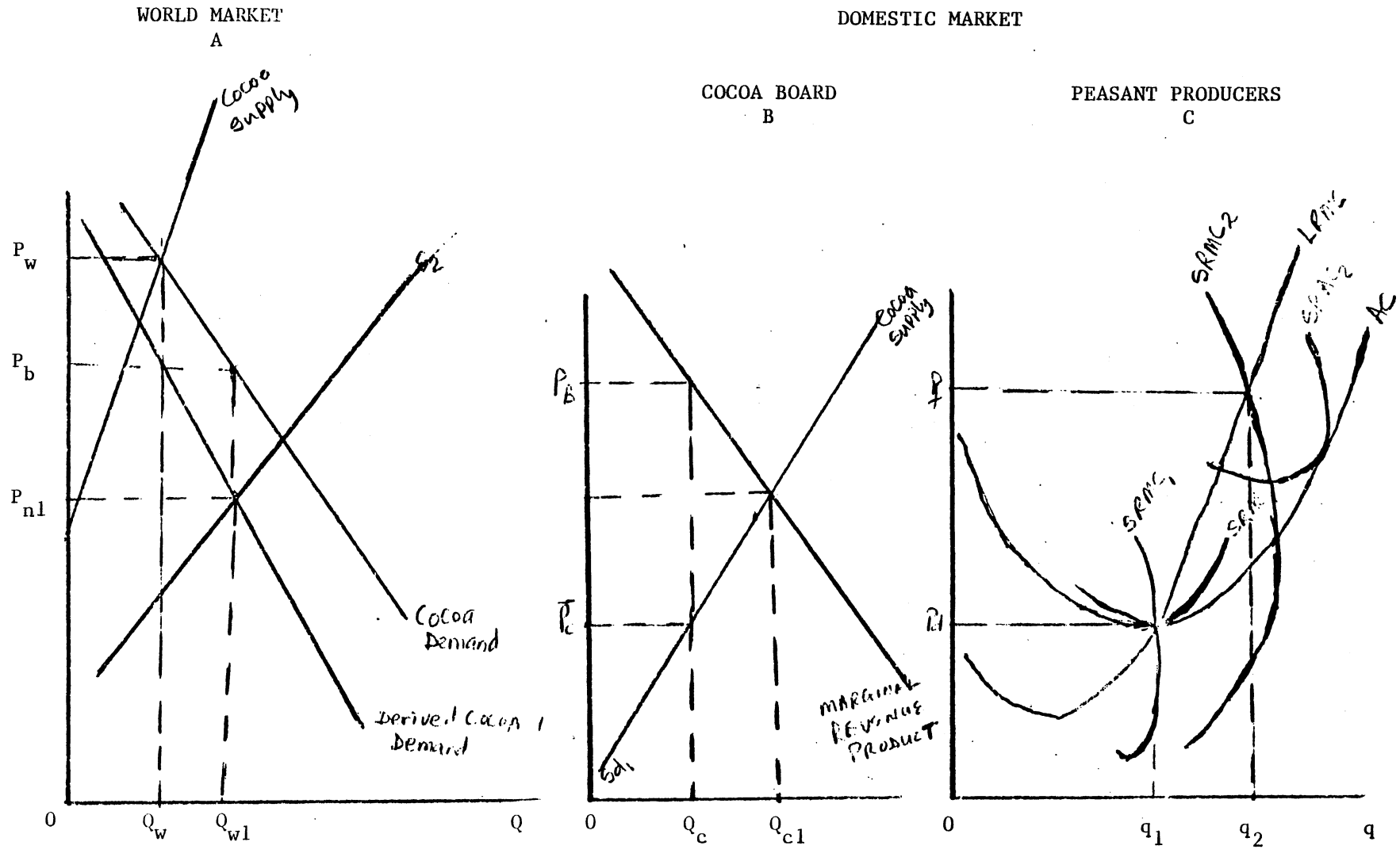


Figure 8. Effect of Equalizing World and Domestic Prices

For the cocoa board to be profit maximizers, they will purchase output $0\overline{Q}_c$ and pay price $\overline{P}_c$ to the peasant producers. Price $\overline{P}_c$ is assumed to be equivalent to price P_d in Section C. At this price, the cocoa producers are producing efficiently. For general equilibrium to exist in the market, the cocoa board will purchase $\overline{Q}_c$ and sell at the external market at price P_b or P_w including transportation cost. Because the peasant producers are not payed price P_b, the equivalent world market price, the cocoa board is making a margin P_dP_f or $\overline{P}_cPB$ which could be used for other purposes if the marginal expenses are less than the margin.

To increase domestic cocoa production, prices received by the peasant producers have to be raised. If the prices are raised equal to the world market price levels, production will increase from $0q_1$ to $0q_2$ (Figure 8C). The production response, however, will result in world price declines, assuming the world demand for cocoa is constant. Prices will fall from $0P_w$ to $0P_{w1}$. This price fall will further accentuate another set of responses form the cocoa producers. In general, however, the effect of Nigerian cocoa producers production increases on the world market will depend on the world market share of Nigerian producers and the reaction of other cocoa producers to the Nigerian planned increases. If the other producing cocoa countries respond with their own programs to increase production, the world market price may indeed fall below the prices received by the domestic producers under the current cocoa board scheme. Even if the other producers did not respond to Nigerian planned production increases the Nigerian share of world market cocoa my results in these planned increases to lead to general price decreases.

Summary

A review of the major cocoa production and consumption patterns was presented. It was found that Ghana and Nigeria are losing their cocoa production shares to other producers, Brazil and Ivory Coast. The organizational structure, functions and the implications of fixing producer prices below the world competitive margin and vice-versa were evaluated.

The organizational set-ups of many of the West African cocoa producing countries are similar to that of Nigeria (Hoos, 1979). For example, Ivory Coast has a similar institution. The main difference between Ivorian and Nigerian production is that Ivory Costs' production is mainly organized by expatriates. The expatriates are given necessary production incentives and subsidies to guarantee increased productions even though prices are fixed at the beginning of each production season.

Brazil, in the Americas, has a similar institution known as "de cocoa institute". The cocoa institute issues licenses, however, to interested cooperatives, private and commercial businesses to purchase and sell their cocoa abroad as opposed to the Nigerian Commodity Board which is the only purchaser and seller of Nigerian cocoa. Brazil, also, has local industries which are encouraged to use and process raw cocoa. The chocolate industry, for instance, utilizes up to 20,000 metric tons of cocoa annually. Nigeria has only one factory with few confectionary industries, implying that a relatively small quantity of raw cocoa is processed domestically. On these grounds, it is possible to postulate that the organizational structure and performance of the Nigerian cocoa board itself, may also have been a factor in the cocoa production decreases.

CHAPTER IV

MODEL SPECIFICATION AND DATA FOR COCOA SUPPLY AND DEMAND RESPONSE

In this chapter, both the Nigerian cocoa supply and demand response models are specified. Also included is the data analysis section. In the course of developing the models, some of the methodological problems involved in estimating the models are also addressed.

Economic researchers turn to economic theory in order to determine pertinent response relationships among various variables and how the explanatory variables impact on the explained variables. Often the relationships from theory are asserted to have a one to one correspondence. As a consequence, model specifications that depend entirely on economic theory may tend to provide unrealistic results because of these exact functional forms. Econometrics bridges the gap between these exact functional forms of economic theory and the actual relationships of the real world. The link afforded by econometric theory allows the researchers to make probabilistic statements, and to accept or refute various hypothesis concerning the effects of the explanatory variables on the explained variables and or other variables of interest to the researchers. This study will be based on economic theory and econometric theory as they are used to develop the appropriate models.

The general cocoa supply response model is first derived from the static theory of a multi-product firm under a perfectly competitive output market for its products and inputs. Next the aggregate demand model for Nigerian cocoa based also on the multi-product firm scenario is derived. Finally the data and their short comings are analyzed.

Model Specification: Supply Response

Generally, the level and changes in the output price of any commodity and the changes in its prices affect producers' responses through influencing the quantity of output they may be willing to produce or bring to the market place. Changes in output prices may cause movements along a given supply curve which in some cases accentuate changes in producer prices. In the long run, primary supply shifters include; (1) technological changes; (2) output prices of related or complementary commodities; (3) input prices of the scarce resources and finally; (4) in the case of agricultural products, the weather condition and or other agronomic requirements of the soil.

There are other factors which could be relatively important in influencing producer response in Nigeria. In the case of annual agricultural commodities such as cotton, groundnut and soybeans, the factors include rehabilitation of the area and harvest of crops (Olayide, 1972). The case of perennial commodities such as cocoa, coffee and rubber, the final outputs are affected by replacement cost and the necessary growth periods of the commodity. Cocoa, for

instance, has about 3 to 5 years growth before yield can begin. Therefore, planting decisions of the present time period, t, may have effects only after three to five years. The effects would continue through the useful life of the tree, which has been asserted in many circles to be over forty years (Ady, 1969).

For agricultural commodities, the specification of a producer response or reactions revolves around the output price anticipated at harvest time, alternative output prices of commodities and the prices of inputs. The input prices of the factors used in the production processes are very important. For example, the input prices of land, labor and technological know-how may determine how much of each input to use in production.

Etuk (1970), as an example, demonstrated that labor and land were the most limiting factors in groundnut production in Northern Nigeria, a case which can also be extended to include cocoa production in the eastern and western states of Nigeria. For cocoa cultivation, there is a high replacement cost and other rehabilitative needs which may not exist for annual crops. Also, weather conditions such as rainfall, temperature and sun radiation, usually regarded as "non-cost" inputs, impact critically on the final output of agricultural commodities during a season or even a series of production seasons (Oury, 1965).

The circumstances surrounding agricultural production of most of the tree crops is made more complex because of the growth required before production and the long life spans of the crops. Planting decisions made at time t-i influence output in time t. In

many situations the lags in output become crucial in determining the effects of a pricing policy in year t-i.

The long run supply response for any commodity may be stated as:

$$Q_i = f_1(P_i^* V_j 0_i) \qquad (1)$$

Where

Q_i = Quantity of the commodity i under consideration

P_i^* = expected producer prices of commodity i

V_j = Prices of inputs used in producing commodities i

and

0_i = other factors affecting production of commodities i and j. The supply function stipulated above states that the quantity of a commodity produced over any given period is a function of the price expectations of the commodity under analysis, the price expectations of the related commodities and the input prices for the commodities involved.

The specification of Nigerian cocoa producer response model will also revolve around the output prices of cocoa expected at harvest time, alternative output prices of other related outputs and the input prices associated with the production of cocoa. The prototype cocoa supply response model of the above is specified as follows:

$$NQ_t = f_2(CP_t^* \; PC_{t-i} \; W_t \; AC_t^* \; U_t) \qquad (2)$$

Where

NQ_t = Quantity of Nigerian cocoa produced in time t,

CP^* = Cocoa price expectation or desired cocoa prices

PC_{t-i} = lagged coffee prices

W_t = Weather Index

$AC_t^* = \lambda_i A_{t-i}$, λ_i = yield per acre in time i and A_{t-1}, acreage planted in time t-i and

U_t = stochastic disturbance term.

Expected future prices cannot be identified in practice because they are unobservable (Nerlove, 1956). Some studies have used one year lagged prices as the proxy for price expectations, assuming that the price producers expect to prevail in the next time period is some function of this year's price and it is this price that the producers react to, to influence present output. Walsh (1944), Smith (1928), and Kohls and Paalberg (1950) pointed out that the producers might not be acting in their own interest if they did use only last year's price as an indication of today's price. In fact, the use of one year lagged prices might be inadequate with perennial crops where output will be affected over strings of years in the future.

The cocoa price expectation, CP^*, is specified therefore in estimable form, in terms of some adjustment between the lagged world cocoa prices and the lagged domestic cocoa prices. That is:

$$CP^* = CP_{t-i} + \beta (CNP_{t-k-i} - CP_{t-k-1}) \quad (3)$$

$$= CNP_{t-k-1} + (1-\beta) CP_{t-k-1} \quad (4)$$

Where

CNP = weighted cocoa price at New York, β = coefficient of adjustment, i = growth lag and t = time. Equation (2) is re-specified as follows, disregarding the signs on the coefficients:

$$NQ_t = \Omega_0 + \Omega_1 \; CNP_{t-k-i} + \Omega_1(1- \;) \; CP_{t-k-i} +$$

$$\Omega_2 \, PC_{t-k-i} + \Omega_3 \, W_t + \Omega_4 \, AC_t + U_t \qquad (5)$$

The age of the cocoa trees and the number of acres planted also affect actual and potential cocoa production. Potential or desired output is affected as well by the newly planted acreages at time period t-i. Consequently, output from a newly planted acreage of cocoa was specified as a function of yield per acre and the lag acreages planted in time t-i. That is:

$$AC_t^* = \sum_{i=k}^{\infty} \lambda_i (A_{t-1}) = \hat{NQ_t} \qquad (6)$$

Where:

$\hat{NQ_t}$ = Potential output

λ_i = yield per acre in time i

k = growth period.

And

A_{t-i} = acreages planted in time t-i.

Cocoa has more than one bearing peak (Ady, 1969). For simplicity and ease of exposition of the model, however, the study will assume only one bearing peak. This will affect the adjustments in λi. Data limitations also prevent the direct use of $\lambda i(A_{t-i})$. Because of the assumption of one bearing peak for cocoa production, and equation (6) can be re-written thus;

$$\hat{NQ_t} = \sum_{i=k}^{\infty} \lambda_1 (A_{t-i}) \qquad (7)$$

A major problem of estimatibility of the potential output or acreages still remains despite the specification in equation (7). The difficulty is circumvented, however, by the respecification of the model in terms of actual output which allowed actual output to

adjust in some manner to some prescribed simple rule. The rule allowed the use of lag response output as the proxy for the lack of data above.

Note that $\hat{NQ}_t$ in equation (7) is represented in the form of an infinite sum of past yields with geometric weight λ_1. Behrman (1966), proposed that a time trend to approximate the potential output from the newly planted acreages can be utilized, which is obtainable through the regression of NQ_t on time.

$$\hat{NQ}_t = \hat{\partial}_0 + \hat{\partial}_1 \text{ Time} \tag{8}$$

Where $\hat{\partial}_0$ and $\hat{\partial}_1$ are regression coefficient estimates. Chern and Just, 1978 suggest rather the use of one year lag of actual production to represent potential output, if it is assumed that only the newest acreages planted reach peak production in the successive years.

That is:

$$NQ_t = \hat{NQ}_{t-1} \tag{9}$$

None of the approaches of equation (8) and (9) can be rejected or accepted on an a priori basis. For the purpose of simplifying the model, potential output was used as the proxy for the newly planted acreages and NQ_t will be represented by only last year's output.

Substituting equation (9) into equation (5) and disregarding the signs, the following is derived.

$$NQ_t = \partial_0 + \partial_1 CNP_{t-k-i} + \partial_1 (1 - \beta) CP_{t-k-i} + \partial_2 PC_{t-k-i} + \partial_3 W_t + \partial_4 NQ_{t-1} + U_t^* \tag{10}$$

Where

$$U_t^* \sim NID(0_1 \sigma^2 I_T)$$

The model to be utilized for the analytical framework will therefore be comprised as follows;

$$NQ_t = \partial_0 + \partial_1 CNP_{t-k-i} + \partial_1 (1-\beta) CP_{t-k-i} + \partial_2 PC_{t-k-1} + \partial_3 W_t + \partial_4 NQ_{t-1} + \partial_5 D_1 + \partial_6 D_2 + \partial_7 D_4 + U_t^* \quad (11)$$

Where

D_1 = civilian government (1937 to 1965 and 1978 to 1980)

D_2 = effect of the abolition of export taxes on cocoa exports (1974-1980)

and

D_4 = the declining difference between world cocoa prices and domestic stabilized prices.

Expected product prices, as indicated earlier, are among the relevant variables that explain Nigerian cocoa supply response. This implies that Nigerian cocoa producers base their decisions, in part, on the anticipated or forecasted prices. But the degree of confidence attached by the producers on these expected prices also influences their production decisions.

Consequently, modelling expected prices which are not observable (Nerlove, 1956) need to reflect the mechanism used by the cocoa producers to gauge the expectations. Heady and Kaldor (1954) showed that farmers' expectations in 10 southern counties of Iowa were based on how the farmers understood the mechanism determining prices. Partinheimer and Bell (1961), on the other hand, found that most of the farmers in the midwest part of the United States based their forecasts on product supply or on both supply and demand.

Overall, the studies suggest that producers use other information sources on market conditions in addition to past realized prices to access their expectations on future prices.

The present study presents two alternative price expectations formations. The first assumes that producer price expectations are based on past realized prices. It is also assumed that these prices do not change with time. This is an implicit assumption in the cobweb type models. Expected prices at time t are the same as those observed at time t-k-i. That is, Nigerian cocoa producers base their price expectation formation only on the actual lagged prices received from the Nigerian Commodity Board.

$$CP_t^* = CP_{t-k-i} \tag{12}$$

CP_{t-k-i} is the lagged domestic stabilized prices taking into consideration the growth period of cocoa. With equation (12), equation (11) is modified as follows:

$$NQ_t = a_0 + a_1 CP_{t-k-i} + a_2 PC_{t-k-i} + a_3 W_t + a_4 NQ_{t-1} + a_5 D_2 + A_6 D_4 + V_t \tag{13}$$

Where

V_t = disturbance term.

Equation (13), implies also that information contained in other past prices or sets of prices do not influence the Nigerian peasant cocoa producer's decision making process.

For the second alternative price expectation formulation, it is assumed that the Nigerian cocoa producers respond to the relative prices between the domestic lagged stabilized prices and the world lagged prices. That is:

$$RATCP_{t-k-i} = \frac{CP_{t-k-i}}{CNP_{t-k-i}}$$

$$RATPC_{t-k-i} = \frac{PC_{t-k-i}}{WPC_{t-k-i}}$$

Which is the alternative competing commodity for cocoa. This model implies that Nigerian cocoa producers do take into consideration all pertinent information available in order to make their planting decisions.

The relative lag response variables for cocoa production are constructed simply by taking the ratios of the domestic to world prices for the two commodities. The model is expressed as:

$$NQ_t = \theta_0 + \theta_1 RATCP_{t-k-i} + \theta_2 RATPC_{t-k-i} + {}_3W_t + \theta_4 NQ_{t-i} + \theta_5 D_1 + \theta_6 D_2 + \theta_7 D_4 + E_t^* \quad (14)$$

Equation (14), is used for testing of the hypothesis of Chapter I, while equations (11) and (13) are specified for comparative purposes in Chapter V.

Model Specifications: Demand Reponse

The main emphasis in this section is the determination of the aggregate demand response for Nigerian cocoa by the United States of America, the European Community and Japan with time series data dated from 1937 to 1980. Though the USSR'S cocoa consumption shares have been on the increase, it may be difficult to aggregate their estimates with those of the "free world" because of the nature of their economy which is centrally planned. As a consequence, USSR consumption may not be responding to market conditions but to

decisions of some centrally planned body. The U.S., E.C. and Japan account for more than 80 percent of Nigerian purchases.

The following, general aggregate demand model was assumed;

$$\sum_{i=1}^{n} NQ_t = A_0 + A_1 \sum_{i=1}^{n} CP_t + A_2 \sum_{i=1}^{n} PS_t + A_3 \sum_{i=1}^{n} AC_t + A_4 \sum_{i=1}^{n} lNC_t + Z_t^* \quad , \qquad i = 1, 2, \ldots n$$

$$\text{and } t = 1, 2, \ldots n$$

$$Z_t^* \sim NID(0_1 \sigma^2 1_t)$$

Where:

$\sum_{i=1}^{n} NQ_t$ = The sum of the total quantity of Nigerian cocoa exported to the U.S., E.C. and Japan,

$\sum_{i=1}^{n} CP_t$ = the random series of average monthly prices of cocoa using the New York, London and Tokyo markets,

$\sum_{i=1}^{n} PS_t$ = total sum of monthly prices of sugar in the U.S., E.C. and Japan,

$\sum_{i=1}^{n} AG_t$ = the aggregate cocoa consumption for the three blocs and finally,

$\sum_{i=1}^{n} In_t$ = the sum of the index of income in the three blocs under review and Z_t, the error term.

All the observations were collected and annual average exchange rates for E.C. and Japan are applied to convert then in terms of the U.S. equivalents.

The equation used the weighted averages of the explanatory variables. The summations in equation (15), were utilized to determine the weights to be assigned to each bloc market variables. The model is expressed as follows:

$$\sum_{i=1}^{n} NQ = A_0 + A_1 \overline{CP}_t + A_z \overline{PS}_t + A_3 \overline{AG}_t + A_4 \overline{INC} + Z_t \qquad (16)$$

$$Z_t \sim NID(0, \sigma_{1T}^2)$$

The treatment of the independent variables in this fashion allowed the model to give more weight to markets with relatively more important explanatory variables.

Price Effect On Product Output And Revenue Under World Market Conditions

Among the factors affecting producer and consumer responses involved in this study are producer and consumer prices for cocoa. The Nigerian cocoa boards have influenced the pattern of producer prices, and hence revenue, by stabilizing prices for cocoa for a whole season at a time. In order to determine the possible policy effect that would have resulted had the cocoa producers faced the world market prices, modifications of equations (14) and (16) are used.

The modified supply equation is:

$$\hat{SNQ}_t = ESRN + b_1 \, RATCP_{t-k-1} \qquad (17)$$

Where

$\hat{SNQ}_t$ = Predicted output at period t

ESRM = Estimated supply intercept holding other variables in the model at their means.

$RATCP_{t-k-1}$ = Ratio of Nigerian producer price to world price at time t-k-1, and b_1 = coefficient of the producer price response.

Based on equation (17), the predicted output at time period t was estimated. The same approach as above was utilized to fit equation (16), which is the aggregate demand function, at its mean.

That is:

$$\hat{DNQ}_t = \overline{ADNC} - k_1 CP_t \quad (18)$$

Where

$\hat{DNQ}_t$ = Aggregate demand output at time t,

$\overline{ADNC}$ = Aggregate demand intercept, with other included variables except the cocoa price at their means,

k_1 = slope coefficient on cocoa price and

CP_t = cocoa price at time period t.

Based on equation (18), CP_t was estimated thus:

$$CP_t = (\overline{ADNC} - \hat{DNQ}) / -k_1, \quad (19)$$

At equilibrium:

$\hat{SNQ}_t = \hat{DNQ}_t$ Equation (17) provided the estimates for the supply quantity SNQ_t. Equation (19) then was used to obtain the estimated price CP_t.

The output and equilibrium prices were generated from equation (17) by first replacing $RATCP_{t-k-1}$ with CNP_{t-k-1}. CNP_{t-k-i} is the real world weighted cocoa prices at time t-k-1. The estimated equilibrium price for each year is determined by applying equation (19). From the estimated of equation (17) and (19), the revenue potential effect for Nigerian cocoa producers is estimated under the world market scenario. In this approach, prices in time periods t-k-1 are used in predicting output in time periods t, while those of t-k-2 were used in estimating outputs in periods t + 1 and so forth until 1980. The time period t, in this instant represents the first initial prediction while t + 1, represents the second and so forth, t, varying from t-k-1 to t-k-n, to predict t varying from t to t+k+n.

Another approach suggested for generating the output and price series under the world market situation also involved some variant of the one discussed above. Instead of allowing each of the real observations to predict the price and quantity series, they were generated internally from the model, except the first observation. Here the CNP_{t-k-1} prices were used to generate the first SNQ_t, the first SNQ_t was then used to generate the second price series and so on. This can be represented mathematically as follows:

$$SNQ_{t1} = ESRM + b_1 RNCP_{t-k-1} \quad (20)$$

$$DNQ_{t1} = \overline{ADNC} - KCP_t \quad (21)$$

$$CP_1 = (SNQ_t - \overline{ADNC})\, K_1$$

$$\hat{SNQ}_{t2} = \hat{ESRM} + b_1 \hat{CP_1} \quad (22)$$

$$\hat{CP_2} = (\hat{\hat{SNQ}}_{t2} - \overline{ADNC})/\, K_1 \quad (23)$$

The above model is supposed to develop estimates which allow for some variability and allow for the comparison of the variability of the price and outputs that would have been received had the producers faced the world market prices as is currently being suggested. The two models will provide some indication of whether cocoa producers would have been better off economically by facing world prices rather than the domestic stabilized prices.

Data Analysis And Data Problems

The explanatory variables for the producer response in equation (14) are composed of; (1) the relative ratio of the real domestic stabilized cocoa prices to the world cocoa prices in dollars per ton; (2) lagged endogenous variables; (3) relative coffee prices in dollars per ton lagged; (4) the index of weather variable; (5) policy variables and; (6) cocoa output lagged by one time period.

For the demand models of equation (16) the explanatory variables considered are the weighted monthly random series of cocoa prices, in New York, London and Tokyo cocoa markets, the weighted monthly random series of sugar prices also in New York, London and Tokyo sugar markets and index of income in the three blocs that is U.S., E.C. and Japan.

Data Sources And Variable Definition

Data Sources

The data needed for the explanatory variables are directly available from published sources. Where these secondary sources of data had conflicting reports, data collected by other researchers were then compared for consistency. Primarily, the data were obtained and aggregated from a variety sources mentioned below, covering the periods from 1937 to 1980.

Secondary Data

The secondary data as mentioned above cover the periods 1937-1980. The data are as follows:

(1) Cocoa production figures obtained were the commodity marketing board export estimates in thousands of metric tons.

(2) Domestic stabilized cocoa prices are the annual average producer prices in Naira per ton but were converted into dollars per ton by using the exchange rates between the Nigerian Naira and the American dollar. These are usually a fraction of the world's annual and/or monthly prices.

(3) World cocoa prices are the random monthly estimates of cocoa prices in the London, New York and Japan markets. The estimates collected were then weighted. This procedure allowed the markets with higher prices to have more weight in the aggregated price than markets with lower prices. The weights obtained were then used to obtain an estimate for the world cocoa price for each of the years under analysis. The prices in London and Japan markets were first converted from their domestic currencies to the U.S. equivalents before the aggregation and weighting process was undertaken.

(4) The prices of competing commodities, such as coffee in Nigeria, are the annual average stabilized producer prices in Naira per ton converted to U.S. dollars per ton.

(5) World's coffee prices were obtained from the London, New York, and Japan coffee markets. The London and Japan quotations were then converted to of U.S. dollars and then aggregated before weighting to obtain the annual coffee price estimates.

(6) Index of weather is an index of rainfall and temperature for the four major cocoa producing towns in Nigeria, i.e. Ibadan, Abeokuta, Ikom and Ilorin.

(7) Index of income are indexes of incomes of the U.S., E.C. and Japan.

Variable Definition

When supply and demand response models are estimated by econometric methods, data problems and multicollinearity among the variables, especially when the explanatory variables are lagged,

prevent the inclusion of a large number of variables. Attempts to drop any of the variables that are supposed to be included, introduces errors in specification (Pindyck and Rubinfeld, 1981). As a result, some of the highly collinear variables are combined.

The rainfall averages for each geographical location of the study were combined and indexed to 1965=100. A similar procedure was utilized to index the temperature estimates. The indexes of temperature and rainfall were then combined to form the weather index for this analysis. The procedure for constructing the other variables are detailed below.

The Relative Cocoa Price

The real domestic lagged stabilized cocoa prices (CP_{t-k-i}) were divided by the real world cocoa lagged prices (CNP_{t-k-i}). The real world cocoa prices, which had no trend, were obtained by randomly selecting a price for each year from the twelve monthly cocoa price averages for each market i.e., New York, London and Japan. The estimates for Japan and EC were first converted to the U.S. equivalents by applying the exchange rates between the pound sterling, Japanese Yen and the U.S. dollar. The three estimates were combined. The combined estimates were then used to determine weights for each market for the analysis. The weights were applied to provide an estimate of the world cocoa price for each of the years under consideration.

The Relative Coffee Prices

The same procedure used to obtain relative cocoa price was used to estimate the annual lagged coffee prices (PC_{t-k-i}).

Government Policy Variable

The cocoa board involvement in controlling the cocoa market prices, as discussed in the previous chapters, especially in Chapter III, took different forms.

(1) Price and income stabilization objectives through holding prices constant over whole seasons at a time.

(2) Development of high-yielding varieties (Amelonado).

(3) Marketing and market development for Nigeria's cocoa.

(4) Direction of the general nature and performance of the marketing and storage subsection of the Peasant Producers Products (Adigun, 1982).

(5) Abolition of cocoa export taxes in 1974.

These activities have to be incorporated into the present analysis of equation (14) either directly or indirectly. The frequent changes in the political system in Nigeria and eventual civil war in 1966 have made it essential for researchers to investigate the impacts of such political upheavals not only on the state of agriculture in general, but on cocoa production in particular. The desired policy variables are constructed with the aid of dummy variables.

In this study, the period from 1937 to 1980 is characterized as a period when three political systems existed. Consequently, dummy variables are constructed such that:

D_5 = 1, civilian government (1937 through 1965) and (1978 to 1980).

= 0, otherwise (1966 to 1977).

During the period under study, one major cocoa board policy has been the abolition of export taxes on all Nigerian export commodities. This policy variable is also represented with a dummy variable as follows.

D_2 = 1, Period for abolition of export taxes (1974 to 1980)

= 0, otherwise (1937 to 1973).

Sugar Price Variable

In the estimation of the demand model of equation (16), sugar prices are used as the variable for the competing commodity. The random monthly wholesale price of refined sugar in New York, London and Tokyo was used. First, the random monthly prices were selected and aggregated. The sum of the prices was then used to estimate the appropriate weight which were in turn used to estimate each of the data series for sugar for each of the years under review. However, wholesale prices in Japan could not be obtained so the study was forced to use the unit value of sugar imported (C.I.F. basis).

Income

Estimate for the index of income were obtained with the base year being 1970. The indexes for each year were then summed and a weighting process generated, as in the other variables above. The weights obtained were then used to construct the average aggregate index of income that are utilized in the analysis.

Aggregate Grindings

This variable is regarded as the total disappearance of cocoa in the three markets. The estimates for each market were summed in order to develop the same type of weights as in the other explanatory variables. From here, estimates for the aggregate weighted grindings for each of the years were obtained.

Chapter Summary

This chapter developed both the supply and aggregate demand models for Nigerian cocoa and presented the format for testing of the hypothesis of Chapter I. Two approaches designed to determine what the output and price series would have been had the Nigerian cocoa producers been allowed to face the world market prices were presented. The chapter also included, the data sources, the analytical framework of the explanatory variables and pitfalls associated with the use of some of the variables.

The next chapter will discuss the empirical results from estimating the models. These results will then be used in evaluating the hypotheses specified in Chapter I.

CHAPTER V

MODEL ESTIMATES AND ANALYSIS

Introduction

General cocoa supply and demand models were developed in Chapter IV. The models were summarized in equations (11), (13), (14) and (16). In this chapter, a re-specification of the models in estimable form is discussed. The exponential function is used in estimating the supply response after determining the appropriate lag structures relevant in estimating the model while the power function is used, on the otherhand, in estimating the aggregate demand response. A discussion of the results, presentation of the procedures for testing the hypothesis specified in Chapter I and the test results are evaluated. The general estimates from the models specified are compared with the results of other studies. The chapter concludes by presenting an overall evaluation of the methodology and the empirical results in line with the problems identified earlier in Chapter I.

Lags

Prior to estimating equations (11), (13), and (14) of the cocoa supply response, the range of the number of lags necessary for the equations was tested by computing the simple correlation coefficients between cocoa prices and the successive values of the cocoa outputs. The correlation coefficients for the domestic

stabilized prices and cocoa output for the 3rd, 4th, 6th, 8th, 9th and 12th year lags respectively ranged as follows: .38, .47, .24, .34, .04 and .29 while for the world cocoa prices the correlation coefficients were .47, .47, .44, .38, .27, and .17. Accordingly, the lag structures attempted were from 3 to 12 years.

A critical look at the correlation coefficients served to indicate that if ordinary least square estimates were run on the dependent variables on the lags directly, that the relevant lags could be obtained. Almon (1965) indicated that multiple regression techniques can be applied directly if (1) the observations under consideration involve annual estimates, (2) the number of relevant lags in the independent variables are small and (3) the successive past observations uncorrelated. From the correlation coefficients presented above, which were relatively low, it was assumed that the various lags for the independent variables were uncorrelated with each other. The ordinary least square multiple regression technique (O.L.S.) was applied directly involving cocoa output, the current cocoa prices and the successive lag structures varying from 3 to 12 years. The adjusted coefficient of determination (R^2) and the minimum mean-square error, were used to select the relevant lags for the domestic and world cocoa prices.

Another approach utilized in determining the relevant lag structure of the prices was the stepwise regression technique. Here the model was estimated using all the lags from 3 to 12 years and the other explanatory variables. On the basis of the maximum R-square improvement on the dependent variable as the lags enter the model and the significance of their t values, the relevant lags were discovered.

Both approaches indicated that, for the domestic and world cocoa prices, the 8^{th} and 12^{th} year lags may be useful in explaining Nigerian cocoa producer response.

Various functional forms were estimated of equations (11), (13) and (14) presented in Chapter IV. The exponential form (semi-log) was selected. Estimated equation (11) with its 8th and 12th year lags and the form utilized can be re-written in one way as:

$$\ln NQ_t = \Psi_0 + \Psi_1(1 - \beta_0)CP_{t-8} + \Psi_2 CNP_{t-8} + \Psi_3(1 - \gamma) CP_{t-12} + \Psi_4 CNP_{t-12} + \Psi_5 PC_{t-8} + \Psi_6 \ln NQ_{t-1} + \Psi_7 lW_t + \Psi_8 D_2 + \Psi_9 D_4 + \Psi_{10} D_5 + Z_t \quad (24)$$

Equation (13) can be re-written as:

$$\ln NQ_t = b_0 + b_1 CP_{t-8} + b_2 CP_{t-12} + b_3 PC_{t-8} + b_4 lW_t + b_5 NQ_{t-1} + b_6 D_1 + b_7 D_2 + b_8 D_4 + b_9 D_5 + V_t^* \quad (25)$$

Equation (14), on the other hand, can be re-written in the following form:

$$\ln NQ_t = \omega_0 + \omega_1 RATCP_{t-8} + \omega_2 RATCP_{t-12} + \omega_3 RATCP_{t-8} + \omega_4 l_t + \omega_5 NQ_{t-1} + \omega_6 D_2 + \omega_7 D_4 + \omega_8 D_5 + E_t^* \quad (26)$$

Equations (24) and (26) are dependent on the assumption that the Nigerian cocoa producers make adjustments in their planning decisions based on some adjustment between the world and domestic cocoa prices. A variant of the two models is also developed in equation (25). The assumption is made that the Nigerian producers are concerned only with prices received from the commodity boards.

Statistical Estimates

The empirical results from the estimation of equations (24), (25) and (26) are presented in equations (27), (28) and (29) below. An asterick on b values implies that the coefficient is statistically different from zero at the .05 probability level. The definitions of the variables are presented in Appendix C. The results in equation (27) consist of using both the world lagged and domestic prices as explanatory variables for the Nigerian cocoa supply response and are as follows:

$$\ln NQ_t = \underset{(2.19)}{1.11481455^*} + \underset{(.68)}{.00016347CP_{t-8}} - \underset{(-.16)}{.00068072CP_{t-12}}$$

$$- \underset{(2.06)}{.001998^*CNP_{t-8}} + \underset{(1.95)}{.01996CNP_{t-12}} - \underset{(-1.72)}{.0001994PC_{t-8}}$$

$$- \underset{(-.82)}{.1100013D_2} - \underset{(-2.33)}{.122624^*ln} + \underset{(6.14)}{.344132^*D_4} +$$

$$\underset{(7.69)}{.77375^*D_5 \ln NQ_{t-1}} - \underset{(-1.03)}{.2804D_5} \qquad (27)$$

F-Ratio = 20.98

R^2 = .90

Dw = 2.31

The results of equation (28) involve the use of only the lagged stabilized domestic prices and are as follows:

$$\ln NQ_t = \underset{(2.07)}{.09378^*} + \underset{(1.30)}{.000366CP_{t-8}} - \underset{(-1.79)}{.007553CP_{t-12}}$$

$$\underset{(-2.36)}{-.288417^*D_2} - \underset{(-1.80)}{.0011538PC_{t-8}} + \underset{(7.20)}{.377111^*D_4}$$

$$\underset{(-2.45)}{-.116442^*ln} + \underset{(9.52)}{.824051^*\ln NQ_{t-1}} - \underset{(-1.99)}{.238456^*D_5} \qquad (28)$$

F-Ratio = 28.02

R^2 = .87

Dw = 2.48

Equation (29) presents the results from using the relative price ratios as explanatory variables as follows:

$$\ln NQ_t = \underset{(1.55)}{.87112177} + \underset{(1.37)}{.1167887}RATCP_{t-8} - \underset{(-1.10)}{.017788}RATCP_{12}$$

$$-\underset{(2.00)}{.001694}*RATCP_{t-8} + \underset{(-2.01)}{.181444}*D_2 - \underset{(-2.34)}{.097889}*\ln$$

$$+\underset{(6.33)}{.361095}*D_4 + \underset{(8.25)}{.822836}*\ln NQ_{t-1} - \underset{(-1.63)}{.302483}D_5 \qquad (29)$$

F-Ratio = 23.73

R^2 = .86

Dw = 2.38

For each variable included in the equations, the sign of the coefficients is placed immediately before the coefficient. The coefficients for the lagged world and domestic stabilized cocoa prices (CP_{t-8} and CNP_{t-8}) for equations (27) and (28) and the relative cocoa lagged price ratio variable ($RATCP_{t-18}$) of equation (29) should be positive for a supply schedule. The coefficients on the lagged coffee domestic prices (PC_{t-8}) equations (27) and (28) and the relative lagged coffee prices ($RATPC_{t-8}$) of equation (29) should be negative if coffee and cocoa compete for the same resources. The coefficients are consistent with a priori expectations.

The 12-year lagged cocoa prices (CP_{t-12} and CNP_{t-12}) of equations (27) and (28) and the relative 12-year lagged cocoa price

ratio ($RATCP_{t-12}$) of equation (29) conform to *a priori* expectations. On *a priori* basis as well, the signs on the coefficient on weather is indeterminate. In this study, the coefficient on the weather index for all the equations was negative. It was, however, significant for all the equations specified at the 95 percent level. The dummy variables D_2 and D_5 were negative while the dummy variable D_4 was positive.

Results

The test for autocorrelated disturbance on equations (24), (28) and (29) were first performed. The t values obtained from testing for the presence of serial correlation led to the rejection of the presence of serial correlation in all the equations specified. Comparing the three equations of the present chapter, indicate the following: that the coefficients of determination ranges from .85 with the relative price ratio equation, .86 for the equation containing lagged domestic stabilized prices only, and .87 for the equation with both lagged 8- and 12-year lagged world and domestic stabilized prices, only the lagged domestic cocoa prices or perhaps some ratio of the two? Note that, depending on the assumptions ne is willing to make concerning the Nigerian cocoa producers' response, each of the three equations may well do as "good a job" as any other.

The results of equation (27) show that 90 percent of the variation of the Nigerian cocoa production or supply was explained by all the explanatory variables taken together. Four of the variables were statistically significant at the probability level of .05. Equation (28) was able to explain 89 percent of the variation in

Nigerian cocoa production or supply with 5 of the variables being statistically significant at the probability level of .,05. For the relative lagged price ratio, (equation 29), 87 percent of the variation in Nigerian cocoa production or supply was explained with 5 of the explanatory variables being statistically significant at the probability level of .05.

Equation (27) suggests that there are other important variables which influence the cocoa producers expectation formation, namely the world cocoa lagged prices. This equation had the highest R^2, though the coefficient on the domestic lagged cocoa prices 8 years was not significant. Similar results are obtained for equations (28) and (29). However, on a priori ground equation (29) is proposed for testing the hypothesis in Chapter I. This equation indicated that Nigerian cocoa producers do respond to the relative ratios between the lagged world cocoa prices and the domestic lagged prices. Nigerian cocoa producers will increase production by .168 thousand metric tons if there is a one dollar change in the ratio of the lagged domestic cocoa stabilized prices and the world lagged cocoa prices. If the ratio in prices increases, the less willing they are to increase production or supply. Overall, it appears that Nigerian cocoa producers base their production decisions on the past histories of the variables under review, in this case the lagged cocoa and coffee prices, and that they are also sensitive to governmental policy changes that affect the structure of the commodity boards, as different institutions emanate in the system and develop their own formula for operating the boards. The dummy variables D_2 and D_5 were negative as indicated earlier. In the case of D_2, this may have been the results of the inelasticity in demand as well as the

effect of abolishing cocoa export taxes. It may also be possible that, with long growth period on cocoa production or supply, it is still impossible to model the impact of abolishing cocoa export taxes on cocoa production, For D_5, the effect of changing political systems and/or governmental systems have been essentially negative on cocoa production. With each new government as outlined in Chapter III, evolves a new commodity board, a fact Okori and Blandford (1979) asserted to be responsible for cocoa production declines in the countries which had or are facing political changes. These political changes have to a large extent results in inconsistent policies for many of the export commodities. Another dummy variable not reported here was used in the analysis but was not significant. This is the dummy variable for the period between 1966 and 19780, representing the period for the Nigerian Civil War. The effect of the civil war was not expected to be significant as far as cocoa production is concerned since the major cocoa production districts were not affected directly by the war, Nigeria maintained her share of world production throughout the course of the war (Appendix B).

Elasticity Estimates

In order to access the responsiveness of Nigerian cocoa producers to changes in the relative prices and relative price ratios, the short- and long-run elasticities were estimated.

$$SR_j \text{ elasticity} = \hat{e}_j \, \hat{\beta}_j \, \frac{\overline{CP}_{t-8}}{\overline{NQ}_j}$$

where:

$\hat{e}_j$ = coefficient on the cocoa price lagged 8 years.

$\hat{\beta}_j$ = coefficient on the lagged dependent variable NQ_{t-1}

$\overline{CP}_{t-8}$ = mean of the cocoa prices lagged 8 years.

and

$\overline{NQ}_j$ = mean of cocoa output.

The cross price elasticity was estimated as:

$$\hat{e}_j \hat{\beta}_j \frac{PC_{t-8}}{NQ_j}$$

where

$\overline{PC}_{t-8}$ = mean of coffee prices lagged 8 years

and

$i \neq j$

The long run elasticity estimate at the mean for the equations are estimated as follows:

$$\frac{SR_j}{1-\hat{\beta}_j}$$

The results are presented in Table VII.

TABLE VII

SHORT AND LONG RUN ELASTICITIES OF SUPPLY FOR NIGERIAN COCOA (1937 THROUGH 1980)

	Equation (27)	Equation (28)	Equation (29)
Own Price Elasticities			
Short Run	.22668	.0001502	.069423
Long Run	1.0008	.0008538	.39186
Cross Elasticities (Coffee)			
Short Run	-.0158	-.0094969	-.00105
Long Run	-.06985	-.053807	-.005925

Results of Table VII show that all the short-run elasticities for the three models are less than one. The short-run, cross-price elasticities with respect to coffee prices are also very inelastic for all the equations. However, the long-run own-price elasticity for equation (27) is approximately equal to one; for equations (28) and (29) the coefficients are less than one. Equation (29) had slightly higher elasticities than equation (28).

The ramifications of the above results have important policy implications. For equation (27), if the Nigerian cocoa producers are allowed to face the world market prices, a one percentage increase in cocoa prices in the world market will induce a .23 percentage increase in domestic production in the short-run, but in the long-run it will lead to a one percentage increase in domestic production. In the case of equation (28), the implications of the elasticities obtained are a one percentage increase in cocoa prices will induce only a .0002 percentage increase in domestic production. The direct implication from these elasticities is that lower prices would have only a very small effect on cocoa production.

Equation (29) on the other hand, showed relatively lower short-run and long-run elasticities but are higher than the results of equation (28). The short-run price elasticity is .078284 while the long-run elasticity is .55053. In synopsis, the equations presented in Chapter V and their elasticities in Table VIII, seem to indicate that even if sufficient time for adjustment is allowed, cocoa production increases will be relatively small. From the manner in which the models are estimated, it is possible to postulate that the likely effects of better and more favorable producer prices which

have bearings on the world market may only induce greater revenue for the producers, not increased production.

Comparison With Other Studies

Bateman (1965) and Behrman (1968), as discussed in Chapter II, estimated cocoa supply response models using 8- and 12-year cocoa price lags as the relevant lags in estimating cocoa producers' response. In contrast, Ady (1968) used current cocoa prices and the 12-year price lag for his model, even though he found the current cocoa price coefficient to be negative. The lagged price cocoa coefficients for both Bateman and Behrman were consistent with *a priori* expectations as well as the 12-year lag of the Ady (1968) study for the Ghanaian cocoa supply response. However, when Ady (1968) applied a similar model that was used by Bateman (1965) and Ady (1968) he found the 8-year cocoa price lag to be negative for the Ghanaian cocoa supply response. He did find the same negative correlation on the Nigerian cocoa production response for the period 1949 to 1965.

For the lag structure on the competing commodity, coffee, Bateman (1965) and Behrman (1968) found the 8- and 12-year lags to be relevant for the Ghanaian cocoa production function. Ady (1968) did not find coffee prices relevant in explaining cocoa production response in Ghana. Ady (1968) reasoned that because coffee was introduced fairly recently into the Ghanaian economy it would not have posed as a serious competitor to cocoa.

The present study, however, found the 8- and 12-year cocoa price lags as relevant in explaining Nigerian cocoa production response. On coffee prices, this study also found that the 8-year lag of coffee price as relevant in explaining Nigerian cocoa production response. This study, however, did not find the 12-year lag on coffee prices to be statistically significant. On the current cocoa prices, the study found a negative and statistically insignificant coefficient. Consequently, the current cocoa prices were not utilized for analysis. The use of the 8- and 12-year lagged cocoa prices was therefore in agreement with the results of Bateman (1965) and Behrman (1968). But the use of only the 8-year lag of the coffee prices was only in partial agreement with these studies.

Bateman (1965), Behrman (1968) and Ady (1969) did not estimate supply elasticities for cocoa. Olayide (1972) however, following their lead, estimated cocoa supply elasticities for Nigeria. He found the elasticities to be low. From these low elasticities he arrived at the following conclusions: that it was the rice stabilization schemes of the marketing boards that had caused the low price elasticities and that to avoid possible future cocoa production crises, new and more consistent policies need to be designed to encourage increased cocoa production. Olayide's (1972) estimates of the cocoa price elasticity were .197 for the short-run and .596 for the long-run. His study did not use coffee or any other perennial crop as an alternative commodity to cocoa. Consequently no cross price elasticities were reported.

Demand Response Equation Estimates

The aggregate demand model (equation 16) developed in Chapter IV is estimated using the double-log form as follows:

$$\ln NQ_t = \theta_0 + \theta_1 \ln CNP_t + \theta_2 \ln \overline{RSP}_t + \theta_3 \ln \overline{AG}_t + \theta_4 \ln \overline{INC} + \theta_5 D_1 + \theta_6 D_3 + Z_t^* \quad (30)$$

where

θ_1 through θ_5 are the parameter coefficients

$\overline{CNP}_t$ is the real average aggregate world cocoa prices

$\overline{RSP}_t$ is the real aggregate average sugar prices

$\overline{AG}_t$ is the average aggregate grinding of cocoa

INC is the average index of eorld income

and

D_1 is the dummy variables to represent the effect of World War II on cocoa purchases

$D_1 = 1$, (1939 - 1948)

$D_2 = 0$, otherwise (1937 to 1938 and 1949 to 1980)

D_3 to represent the impact of the 1973/74 cocoa agreement.

The non-linear multiplicative model on the aggregate demand for Nigerian cocoa implies that the explanatory variables have constant percentages effects on Nigerian cocoa output purchases by the various blocs under review for all the values of cocoa prices and income. This property, however, has the innate disadvantage that Nigerian cocoa purchases by the blocs cannot become negative for high values of cocoa prices or low values of income. A practical advantage of the model is that the regression coefficients are the elasticities.

The aggregate demand model of equation (30) shows the impact of changes in prices as they relate to cocoa purchases by the consuming

nations. The results from the estimation of equation (30) are presented in Table VIII.

TABLE VIII

STATISTICAL RESULTS FOR THE MODEL OF AGGREGATE DEMAND FOR NIGERIAN COCOA (EQUATION 30) 1937-1980

Variables	Equation 30 Coefficients	PROB > |T|
INTERCEPT	-2.0656*	.0083
CNP	- .07375*	.0156
RSP	.44081*	.0179
AG	.39544*	.0001
INC	1.0403*	.0467
D_1	- .42185*	.0015
D_3	.01321	.1753
F-RATIO	38.12	
Dw	2.14	
R^2	.81	

*Significant at 10% level.

The estimated elasticities of aggregate demand are obtained directly from Table IX because the double-log form was applied in estimating the equation.

The results indicate that the own price elasticity is inelastic. There is pertinent for policy implications. The low elasticities implies that a one percentage increase in Nigerian cocoa price will induce only .07 percentage decline in purchases of Nigerian cocoa by the blocs under consideration. For sugar, a one percentage increase in its price will lead to a .44 percentage increase in Nigerian cocoa purchases by the consuming nations. As a consequence, sugar in the case of Nigeria is a competitive commodity to cocoa. A one percentage increase in aggregate grinding for cocoa will result in a .395 percentage increase in purchases of Nigerian cocoa. The income elasticity for Nigerian cocoa is relatively more elastic than the own price. A one percentage increase in the index of income will increase purchases for NIgerian cocoa by 1.04 percent. This indicates the extreme interdependence of Nigerian cocoa producers to the incomes in the cocoa consuming nations of the world.

Clearly, two possible policy implications are derivable: price increases for Nigerian cocoa will not lead to significant declines in purchases of Nigerian cocoa and the most relevant explanatory variable is income which implies that, as the income of the western world increases, purchases of Nigerian cocoa will also increase. There is a clear relationship between what is happening in the economies that purchase cocoa and those that consume it. This interdependency influences the economic pockets of Nigerian cocoa producers.

Specification of the Independent Variables

Three different model forms are used in specifying Nigerian cocoa production. The first model is based on the assertations that

the expected price for Nigerian cocoa producers takes into account both the lagged Nigerian stabilized cocoa prices and an adjustment between world and Nigerian prices. The implication is that economic agents base their decision not only on the lagged cocoa prices but also the lagged world prices, with some coefficient of expectations. The second model is not based on price expectations. It assumes that the only relevant parameter for forming or making production decisions are the lagged domestic producer prices.

In the case of the third model, the price expectations are based on the relative ratio between the Nigerian domestic stabilized prices and the world prices. The coefficient of expectation is assumed to be one. In this instance what matters is the gap between the world and domestic prices. As the price ratio decreases, productive activities will, as well, increase and vise-versa. This formulation is a variant of model one, which implied that economic agents do take into consideration all the relevant information in forming expectation.

Three major policy variables used in the supply response models are the system of government, effect of abolition of export taxes on cocoa production and the impact of price increases to reflect world market production prices on Nigerian cocoa output. It is shown that governmental programs throughout the period of observation (1967 through 1978) have had a negative effect on total cocoa production. In fact, there was also a negative effect on the policy variable when export taxes on cocoa was abolished (1974-1980). However, the inconsistent sign does not imply a backward bending supply response

cocoa model. The inconsistent signs may be due to the inelasticity of both cocoa demand and supply. It could also have risen because of the length of time since the policy instrument was effected. If this is the case, then the time lag is not long enough to ascertain the true effect of abolishing export taxes on cocoa. One notes that the sign is not surprising. Ady (1969) found a negative but significant coefficient on the current price in a supply response model for Ghana.

The long-run implications of raising prices to reflect world cocoa prices was shown to be positive and significant. The results is consistent with expectations since real price increases will result in income increases for cocoa producers which in turn may results in production increase. The final supply function which is utilized for empirical specification consisted of the following explanatory variables. The ratio of domestic to world prices lagged 8 years, the ratio lagged 12 year, the ratio of domestic to world coffee prices lagged 8 years, weather index lagged 1 year output and the policy variables enunciated above. The supply response models are estimated with the help of the semi-log form or exponential form.

The aggregate demand model specified was based on current actual prices rather than expected prices. It is asserted that demand for Nigerian cocoa export is a function of real actual weighted prices, index of income and the level of average aggregate grinding. The static non-linear model of the power or double-lob form was used to estimate the aggregate demand function. The markets under consideration are considered to be free markets. As such, it could be hypothesized that individual purchases played an important role in

determining in the final analysis what quantities of Nigerian cocoa was purchased. Behrman (1965) and Viton (1970) utitilized the same type of functions to estimate aggregate demand for world cocoa, while Okorie and Blandford (1979) used the same form for the United States and European Community and the dynamic partial adjustment model for Japan. The results of the elasticities obtained in this study are consistent with all of these studies except Viton's. In Viton's (1968) study, sugar was not considered as a relevant explanatory variable and as such was excluded while Behrman (1968) even after applying the instrumental variable technique, did not find the results obtained to be better than OLS. The elasticities obtained form the various studies are presented in Table IX.

The two major policy variables used in the demand model for Nigerian cocoa are (1) the interruption of world events on account of the Second World War and (2) the effect of the OPEC oil embargo of 1973/74 and cocoa agreement of 1973/74 on purchases of Nigerian cocoa. As before, the policy variable for (1) is modelled with a dummy variable which divided the period of observation into two periods: the period 1939 to 1948 as the periods of the war and the impending effect of the continental war time control measures on the market for cocoa. A similar approach was adopted for the second dummy variable which involved the impact of the OPEC oil embargo and the cocoa agreement on purchases of Nigerian cocoa. Here a dummy variable was applied for the periods 1973/1974 to 1980 to at account for the above effect. It was discovered that the Second World War had a negative significant effect on purchases on Nigerian cocoa. The OPEC oil embargo and cocoa agreement also had a similar effect but

TABLE IX

ELASTICITY ESTIMATES FOR MAJOR CONSUMING COUNTRIES AND MARKETS IN PREVIOUS STUDIES**

REGION	PERIOD	AUTHOR	ELASTICITIES		
			INCOME	PRICE	CROSS-PRICE (With Respect to sugar)
Planned Economics	1953-1968	Viton	.25	-.25	----
Western Europe	"	"	.29	-.29	----
U. S.	"	"	.18	-.18	----
U. S.	1951-61	Behrman	-1.9	-.40	-.23
Fed. Rep. of Germany	"	"	.77	-.05	.03
United Kingdom	"	"	-.35	-.01	.05
Netherlands	"	"	.13	.17	.59
France	"	"	.22	-.01	.99
U. S.	1948-1964	Behrman	*	-.25	.08
Fed. Rep. of Germany	"	"	.93	-.18	*
United Kingdom	"	"	.71	-.16	*
Netherlands	"	"	.62	-.89	*
France	"	"	.68	-.38	.15
USSR	1951-1975	Ikorie & Blandford	.79	-.13	*
E. C.	"	"	.29	-.25	.17
U. S.	"	"	.27	-.17	-.16
Japan	"	"	.38	-.88	-.10

\- Variable was not used for analysis

* Coefficient was not reported because it was insignificant

** Estimates used are total world or regional consumption

Source: Adapted from Okorie and Blandford, World Market Trends and Prospects for cocoa, Department of Agricultural Economics, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, New York, Sept. 1979.

not significant. The results are therefore consistent with *a priori* expectations. In the final analysis, the aggregate demand model for Nigerian cocoa which is subjected to empirical specification has as explanatory variables: real world weighted prices for Nigerian cocoa, sugar prices, average aggregate weighted grinding, index of income and the policy variables indicated above.

Hypothesis Tests And Test Results

In Chapter I, it was stated that increasing the domestic producer stabilized cocoa prices to reflect the world market competitive prices will not affect increased cocoa production. On this basis, four main areas of concern were developed. These concerns were then hypothesized and are re-stated below.

(I) That there will not be any significant differences in sales volume offered as a result of changing the announced stabilized producer domestic prices to reflect the competitive market world prices.

(II) That farm income will not change by a proportional amount as a consequence of any divergencies between producer prices and world prices.

(III) That the real income from cocoa would not have changed over the years even without a domestic price stabilization policy.

(IV) That there would not have been any changes in output even without domestic price stabilization policy.

To test the hypotheses presented above, priority models signified by equations (29) and (30) are employed.

To test the hypotheses presented above, priority models signified by equations (29) and (30) are employed. The figures in parentheses are the "t" values and those values marked the asterisks are the significant t values. The variables are as defined previously in Chapter IV. Testing the first hypothesis is the same as testing the null hypothesis that

H_0: $b_1 = 0$

H_A: $b_1 \neq 0$

Tabulated t_{32}, 05 = 1.684

That is, the test involves testing if the coefficient on the ratio of cocoa price is equal to zero. We expect on a priori basis that if the ratio between the lagged cocoa prices and world cocoa prices 8 years changed by one dollar, production will only increase by 168 metric tons. From the t test conducted above, we can not reject the null hypothesis and we must conclude that sales volume will not change significantly if the Nigerian cocoa producers were allowed the world market competitive prices.

Hypothesis II was also tested by utilizing the t-statistics. A dummy variable was assigned to periods in which the difference between world prices and domestic stabilized prices were low and the test statistic involved essentially testing if the dummy variable D_4 was significantly differently from zero.

From this test, Hypothesis II was rejected with the conclusion that farm income would have changed over the years had there been no divergencies between producer prices and world prices.

In testing Hypotheses III and IV, the technique explained in Chapter IV were adopted. The first technique, Model I, involved

generating output for cocoa based on the 8-year price response for cocoa (equation 29). For example, 1937 prices are used to predict output in 1944. Using the 1944 predicted output, world equilibrium price for cocoa in the same year are generated with the help of aggregate demand response (equation 30). Economic theory specifies that at equilibrium, supply and demand quantities must be equal which in turn will result in equilibrium prices. The interplay of the aggregate supply response and aggregate demand resulted in equilibrium prices. That is

$$N\hat{S}Q_t = NDQ_t$$

where

$N\hat{S}Q_t$ = Predicted output from the supply response

and

$\hat{N}DQ_t$ = Generated output demand in the year under consideration

Based on this analysis, equilibrium predicted outputs and prices for cocoa are estimated at their mean from 1944 to 1951.

To obtain estimates for cocoa prices and output had there been no stabilization policy from 1952 to 1980, the cocoa price ratio of the domestic and world cocoa prices lagged 8 years were first plotted to determine if there were patterns in the price ratios. The plots did not show the existence of presence of a trend or pattern, and the ratio ranged from .2 to 1.6. Based on this knowledge, the study generated four thousand alternative price ratios between the Nigerian domestic cocoa prices and the world cocoa prices lagged 8 years ranging from .2 to 1.6. From the generated alternative price ratios, the procedure of sampling with replacement was adopted so as to give equal probability of selecting each price ratio for analysis.

Thirty-two ratios from the four thousand ratios were selected. The first ratio selected was used to represent the price ratio for the year 1952, the second, 1953 and so on to 1980. The selected ratios were used to obtain cocoa outputs from the supply equation (equation 29) which in turn were used to obtain what the prices would have been without domestic price stabilization by applying equation (30).

The second alternative, Model II, involved the use of the 1937 price ratio as the base or initial year and generating outputs for time t + 8 from the supply response model of equation (29). The predicted outputs at time t + 8 was used to obtain the predicted price at time t, had there been no domestic price stabilization policy. Time t price was subsequently used to obtain a price ratio between the domestic and world prices at time t which in turn was used to predict output in time t + 8. This process was continually applied until all the necessary observations for the period under analysis were obtained.

The internal generation of output price ratios lagged 8 years and the predicted current prices with no domestic stabilization policy indicated that cocoa prices would have been on the increase from 1944 to 1952. From 1953 to 1959, there would have been relatively lower prices which were to be followed by further price increases in the 1960 decade. Prices in the 1970 decade would have shown moderate increases and declines by 1980 or the second half of the decade.

For Model I, predicted prices in general would not have been as high as in Model II. The pattern or trends exhibited were similar to

that of Model II. Prices increasing and falling over the same periods.

Cocoa output was determined to be more stable in Model I than in Model II but cocoa output would have been greater under both models form 1944 to 1960 than under the actual domestic stabilized prices. Output under the models began declining moderately until 1968. From 1969 to 1972, cocoa production would have declined and greater fluctuations from 1973 to 1976 than increased moderately above the actual output under the current price stabilization policy.

The estimates of cocoa price and outputs obtained form each of the two models are used to obtain the revenues from the different models. These estimates are presented in Table X. Mean revenue from Model I is 33.61 million dollars while for Model II, the mean revenues is 38.59 million dollars. The standard deviation associated with the revenues from the two models are 16.89 and 40.47 million dollars respectively.

The domestic stabilized price utilized for the analysis above did not include the maritime transportation cost form Lagos Port to New York. The prices of cocoa at New York, on the other hand, had the transportation cost included in them. Consequently, comparison of the results from the two models with the stabilized domestic price could not be done directly. On this basis, the mean price 8-year lagged ratio of .68186 was assumed to be the lower limit of what the actual mean ratio would have been had the transportation cost been included in the domestic stabilized prices. As a result, the estimates of total revenue presented above were overstated by the models.

TABLE X

ESTIMATED AVERAGE REVENUE FROM MODELS I AND II AND ACTUAL REVENUES IN DEFLATED NAIRA, NIGERIA, 1944-1980

	Model I	Model II	Actual
Mean	33,609,200	38,594,470	22,670,997
Adjusted Mean	21,509,888	24,700,461	-
Standard Deviation	16,892,456	40,470,960	10,123,900
Adjusted Standard Deviation	10,811,172	25,901,414	-
Coefficient of Variation	50	105	44

Information on maritime transportation costs of cocoa shipments from Lagos to New York could not be obtained directly in order to correct for the over estimated from the two models. However, the annual values of cocoa at Lagos Port from 1965 to 1976 were obtained from the Annual Central Bank of Nigeria, economics and financial review report, The difference between the reported cocoa value and the value of cocoa at the New York cocoa market was obtained. This difference was then assumed to represent the maritime transportation cost of shipping cocoa from Lagos to New York for the years in which data could be obtained. A ratio of the difference in cocoa value between the Lagos cocoa value and the New York value was obtained. The ratios of the difference was .36. The mean difference was applied to the estimates of the two models so as to factor out the part of the mean revenue that would have been attributed to transportation cost under a free market scenario.

The adjusted estimates of the mean revenue from cocoa under Model I (from Table X) is 21.51 million dollars and the standard deviation adjusted accordingly is 10.8 million dollars. In contrast, Model II has an adjusted means revenue of 24.70 million dollars with a variance of 25.90 million dollars. These estimates are then compared with the actual mean revenue from the stabilization policy. The mean revenue from the policy is 22.7 million dollars and the standard deviation was 10.1 million dollars for the period under analysis.

Model I indicated that Nigerian producers' income would have decreased by 5.7 percent when compared with the actual mean revenue from Table X. Model II however, showed a higher percentage change.

Model II indicated that producers' income would have increased by 9.0 percent as compared with the actual mean revenue of the Cocoa Board. Both models utilized above had higher variances in farmer's income than the variance from the domestic stabilization policy. The implication here is that when Model II revenues are compared with the actual revenue from the price policy, farmers income would have increased and had greater variability. When the price-policy revenue is compared with the results of Model I, actual mean revenue would have increased with a slightly lower variability. Because of these estimates, Hypothesis III was not rejected and hence, it could not be concluded that real income for the farmers would have been greater had the farmers faced the world market prices rather than the domestic stabilized prices.

The above models were also used for testing the fourth hypothesis. The mean output for Model I was 148,869 thousand metric tons with a standard deviation of 5.29 thousand metric tons. The mean output from Model II was 160,239 thousand metric tons and a standard deviation of 10.76 thousand metric tons. In contrast, actual output had a mean of 157,862 thousand metric tons and a standard deviation of 5.98 thousand metric tons. The percentage changes in output from Models I and II were -5.69 and 1.50 respectively. Variance in cocoa output from the stabilization policy was less than Model II but greater than Model I. On these grounds, the fourth hypothesis was also not rejected. The study concluded that cocoa output would not have been different had the cocoa farmers' faced the world market prices.

The results of the above hypothesis have varying interesting results. First, increasing cocoa price alone might improve farmers income potential but as far as increasing productivity and production, other more pertinent relationships must be explored. Clearly, this conclusion, is not consistent with the intentions given by the government for raising prices in order to encourage cocoa production. Second, the commodity boards have been able to stabilize producers income over the year but there may have been great variability in cocoa production. The variability in cocoa output is not the result of the price policy but of other relevant variables such as weather that were specified in the supply response model. The produce price stabilization scheme can still be given priority but other avenues apparently must be pursued to achieve increasing cocoa production. However, since the demand elasticities are relatively low, increased cocoa production, if successful, may result in lower prices and incomes for Nigerian cocoa producers than the current situation. Third, with both low supply and demand elasticities for cocoa, it may be advisable for Nigeria and other cocoa consuming nations to reach agreements on how to reduce these inelasticities.

Conclusions

In this chapter, the estimated supply and demand elasticities and the implications of the elasticities were presented. It was determined that producers' income would be significantly different under a price scheme that involves the payment of higher prices for cocoa which reflect the world market prices. However, with these

relatively higher prices, significant output increases would not results. If policy considerations on price stabilization are to be based on the slopes of demand and supply schedules, the benefits will depend on the price level selected for stabilization. Hazzell and Scandizzo (1975) arrived at a similar conclusion when they state that when the anticipated expected prices were consistently lower than the "natural margin" on average cost, the stabilization agencies are the ones to make most of the profits at the expense of the producers if the stabilization pricing scheme is focused only on the supply response.

The gains from any price stabilization scheme which sets the expected values of the prices received by the producers far below world prices serves only to enhance the board's surplus accumulations and benefits consumers of the major cocoa importing countries. In this regard, paying higher prices equivalent to the world market prices could be the cornerstone for any initiative aimed at improving farmers income but increased production would not necessarily follow.

The commodity boards face a fairly competitive market, as a result, a situation which might have called for price decreases so as to exact increased earnings may not be advantageous to Nigeria. With no cartel arrangements or other pertinent controls, increased production, if successful, would lead to world price declines and perhaps to stabilized domestic prices far below world price levels.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The main thrust of this study is to analyze the implications of increasing cocoa producers' prices to reflect that of the competitive world market prices. Using Grossack measures of industrial concentration approach it was determined that Nigeria, which is a major cocoa producer, is experiencing continual permanent declines in her production shares. One reason suggested in the literature for the decline in production is the stabilized domestic price system. Theoretically, if the Nigerian cocoa producers are paid the competitive world market prices, their income will increase which will in turn engender more permanent investments in cocoa productive activities. The consequences of this will be increased cocoa productivity and or supply.

In Chapter IV and V, models for developing the hypotheses presented in Chapter 3 are specified. The study provides, therefore, the preliminary quantitative knowledge on the influence of (1) changing the domestic stabilized cocoa prices to reflect world competitive market prices; (2) the effects of increasing world prices on both nominal and real incomes of Nigerian cocoa producers; and (3) the implications of what would have happened if Nigerian producers had faced world market prices rather than the domestic stabilized ones.

Summary

Prior to developing the aggregate supply and demand models of Chapter IV, Grossack models for measuring permanent industrial concentration ratios are used to develop permanent cocoa concentration ratios for cocoa producing countries from 1933 to 1980. The five-year moving averages are used to smooth the raw or original annual estimates of production. The averages were then used to remove the seasonal and irregular fluctuations in the data series for all the major cocoa producing countries, which is from favorable weather variations for the cocoa production seasons. Weather and other irregular fluctuations are deemed to be the transitory component of the production shares. The results of the analysis indicated that the major cocoa producing countries as a group have been losing their permanent shares and that the loss in the shares is not due to new entrants or to smaller but already existing cocoa producing countries but rather to other large cocoa producing countries.

The β coefficients presented in Table VII, declined from .93 for the periods 1933 and 1939 to .38 for the entire period between 1933 and 1980. The low β coefficient for the period 1933 and 1980 indicates a declining concentration of the cocoa industry. The correlation coefficients ρ, changed from .99 for the period 1933 and 1939 to .56 for the entire period under analysis. An indepth or closer look at the shares showed that of the five major cocoa producing countries, Nigeria and Ghana are the only countries actually losing their shares. The loss in their shares are gained by

Ivory Coast and Brazit. Cameroun has maintained its dynamic share components.

One major criticism of the Cocoa Board is that it has been responsible for the declines in Nigerian production shares. In this vein, it has been suggested that the pricing policies of the cocoa Board be revised to reflect the world market price situations by raising the domestic prices paid the cocoa producers. Models were developed on the strength of the above, from the theory of a multi-product firm facing product uncertainty to determine the effects of such a policy. Cocoa is shown to be a function of the relative price ratios between domestic and world prices, a trend variable represented by a one year lag in cocoa output and an index of weather for the aggregate demand model. Purchases of Nigerian cocoa by the United States, European Community and Japan are dependent on cocoa output prices, sugar prices, aggregate grindings of cocoa and income of consumers in these blocs. Both the supply and demand models are modified to incorporate policy variables and the expected production and consumptions of Nigerian cocoa.

Two models, I and II, were developed based on the specified supply and demand response for cocoa. The models were used to determine what would have happended to producers' revenue and output of the cocoa farmers had they faced the world competitive market prices directly. Model I indicated that mean revenue without the current price statization would have been 21.51 million dollars while Model II indicated a mean revenue of 24.70 million dollars. The actual revenue was 22.7 million dollars, which is in between the two models.

However, there would have been greater price variability under the world price models.

The two models, I and II, showed that cocoa output would have been 148.869 and 160.237 thousand metric tons, respectively. Actual production was 157.862 thousand metric tons. These estimates indicate that the cocoa boards actions had not influenced production significantly. For revenue, the cocoa board policy had a slight downward effect if the comparison is based on Model II. The cocoa board policy, however, has succeeded in stabilizing cocoa prices as exemplified by the low correlation coefficient of 44.

Both the supply and demand models incorporated five major policy variables. The supply response had three of the five. The three policy variables of the supply response models were; (1) the system of government, (2) effect of the abolition of export taxes on cocoa production; and (3) the impact of price increases to reflect world market prices on Nigerian cocoa output. It was determined that governmental programs throughout the period of observation (1967 through 1978) have had a negative effect on total cocoa production ion. The policy variables on the abolition of export taxes on cocoa was also negative.

The two major policy variables used for the demand model are (1) the interpretation of world events on account of the second world war and (2) the effect of the OPEC oil embargo of 1973/74 and cocoa agreement of 1973/74 on purchases of Nigerian cocoa. The results indicated that the second world war had a negative significant effect on purchases of Nigerian cocoa. The OPEC/cocoa agreement had a similar but not significant effect.

Evaluation Of Results

The process of evaluating empirical results is based upon how well the specified equations satisfy the restrictions of economic theory and on the overall statistical fit of the models under consideration. None of the three models satisfied all the restrictions on the estimated coefficients as expected.

The percent of the observed variation in cocoa supply or production explained by all the explanatory variables in the models varied little in the three models. The overall predictive power of the model with both lagged domestic and world prices is 90, for the equation with only domestic prices .88 and the equation that utilized the relative price ratio variable .86. The results suggest that any of the three models could be used for analyzing or estimating Nigerian cocoa production or supply relationships depending upon the assumptions one is willing to make. For the purposes of this study however, the relative price ratio model was used.

The aggregate demand response model satisfied the restrictions on the estimated coefficients as expected. All the signs before each of the coefficients estimated were consistent with a priori expectations. The overall explanatory power of the model (R^2) was .83.

The elasticity estimates show that, on the average, the short-run own-price elasticities are low or inelastic both for the aggregate demand and supply responses. The cross elasticities, in the case of supply is the coffee price which was also very low or more inelastic when compared with the own-price elasticity while for

the aggregate demand response, it is sugar. It is inelastic as well but more elastic than the own-price elasticities. Clearly, the implications of these low inelastic demand and supply own price elasticities are that increases in cocoa production will be difficult to achieve.

For the demand, price increases might not be matched by a proportional cut in Nigerian cocoa purchases. Consequently, if prices were to rise by one percent, output purchases may decline only by .07 percent. The major factors influencing the demand for Nigerian cocoa were asserted to be, income, sugar prices and average aggregate grindings. The importance of the variables are in the order stated above. The income elasticity is 1.04. The elasticity estimate implies that a one percentage increase in the average income induces a more than 1.04 percentage increase in Nigerian cocoa purchases. The coefficients for sugar and cocoa grindings are inelastic but more elastic than the own-price. Overall, the estimated elasticities are consistent with those of the previous studies on both supply and demand analysis.

One significant difference between the demand elasticities presented in Table IX, with those of the present study is that the present study is focused primarily on Nigeria while the other studies are more concerned with the aggregate world demand. From the estimated supply and demand equations two alternative models were developed to ascertain what cocoa output and prices would have been had there been no domestic price stabilization. The models were then used to determine what total and average revenues from cocoa would have been under a non-stabilized policy scenario. The estimates

obtained were compared with what the actual revenue of the farmers were under the current price stabilization scheme. It was found that the farmers would not have had higher revenues with Model I but this is not the case with Model II. This would have been at the expense of much higher variability in their earnings when compared to the variability in earnings in the domestic price stabilization situations. The models also indicated that cocoa production would not have been any different had the farmers faced the world market price directly. On this basis, the study concluded that farmers income would have been slightly higher but more variable under a "free market"and that production would have not increased significantly.

Summary Of Conclusions On Hypotheses

The hypothesis that there will not be any differences in sales volume offered the cocoa boards' as a result of changing the announced cocoa producer prices to reflect the competitive world cocoa prices was not rejected at .05 probability level. This implies that changing the announced producer prices alone will not be effective in increasing production or will it be the appropriate policy instrument to ameliorate declining cocoa production. Other policies or devices must be undertaken if the cocoa board is to expect larger volume purchases from cocoa producers. Past government policies and programs apparently had negative effects on production. More consistent policies and programs would be needed to encourage production.

The impact of low inelasticities of demand on cocoa production will depend to a great extent on the following factors: (1) the importance of cocoa in the final products that cocoa is used to produce i.e. the ratio of cocoa to other commodities in the final products of cocoa; (2) The availability of substitutes in terms of other materials and other factors of production; and (3) the percentage of cost of the final output that is attributed to cocoa.

Hypothesis II is rejected at the .05 probability level. Hypotheses III and IV are not rejected at the .05 probability level, implying that producer's income and cocoa output increases would not have been realized even if the Nigerian cocoa producers had faced world cocoa prices directly. The results indicate that other pertinent factors have been responsible for the lack of cocoa production increases in Nigeria.

It was shown that the weather index had a significantly negative effect on production. The implications are that most of the variations in production are due to weather. Another factor which might affect cocoa production that could not be subjected to empirical testing was the severe lack of production alternatives or competitive commodities as avenues for market pressure. For instance, coffee which was used as an alternative commodity for cocoa in production had a significant coefficient but the cross price elasticity was low.

Attempts to increase production through price stabilization policies aimed at paying farmers higher prices to reflect world competitive market conditions may not be the right policy. Increase in output alone may not mean increased earnings potential for

Nigeria. In fact, to the contrary, increases in output may lead to price depressing strategies in the world market for cocoa. However, in the long run, if producers are allowed to face world competitive prices, equilibrium prices and quantities may vary considerably but on average slightly increase producers' revenue.

Limitations of the Study

The aggregate supply and demand models theoretically derived from the theory of the firm has inputs prices in the case of supply as factors influencing supply. The lack of appropriate cost data prevented an insight into the influence of changing production costs on the production. For demand, the form of estimation did not allow for estimating the marginal revenue. The use of the relative price ratios may be misleading since it is assumed that there is a linear relationship between Nigerian domestic prices and world prices. The use of lagged cocoa prices and lagged cocoa output as proxies for the acreage data and trend variables may have been one of the major limiting factors in the study. This is because the supply models estimated were indirectly varying forms of the adaptive and partial adjustment models. Under this situation it is difficult to make adequate assertions about the disturbance terms in the supply models. It is assumed in the study that cocoa had only one bearing peak with a geometric lag distribution structure. To the extent that this is not the case, the assumption would have affected the specifications of the supply response models presented in this study. Criticisms on the use of OLS rather than a simultaneous equation approach has also

been voiced by French and Mathews. However, OLS may provide biased but consistent estimators as discussed in Chapter IV.

Directions For Future Research

Ordinary Least Square (OLS) was used to empirically estimate both the aggregate supply and demand models independently. The results did not show serial correlation as supported by the result of the Durbin h test. Though the models on cocoa production and supply may be adequate for investigating Nigerian cocoa production, future research in this area should test the models using non-linear techniques. In the same direction, future research could be geared towards estimating the supply and demand models simultaneously. The results obtained might be different from the results of this study. The performance of the models of this study using alternative approaches such as rational expectations and adaptive expectations can be further investigated for comparisons. The assumption of one peak for cocoa production can also be varied in future work and the results compared with those obtained in the present study.

SELECTED BIBLIOGRAPHY

Adams, G. F. and K. A. Sonia. Stabilizing World Commodity Markets. Lexington, Massachusetts, Toronto, D. C. Heath and Company, 1978.

Adams, G. F. and J. R. Behrman. Econometric Modeling of World Commodity Policy, Lexington, Massachusetts, Toronto, D. C. Heath and Company, 1978.

Adamu, S. O. "On the Stabilization Policy of the Marketing Board in Nigeria." Nigerian Journal of Economic and Social Studies. (Volume XII No. 3, Nov. 1970) pp 323-340.

Adegboye, R. O. "Procurring Loans Through Pledging of Cocoa Trees." Journal of Geographical Association of Nigeria, (Vol. XII Nos 1 & 2 Dec. 1969).

Adigun, J. A. "Econometric Analysis of Groundnut Production in Nigeria: A Study Response and Policy Considerations" (Unpublished Ph. D. Dissertation, Oklahoma State University, July 1982.)

Akintomide, M. A. "A Comparative Analysis of Marketing Board Systems and Other Arrangements for Commodity Marketing." (Mimeo) paper presented at the International conference on the marketing board systems, Kadan, Nigeria, 1971.

Almon, S. "The Distributed Lag Between Capital Appropriations and Expenditures." Econometrica, Vol. 33 No9. 1, Jan. 1965.

Amoa, R. D. "A Study in Demand: An Analysis of the Cocoa Bean and Cocoa Products Markets of the United States." (Unpublished Ph. D. Dissertation, Massachusetts Institute of Technology, 1965.)

Askari, H. and J. T. Cummings. "Estimating Agricultural Supply Response with the Nerlove Model: A Survey." International Economics Rev., 18(1977), pp 257-291.

Bareau, P. Cocoa: A Crop With a Future. London, Cadbury Brothers Ltd. 1953.

Bateman, M. J. "Aggregate and Regional Supply Functions for Ghanaian Cocoa." Journal of Farm Economics, (Vol. 47, May, 1965) pp 384-401.

Bateman, M. J. "Cocoa in the Ghanaian Economy" (Unpublished Ph. D. Dissertation, Massachussets Institute of Technology, 1965.)

Bateman, M. J. "Supply Relations for Tree Crops in the Less Developed Areas." Paper presented at the Agricultural Development Council Conference on Supply and Market Relationships for peasant Agriculture in Minneapolis Feb. 1966, (Mimeo).

Bauer, P. T. and F. W. Paish. "The Reductions of Fluctations in Income of Primary Producer: Further." Economic Journal (Vol. 64 Dec. 1954), pp 704-729.

Behrman, J. R. "Cocoa: A Study of Demand Elasticities in the Five Leading Consuming Countries." Journal of Farm Economics, (Vol. 47, May 1965), pp 410-417.

Behrman, J. R. Supply Response in Underdeveloped Agriculture. Amsterdam, North-Holland, 1968.

Caine, S. "Instability of Producers Incomes: A Protest and a Proposal." Economic Journal (Vol. 64, No. 355, 1954)

Dean, R. E. "Economic Analysis and African Response to Price." Journal of Farm Economics Vol. No. 2, 1965.

Erb, G. F. Schiavo - Campo S. "Export Instability, Level of Development and Economic Size of Less Developed Countries." Bulletin of the Oxford University Institute of Economics and Statistics (Volume 31, No. 4, 1969).

Essang, S. M. "Institutional "Arrangements and Income Distribution in a Primary Export Economy." Bulletin of Rural Economic and Sociology (Vol. 6 No. 2, 1971).

Essang, S. M. "Impact of the Marketing Board on the Distribution of Cocoa Income in Western Nigeria." Journal of Geographical Association (Vol. 15, No. 1, June, 1972) pp 35-47

FAO. Commodity Report: Cocoa Situation, Rome: 1950

FAO. Cocoa Study Group: The Cocoa Situation, Rome: 1961

FAO. Agricultural Development in Nigeria, 1965-80, Rome 1965

Federal Government of Nigerian, Cooperative Decree No. 5 Suppliment to Official Gazette, No. 8 Vol. 61, Feb. 1974.

Fisher, F. M. "Dynamic Structure and Estimation in Economy Wide Econometric Models." Massachusetts Institute of Technology, (Mimeograph), 1963

French, B. C. and J. L. Mathews. "A Supply Response model for Perennial Crops." American Journal of Agricultural Economics (Vol. 43, Aug. 1971), pp 478-490.

Galleti, R. K., D. S. Baldwin and I. O. Dina. Nigerian Cocoa Farmers, London, Oxford University Press, 1956.

Gill and Duffus. Cocoa Statistics, London: 1965.

Grossack, I. M. "The Concept and Measurement of Permanent Industrial Concentration." Journal of Political Economy (Vol. 80, 1972), pp 745-760.

Grossack, I. M. "Towards an Integration of Satic and Dynamic Measures of Industry Concentration," Rev. of Econ. and Stat., (Vol. 67, Aug. 1965), pp. 301-308.

Hazell, P. and P. Scand. Zzo. "Market Intervention Policies When Production is Risky." American Journal of Agricultural Economics, (Vol. 57, 1975): pp. 641-649.

Heady, E. O. and M. Dillon. Agricultural Production Functions. Ames Iowa State University Press, 1961.

Hueth D. and A. Schmitz. "Internationala Trade in Intermediate and Final Goods; Some Welfare Implications of Destabilized Prices." Quarterly Journal of Economics, (Vol. 86, 1972) pp 351-365.

Helleiner, G. "The Fiscal Role of Marketing Boards." Economic Journal, (Sept., 1964) pp 582-610.

Helleiner, G. "Marketing Boards and Domestic Stabilization in Nigeria." Review of Economics and Statistics, (Feb. 1966). pp 69-78.

Helleiner, G. Peasant Agriculture, Governemnt and Economic Growth in Nigeria. Homewood, Illinois: Richard A. Irwin Inco., 1966.

Hoos, S. Agricultural Marketing Boards - An International Perspective. Cambridge, Massachusetts: Ballinger Publishing Co., 1979.

Huang, D. S. Regression and Econometric Methods. Huntington, N. Y.: Robert E. Kreger Publishing Co., 1980.

Idachaba, F. S. "Marketing Board Taxation of Nigerian Agriculture: Some Implications." (Unpublished PH. D. Dissertation, Michigan State University, East Lansing, 1972.)

Kenen, V. "Export Instability and Econometric Growth." Kyklos (Vol. 25, 1972) pp 791-802.

Leith, J. C. "Export Concentration and Instability." Economic Bulletin of Ghana, 1971.

Lim, D. "Export Instability and Economic Development: The Example of West Malaysia." Oxford Economic Papers, March 1974, pp 79-91.

Liviatan, N. "Consistent Estimation of Distributed Lags." International Economic Review. (Vol. 4, Jan. 1963).

Massel, B. F. "Price Stabilization and Welfare." Quarterly Journal of Economics, (Vol. 83, 1969), pp 284-298.

MacBean, A. L. "Problems of Stabilization Policy in Underdeveloped Countries." Oxford Economic Papers, (New Series, Vol. 14).

MacBean, A. L. Export Instability and Economic Developement. George Allen and Unwin, London: 1966.

Montgomery, E. G. A. M. Taylor. "World Trade in Cocoa," United States Department of Commerce, Foodstuffs Division, Industrial Series No. 71, 1947.

Nerlove, M. "Adaptive Expectations and Cobweb Phenomena." Quarterly Journal of Economics, (Vol. 73, May, 1958) pp. 227-240.

Mlay, G. L. "Economic Analysis of Acreage Supply under risk: The Case of Selected Crops in Oklahoma." (Unpublished Ph. D. Dissertation, Oklahoma State University, Dec. 1981).

Nurkse, R. "The Quest for Stabilization Policy in Primary Producing Countries." Kyklos, 1958.

Oi, W. Y. "The Desirability of Price Instability Under Perfect Competition." Econometrica,(Vol. 29, 1961) pp. 58-64.

Oi, W. Y. The Consumer Does Benefit From Feasible Staility Comment." Quarterly Journal of Economics, (Vol. 86, 1972), pp. 494-498.

Oni, S. A. "The Semand for Nigerian Cocoa: A Statistical Analysis of Regional Markets and Projections." Journal of Economics and Social Issues, March, 1970, pp. 61-77.

Oni, S. A. "An Econometric Analysis of the Provincial and Aggregate Supply Response Among Western Nigerian Cocoa Farmers." (Unpublished Ph. D. Thesis, University of Ibadan, June, 1971).

Pashigan, B. P. "Rational Expectations and the Cobwebs Theory." Journal of Political Economy, (Vol. 78, April 1970), pp 338-352.

Philip, A. "Structure, Conduct and Performance---and Performance Conduct and Structure?" In J. W. M:arkham and G. F. Papanek (eds.), Industrial Organization and Economic Development, 1970, pp. 26-37.

Pindyck and Rubinfeld. Econometrics Models and Econometric Forecasts New York: McGraw-Hill Book Co., pp 76; 94-1977-1981.

Qury, B. "Allowing for Weather in Crop Production Model Building." Journal of Farm Economics, (Vol. 447, 1965), pp. 270-283.

Sara, S. B. "Cocoa and Economic Development in Western Nigeria." (Unpublished Ph. D. Dissertation, University of Michigan, 1967).

Samuelson, P. A. The Consumer Does Benefit from Feasible Price Stability." Quarterly Journal of Economics, (Vol. 86, 1972), pp. 476-493.

Schultz, T. W. Transforming Traditional Agriculture. New Haven, Yale University Press, 1966, p. 4.

Tisdel, C. "Uncertainty, Instability, Expected Profit." Econometrica (Vol. 31, 1963): pp.243-247.

Turnovsky, S. J. "Price Expectations and Welfare Gains from Price Stabilization." American Journal of Agricultural Economics (Vol. 56, 1974c), pp. 706-716.

Turnovsky, S. J. "The Distribution of Welfare Gains from Price Stabilization: The Case of Multiplicative Disturbances." International Economic Review, (Vol. 17, 1976a), pp. 133-144.

Turnovsky, S. J. "Stabilization Rules and Benefits from Price Stabilization." Australian National University Working Paper. 1976b.

United Nations. Monthly Bulletin of Statistics, 1950-1978.

United Nations. "UNCTAD: Proceedings of the United Nations Conference on Trade and Development." Commodity Trade New York (Vol. 3, 1964).

United States Government. Economic Report of the President, Washington D. C. G. P. O., 1962.

Vernon, J. M. and D. A. Graham. "Profitability of Monopolization by Vertical Intergration." Journal of Political Economy, Vol. 79, No. 4 (July/August 1971), pp. 924-925.

Viton, A. "Cocoa: Review of Current Trends in Production, Price and Consumption." FAO Series Bulletin, No. 27, 1965.

Viton, A. "The Prospect and Promise of Cocoa," Study Group on Cocoa, 27th Session, Committee on Commodity Problems FAD, 1970, Rome.

Wall Street Journal, Vol. LXXI No. 60, March 30, 1978.

Waugh, F. V. "Does the Consumer Benefit from Price Instability?" Quarterly Journal of Economics, (Vol. 58, 194), pp. 602-614.

Wicker, V. D. Coffee, Tea and Cocoa: An Economic and Political Analysis. Stanford Food Research Institute, Stanford University Press, 1951.

Williamson, O. "Predatory Pricing: A Strategic and Welfare Analysis." Yale Law Journal, Vol. 87, 1978.

Zucker, A. "On the Desirability of Price Instability." Econometrica. (Vol. 32, 1965), pp. 437-441.

APPENDIXES

APPENDIX A

VARIABLE DEFINITIONS

NQ_t = Aggregate Nigerian production/supply in thousand metric tons.

CP_{t-8} = Deflated domestic cocoa producer prices in lagged eight years in dollars/tons.

NCP_{t-8} = Deflated domestic coffee prices lagged eight years in dollars/tons.

CNP_{t-12} = Deflated world coffee prices (weighted) lagged twelve years in dollars/tons.

PC_{t-8} = Deflated world coffee prices (weighted) lagged eight years in dollars/tons.

D_2 = Policy variable, effect of abolishing export taxes on cocoa = 1, if 1974 or greater and zero otherwise.

D_4 = Policy variable, impact of increasing prices on income. Measured by taking the difference between world and producer prices allowing dummy on the declining difference between years = 1 and zero otherwise.

D_5 = Policy variable = 1, if civilian goverment (1937 to 1965 and 1978-1980), zero otherwise.

I = Index of weather.

NQ_{t-1} = One year lag on cocoa production/output.

$RATCP_{t-8}$ = Deflated relative cocoa price ratio of the domestic stabilized prices and deflated weighted cocoa prices all lagged eight years in dollars/tons.

$RATCP_{t-12}$ = Deflated relative cocoa price ratio of domestic and stabilized prices and deflated weighted cocoa prices all lagged eight years in dollars/ton.

$RATCP_{t-8}$ = Deflated relative coffee price ratio of domestic prices and deflated world coffee prices lagged eight years in dollars/ton.

APPENDIX B

DATA FOR CHAPTER III

TABLE XI

WORLD COCOA PRODUCTION SHARES, 1939-1980

	Countries													
Year	WSE	NASE+	GASE+	CASE+	OTSE	IVSE+	SPSE	COSE	DNSE	TTSE	VASE	ECSE	ECSE+	AOSE
1939	.18	.15	.38	.03	.07	.073	.01	*	.03	.01	.02	.02	*	.005
1940	.18	.15	.38	.04	.07	.07	.01	*	.04	.02	.02	.02	*	.010
1941	.21	.17	.35	.03	.06	.06	.007	*	.03	.01	.02	.02	*	.010
1942	.18	.15	.31	.04	.09	.07	.01	*	.05	.01	.03	.04	*	.010
1943	.21	.17	.35	.06	.07	.02	.009	*	.05	.008	.03	.03	*	.010
1944	.20	.14	.37	.07	.06	.03	.02	*	.05	.007	.03	.02	*	.003
1945	.15	.14	.40	.07	.05	.05	.015	*	.04	.005	.02	03	*	.003
1946	.20	.15	.37	.04	.05	.05	.014	*	.04	.004	.02	.02	*	.002
1947	.23	.17	.29	.05	.05	.06	.014	.02	.04	.005	.03	.02	.02	.010
1948	.16	.12	.34	.06	.03	.06	.009	.02	.05	.01	.04	.03	.03	.01
1949	.17	.15	.37	.07	.05	.06	.01	.02	.05	.010	.02	.03	.02	.010
1950	.20	.13	.33	.06	.04	.07	.01	.02	.03	:01	.02	.03	.02	.01
1951	.17	.14	.34	.06	.04	.08	.01	.02	.05	.01	.02	.04	.02	.01
1952	.15	.16	.32	.06	.04	.07	.01	.02	.03	.01	.03	.03	.02	.01
1953	.13	.14	.33	.08	.04	.08	.01	.02	.04	.01	.02	.03	.02	.01
1954	.17	.13	.29	.07	.06	.07	.01	.02	.05	.01	.02	.04	.02	.01
1955	.20	.12	.28	.08	.07	.08	.01	.01	.04	.01	.02	.03	.02	.01

TABLE XI (Continued)

	Countries													
Year	BRSE	NASE	GASE	CASE	OTSE	IVSE	SPSE	COSE	INSE	TTSE	VASE	EGSE	EGSE	OASE
1956	.19	.12	.28	.07	.06	.08	.01	02	.04	.01	.02	.03	.03	.01
1957	.18	.13	.29	.07	.06	.09	.01	.01	.03	.01	.02	.03	.03	.01
1958	.22	.10	.27	.08	.07	.06	.01	.01	.04	.01	.02	.04	.03	.02
1959	.19	.16	.29	.07	.07	.06	.01	.01	.03	.01	.01	.04	.02	.02
1960	.18	.15	.32	.06	.06	.06	.01	.01	.04	.01	.01	.04	.03	.02
1961	.10	.17	.38	.06	.06	.08	.01	.01	.03	.01	.01	.04	.02	.02
1962	.10	.17	.37	.07	.07	.07	.01	.01	.03	.01	.01	.04	.02	.02
1963	.10	.15	.37	.07	.09	.07	.01	.01	.03	.01	.01	.04	.03	.02
1964	.10	.18	.36	.07	.06	.08	.01	.01	.03	.004	.02	.03	.03	.02
1965	.08	.20	.38	.06	.05	.10	.01	.01	.02	.003	.01	.03	.02	.02
1966	.14	.15	.34	.06	.06	.09	.01	.01	.02	.004	.02	.03	.03	.02
1967	.13	.20	.29	.06	.06	.11	.01	.01	.02	.003	.02	.04	.03	.02
1968	.11	.18	.31	.07	.06	.11	.01	.01	.02	.004	.02	.05	.03	.02
1969	.13	.15	.27	.08	.06	.12	.01	.02	.02	.003	.02	.04	.03	.03
1970	.14	.16	.29	.08	.06	.13	.01	.01	.03	.004	.01	.04	.02	.03
1971	.12	.22	.26	.07	.07	.12	.01	.01	.02	.003	.01	.04	.02	.03
1972	.11	.16	.29	.08	.07	.14	.01	.01	.03	.003	.01	.04	.01	.03
1973	.12	.17	.30	.08	.08	.19	.01	.02	.02	.004	.01	.03	.01	.03

TABLE XI (Continued)

	Countries													
Year	BRSE	NASE	GASE	CASE	OTSE	IVSE	SPSE	COSE	DRSE	TTSE	VASE	ECSE	EGSE	AOSE
1974	.16	.15	.24	.08	.07	.14	.01	.02	.02	.002	.01	.05	.01	.04
1975	.18	.14	.24	.08	.06	.16	.004	.01	.02	.003	.01	.05	.01	.04
1976	.17	.14	.26	.06	.06	.15	.01	.02	.02	.002	.01	.04	.01	.04
1977	.17	.12	.23	.06	.07	.17	.004	.02	.02	.003	.01	.05	.01	.04
1978	.19	.13	.18	.07	.07	.20	.004	.01	.02	.003	.01	.05	.004	.04
1979	.20	.10	.16	.09	.06	.22	.003	.01	.02	.004	.01	.04	.01	.03
1980	.21	.10	.16	.09	.06	.22	.003	.01	.02	.004	.01	.04	.01	.04

*Observations not available

+African countries which produce cocoa

EXPLANATION OF ABBREVIATIONS

BRSE = Brazilian cocoa production shares.

NASE = Nigerian cocoa production shares.

GASE = Ghanaian cocoa production shares.

CASE = Camerounian cocoa production shares.

OTSE = Other small producing countries' production shares.

IVSE = Ivory Coast cocoa production shares.

SPSE = Sao-Tomian cocoa production shares.

COSE = Columbian cocoa production shares.

DRSE = Dominican Republic cocoa production shares.

TTSE = Trinidad and Tobago cocoa production shares.

VASE = Venezuelan cocoa production shares.

ECSE = Ecuadorian cocoa production shares.

EGSE = Equatorial Guinean cocoa production shares.

AOSE = Asia and Oceanian cocoa production shares.

APPENDIX C

PRODUCTION/SUPPLY AND DEMAND

FOR CHAPTERS IV AND V

TABLE XII

COCOA PRODUCTION (THOUSAND METRIC TONS) AND PRODUCER PRICES (N/TON) OF SELECTED EXPORT CROPS, NIGERIA, 1937

YEAR	COCOA PRODUCTION	COCOA PRICES*	COFFEE PRICES*	PALM KERNEL PRICES*	RUBBER PRICES*	CONSUMER PRICE INDEX CPI*
1937	103.216	70.9	158.9	9.2	41.0	7.58
1938	97.104	32.4	95.2	5.5	49.0	7.46
1939	113.841	31.2	74.9	5.2	43.0	7.85
1940	89.737	35.3	86.0	5.1	45.0	8.19
1941	104.81	38.2	114.0	4.6	91.0	8.40
1942	59.937	34.8	134.0	4.7	119.0	8.51
1943	87.487	35.3	130.0	5.7	100.0	9.02
1944	70.051	27.2	127.0	7.8	108.0	9.24
1945	77.004	55.8	187.0	8.7	114.0	8.79
1946	100.186	75.5	302.0	9.2	116.0	9.96
1947	110.793	81.4	270.0	10.7	123.0	10.02
1948	91.449	77.0	307.0	21.0	90.0	10.35
1949	103.637	120.0	400.0	26.0	86.0	9.99
1950	99.949	100.0	650.0	26.0	208.0	13.86
1951	121.478	120.0	650.0	32.0	359.0	12.48
1952	114.731	170.0	660.0	36.0	226.0	11.08
1953	104.671	170.0	720.0	34.0	155.0	26.26
1954	98.373	170.0	800.0	34.0	139.0	27.40
1955	88.413	200.0	800.0	31.0	184.0	28.80

TABLE XII (Continued)

YEAR	COCOA PRODUCTION	COCOA PRICES*	COFFEE PRICES*	PALM KERNEL PRICES*	RUBBER PRICES*	CONSUMER PRICE INDEX CPI*
1956	117.133	200.0	740.0	31.0	169.0	31.0
1957	135.300	150.0	740.0	31.0	176.0	1.60
1958	87.648	150.0	650.0	30.0	185.0	31.90
1959	142.800	150.0	500.0	30.0	277.0	33.1
1960	154.176	160.0	510.0	30.0	249.0	35.0
1961	183.912	112.0	344.0	31.0	200.0	37.3
1962	194.652	100.0	418.0	26.0	190.0	39.0
1963	175.000	105.0	371.0	26.0	187.0	38.2
1964	197.000	110.0	446.0	28.0	169.0	38.5
1965	165.000	120.0	440.0	28.0	162.0	40.1
1966	263.000	165.0	474.0	28.0	172.0	44.0
1967	234.000	179.0	390.0	28.0	168.0	42.3
1968	186.000	189.0	434.5	28.0	121.0	42.1
1969	224.000	288.0	453.5	57.0	172.0	46.4
1970	302.390	297.0	453.5	59.0	151.0	52.8
1971	253.722	297.0	468.5	59.0	243.0	61.3
1972	240.804	297.0	521.0	59.0	179.0	62.9
1973	214.985	419.0	497.5	130.0	396.0	66.5
1974	205.000	660.0	543.5	150.0	636.0	74.8
1975	225.000	660.0	655.0	150.0	276.0	100.0
1976	120.865	660.0	655.0	150.0	348.0	123.9

TABLE XII (Continued)

YEAR	COCOA PRODUCTION	COCOA PRICES*	COFFEE PRICES*	PALM KERNEL PRICES*	RUBBER PRICES*	CONSUMER PRICE INDEX CPI*
1977	187.848	1030.0	574.0	150.0	367.0	143.2
1978	185.123	1030.0	585.0	150.0	404.7	165.2
1979	144.00	1200.0	602.6	150.0	406.4	186.3
1980	114.000	1300.0	593.9	150.0	360.5	204.8

* Net Producer Prices.

** 1975 = 100.

Sources: Federal Office of Statistics, Lagos, Nigeria, "Index of Economic Indicators" (up to 1977): Federal Office of Statistics, Lagos, Nigeria, "Digest of Statistics" (up to 1977): Central Bank of Nigeria, "The Annual Reports and Economic Indices" (up to 1981). G.K. Helleneiner, "Peasant Agriculture, Government and Economic Growth in Nigeria", pp. 429-590; United Nations Economic Commission for Africa, "Survey of Economic Conditions in Africa", (1979, p. 127); Food and Agricultural Organization, Production and Trade Summary (up to 1980); Federal Republic of Nigeria, Office of Meterological Service, Lagos; Nigeria, 1979, Food and Agricultural Organization of the United Nations Commodity Year Book (up to 1980); Olajuwon Olayide, "Some Estimates of Supply Elasticities for Nigerian Cash Crops", (1968, p. 265); Nigerian Palm Produce Board, "Annual Report and Statement of Accounts. (up to 1979).

TABLE XIII

AVERAGE ANNUAL COCOA GRINDINGS IN THE UNITED STATES OF AMERICA, EUROPEAN AND JAPAN IN THOUSAND METRIC TONS, 1937 THROUGH 1980.

Year	US	EC	JAPAN+
1937	232.000	250.000	-
1938	214.400	258.00	-
1939	281.450	240.000	-
1940	308.000	-	-
1941	298.000	-	-
1942	102.000	-	-
1943	259.000	-	-
1944	304.000	-	-
1945	281.000	-	-
1946	268.000	201.000	-
1947	267.000	205.000	-
1948	248.000	260.000	-
1949	270.000	272.000	-
1950	280.000	337.000	-
1951	260.000	306.000	-
1952	250.000	337.000	2.000
1953	234.80	342.000	2.000
1954	194.000	327.000	4.000
1955	188.000	312.000	3.000
1956	223.000	348.000	4.000

TABLE XIII continued

Year	US	EC	JAPAN+
1957	232.000	398.000	6.000
1958	206.000	349.000	6.000
1959	202.000	341.000	7.000
1960	215.000	375.000	9.000
1961	241.000	412.000	15.000
1962	251.000	459.000	23.000
1963	261.000	460.000	29.000
1964	262.000	461.000	29.000
1965	281.000	513.000	29.000
1966	289.000	511.000	32.000
1967	289.000	482.000	32.000
1968	286.000	468.000	32.000
1969	264.000	442.000	33.000
1970	266.000	439.000	35.000
1971	299.000	453.000	36.000
1972	289.000	485.000	36.000
1973	278.000	508.000	38.000
1974	230.000	454.000	30.000
1975	208.000	423.000	29.000

TABLE XIII continued

Year	US	EC	JAPAN+
1976	225.000	485.000	32.000
1977	184.000	465.000	26.000
1978	183.000	465.000	22.000
1979	160.000	459.000	28.000
1980	135.000	438.000	27.000

- Data Unavailable

+Estimates Prior to 1952 Used in the analysis is based on EC and U.S. for the years a weight of 100 was assigned U.S.

Source: Gill and Diffus. Cocoa Statistics, (up to 1977) FAO, Trade Year Book; FAO Production Yearbook; United Nations Commodity Yearbook; (up to 19890). Basic Statistics of the European Communities, (up to 1979). Aja Okorie and David Balndford, "World Market Trends and Prospects for Cocoa", pp. 52.-59.

TABLE XIV

WORLD PRICES OF SELECTED COMMODITIES IN NEW YORK, LONDON AND TOKYO MARKETS, 1937 THROUGH 1980

	NEW YORK		LONDON		LONDON & GERMANY	TOKYO*	
Year	CP($/100 Kg)	PC($/100 Kg)	PS($/100 Kg)	CP(DM/100 Kg)	PS(DM/Kg)	CP(Yen/Kg)	PS(Yen/Kg)
1937	5.42	15.9	10.0	201.0	80.5	--	--
1938	5.14	11.2	8.7	194.0	89.6	--	--
1939	6.01	10.7	7.1	180.0	74.6	--	--
1940	4.43	10.3	7.7	190.0	56.3	--	--
1941	7.83	16.3	7.7	140.0	56.4	--	--
1942	8.70	16.3	7.7	140.0	56.0	--	--
1943	8.70	16.3	7.7	140.0	56.0	--	--
1944	8.70	16.3	7.7	140.0	56.0	--	--
1945	8.70	16.3	8.50	140.0	56.0	--	--
1946	8.70	19.5	14.70	197.0	91.0	--	--
1947	30.9	26.8	14.90	250.0	89.0	--	--
1948	112.4	37.8	16.80	268.0	100.0	--	--

TABLE XIV (Continued)

	NEW YORK		LONDON	LONDON & GERMANY		TOKYO*	
Year	CP($/100 Kg)	PC($/100 Kg)	PS($/100 Kg)	CP(DM/100 Kg)	PS(DM/Kg)	CP(Yen/Kg)	PS(Yen/Kg)
1949	89.1	37.9	7.2	270.0	105.0	--	--
1950	57.1	38.4	17.2	291.0	110.0	--	--
1951	76.1	45.5	18.1	269.0	110.9	--	--
1952	70.5	72.9	18.6	349.0	112.5	302.0	49.0
1953	70.1	77.7	18.9	332.0	112.5	257.0	40.0
1954	103.2	77.4	18.9	540.0	112.5	402.0	38.0
1955	118.4	83.7	18.6	350.0	112.5	349.0	39.0
1956	71.4	112.1	19.0	256.0	96.0	237.0	38.0
1957	58.6	81.6	19.8	286.0	98.0	228.0	50.0
1958	57.1	83.4	19.0	405.0	101.0	358.0	36.0
1959	73.3	82.0	19.0	327.0	101.0	306.0	31.0
1960	82.5	70.0	19.2	259.1	101.0	238.0	30.
1961	84.4	53.8	19.2	198.0	101.0	186.0	26.0

TABLE XIV (Continued)

	NEW YORK		LONDON		LONDON & GERMANY	TOKYO*	
Year	CP($/100 Kg)	PC($/100 Kg)	PS($/100 Kg)	CP(DM/100 Kg)	PS(DM/Kg)	CP(Yen/Kg)	PS(Yen/Kg)
1962	56.2	52.8	19.7	187.0	101.0	177.0	26.0
1963	47.4	49.1	24.5	227.0	101.0	201.0	56.0
1964	46.1	49.2	22.1	208.0	99.0	188.0	57.0
1965	60.8	49.5	21.0	160.0	97.0	145.0	32.0
1966	51.6	68.6	21.2	215.0	101.0	176.0	26.0
1967	37.7	64.6	21.9	262.0	99.0	214.0	24.0
1968	54.9	59.3	34.3	306.0	95.0	236.0	25.0
1969	60.7	55.7	23.6	367.0	92.0	343.0	32.0
1970	109.8	55.3	34.8	268.0	92.0	368.0	39.0
1971	72.5	54.9	25.9	197.0	94.0	214.0	45.0
1972	51.6	55.4	27.2	214.0	97.0	192.0	49.0
1973	84.9	70.7	29.4	352.0	97.0	293.0	500

TABLE XIV (Continued)

	NEW YORK		LONDON		LONDON & GERMANY	TOKYO*	
Year	CP($/100 Kg)	PC($/100 Kg)	PS($/100 Kg)	CP(DM/100 Kg)	PS(DM/Kg)	CP(Yen/Kg)	PS(Yen/Kg)
1974	177.5	62.6	70.7	558.0	115.0	504.0	123
1975	263.0	77.6	68.7	368.0	125.0	517.0	201
1976	151.0	92.0	41.9	379.0	125.0	520.0	260
1977	356.0	71.0	73.3	388.0	127.0	516.0	261
1978	564.0	75.2	45.0	580.0	126.0	521.0	170
1979	403.4	74.9	50.3	530.0	128.0	517.0	166
1980	366.1	70.0	54.6	521.0	130.0	525.0	169

CP = Cocoa Prices

PC = Coffee Prices

KPS = Sugar Prices

* Estimates of Japan are CIF unit values

Source: Aja Okorie and David Blandford, "World Market Trends and Prospects for Cocoa", (pp 52.069); United Nations Commodity Year Book (up to 1980). Gill and Duffus Cocoa Statistics (up to 1977). FAO "Cocoa Statistics", FAO Trade Year Book, (up to 1979).

TABLE XV

INDICES OF WEATHER AND INCOME (1937 THROUGH 1980)

	Weather (Nigeria)		Income		
Year	Rainfall*	Temperature*	US*	EC*	JAPAN*
1937	86.5	94.7	40	43	14
1938	105.7	113.6	42	41	15
1939	98.4	112.8	43	43	16
1940	106.7	108.7	*	*	*
1941	106.9	105.3	*	*	*
1942	121.7	102.6	*	*	*
1943	109.1	109.1	*	*	*
1944	115.8	109.8	*	*	*
1945	115.3	114.3	*	*	*
1946	111.1	114.0	57	33	10
1947	122.6	113.6	55	39	10
1948	117.2	114.7	58	39	13
1949	93.7	111.7	55	40.7	17
1950	96.5	107.2	60	41.5	18
1951	98.0	114.7	62	43.2	20
1952	113.0	107.9	64	43.6	20
1953	107.4	107.2	67	46.8	21
1954	114.7	110.6	63	48.3	24
1955	112.6	103.9	67	52.0	25
1956	106.9	112.1	68	52.8	26

TABLE XV continued

	Weather (Nigeria)		Income		
Year	Rainfall*	Temperature*	US*	EC*	JAPAN*
1957	124.2	101.0	68	54.6	27
1958	114.4	110.9	66	54.3	31
1959	99.2	113.6	69	57.3	36
1960	115.3	113.6	69	60.7	40
1961	85.0	104.8	70	63.0	43
1962	105.7	104.2	73	65.3	44
1963	120.1	105.2	75	67.3	49
1964	98.2	107.2	78	70.5	50
1965	93.2	106.4	82	72.8	55
1966	100.9	109.8	86	74.7	62
1967	100.0	100.0	88	77.0	70
1968	104.2	107.5	92	81.0	76
1969	94.4	99.6	94	84.8	84
1970	101.0	114.7	93	88.8	89
1971	116.3	105.3	95	91.2	94
1972	112.1	108.3	99	94.7	102
1973	110.5	106.0	104	83.7	101
1974	104.5	106.8	102	101.7	100
1975	100.7	106.0	100	100.0	100
1976	107.2	106.0	105	105.0	110
1977	100.7	1098.3	110	106.8	116

TABLE XV continued

	Weather (Nigeria)		Income		
Year	Rainfall*	Temperature*	US*	EC*	JAPAN*
1978	118.8	113.6	114	110.0	116
1979	106.1	113.6	114.1	110.8	118
1980	103.4	111.7	114.8	110.9	119

Source: Weather Indices- Computed from data obtianed from the Federal Republic of Nigeria, Office of Metrological Service, Lagos: Nigerian 1980. Some estimates were obtained also through personal contacts with friends working at the Metreological Service Stations at Ikom. Index of Income: obtained from the United Nations Statistical Year Book, (up to 1980). Estimates before the birth of EC as a bloc were computed based on the initial six members that formed the pack. However, as new states became members their estimates were added and aggregated as well.

*Years in which data could not be obtained, random low values are selected based on some initial estimates.

TABLE XVI

AVERAGE ANNUAL EXCHANGE RATES OF SELECTED CURRENCIES
(1937 Through 1980)

Year	$/Naira	Dm/$	Yen/$
1937	2.80	2.5	3.470
1938	2.80	2.5	3.509
1939	2.80	2.5	3.848
1940	2.80	2.5	4.267
1941	2.80	2.5	4.267
1942	2.79	2.5	4.267
1943	2.79	2.5	4.267
1944	2.81	2.5	4.267
1945	2.70	2.5	4.267
1946	2.70	2.5	4.267
1947	2.70	2.5	4.267
1948	2.38	3.3	4.267
1949	2.40	4.2	4.267
1950	2.30	4.2	360.0
1951	2.55	4.2	360.0
1952	2.35	4.2	360.0
1953	2.30	4.2	360.0
1954	2.30	4.2	360.0
1955	2.02	4.2	360.0
1956	1.7	4.2	360.0
1957	2.8	4.2	360.0

TABLE XVI continued

Year	$/Naira	Dm/$	Yen/$
1958	2.8	4.2	360.0
1959	2.8	4.20	358.3
1960	2.8	4.17	361.8
1961	2.8	3.99	358.2
1962	2.8	3.98	362.0
1963	2.8	3.75	358.3
1963	2.8	3.975	358.3
1964	2.8	3.977	362.0
1965	2.8	3.90	362.5
1966	2.8	3.98	362.5
1967	2.8	3.00	361.0
1968	2.8	4.00	357.7
1969	2.8	3.70	357.8
1970	2.8	3.60	357.6
1971	3.04	3.30	314.8
1972	3.04	3.20	302.2
1973	1.52	3.26	337.8
1974	1.62	2.295	368.5
1975	1.59	3.07	357.2
1976	1.58	2.74	340.2
1977	1.53	2.56	291.5
1978	1.34	2.38	253.5

TABLE XVI continued

Year	$/Naira	Dm/$	Yen/$
1979	1.78	2.28	315.8
1980	1.44	2.49	258.9

Source: Basic statistics of the European communities (up to 1979); International financial statistics. "Year Book" (up to 1981).

*Note prior to 1957, United Kingdom had fixed exchange rate system. Apparently, the world in general operated a fixed exchange rate system since most of the countries show constant annual exchange rates.

APPENDIX D

PREDICTED OUTPUT AND REVENUE FROM MODELS I AND II

TABLE XVII

PREDICTED NIGERIAN COCOA OUTPUT, PRICES AND REVENUE UNDER MODEL I

Year	Output (000) Metric Tons	Prices (dollars/ton)	Total Revenue
1944	156.324	103.99	162561.1
1945	152.023	151.81	23078.6
1946	149,419	191.88	28670.5
1947	156.242	104.74	16364.8
1948	147.233	234.22	34486.1
1949	145.766	268.41	39125.1
1950	145.940	264.10	38542.8
1951	143.144	343.31	49142.8
1952	153.263	135.97	20839.2
1953	151.900	153.48	23313.6
1954	147.200	235.04	34597.9
1955	137.600	586.54	80707.9
1956	138.400	542.20	75040.5
1957	150.600	172.46	25972.5
1958	140.100	459.48	64373.1
1959	143.000	348.03	49768.3
1960	159.266	80.76	12862.3
1961	152.903	140.38	21464.3
1962	150.380	175.91	26453.3
1963	155.879	108.09	16849.0
1964	152.310	147.98	22538.8

TABLE XVII (Continued)

Year	Output (000) Metric Tons	Prices (dollars/ton)	Total Revenue
1965	151.512	158.90	24075.3
1966	144.432	304.05	43914.5
1967	150.943	167.22	25240.7
1968	147.373	231.33	34091.8
1969	154.916	117.57	18213.5
1970	150.328	176.73	26567.5
1971	154.053	126.82	19537.0
1972	147.975	218.89	32390.2
1973	150.620	172.15	25929.2
1974	149.317	193.67	28918.2
1975	143.923	318.95	45904.2
1976	152.948	139.82	21385.2
1977	143.307	338.06	48336.4
1978	139.133	504.73	70224.46
1979	149.722	186.69	27951.6
1980	148.722	720.70	30302.8

TABLE XVIII

PREDICTED NIGERIAN COCOA OUTPUT, PRICES AND REVENUE UNDER MODEL II

Year	Output (000) Metric Tons	Prices (dollars/ton)	Total Revenue
1944	156.324	103.99	16256
1945	152.023	151.81	23079
1946	149.419	191.74	28650
1947	156.242	104.74	16365
1948	147.238	234.22	34486
1949	145.766	268.41	39125
1950	145.940	264.10	38543
1951	143.244	343.31	49177
1952	162.679	60.58	9855
1953	177.767	18.20	3235
1954	175.993	20.85	3669
1955	187.700	8.70	1633
1956	157.258	95.92	15084
1957	192.255	6.29	1209
1958	166.488	44.26	7369
1959	167.049	42.29	7065
1960	171.257	30.18	5169
1961	135.815	700.13	95088
1962	135.310	736.43	99646
1963	135.150	743.36	100465
1964	144.653	297.81	43079

TABLE XVIII (Continued)

Year	Output (000) Metric Tons	Prices (dollars/ton)	Total Revenue
1965	134.806	774.64	104427
1966	137.139	614.65	84332
1967	137.363	600.40	82473
1968	212.099	1.66	352
1969	200.434	3.58	718
1970	152.581	144.45	22040
1971	218.901	1.08	236
1972	176.923	19.41	3434
1973	218.399	1.12	245
1974	185.015	10.59	1959
1975	169.770	33.97	5767
1976	134.868	769.81	103823
1977	134.273	817.38	109752
1978	141.423	404.50	57206
1979	134.206	822.97	110448
1980	135.002	759.52	102537

APPENDIX E

EXPORTS OF MAJOR AGRICULTURAL COMMODITIES FROM NIGERIA, 1948-1976 (1,000 TONS)

TABLE XIX

EXPORTS OF MAJOR AGRICULTURAL COMMODITIES FROM NIGERIA
1948-1976 (1,000 TONS)

	Cocoa		Palm Kernels		Groundnuts		Rubber	
Year	Q	%	Q	%	Q	%	Q	%
1968								
1969	Civil War--No Figures Recorded for 1968-70							
1970								
1971	271,000	-	272	-	114,000	-	5,100	-
1972	228,000	-(15.9)	212	-22.1	104,000	- 8.8	41,000	-19.6
1973	211,000	- (7.0)	137	-35.1	129,000	.24	49,000	19.5
1974	180,000	-(14.9)	186	35.8	30,000	-76.7	61,000	24.5
1975	192,000	6.7	172	-7.5	-	-	61,000	-
1976	228,000	18.8	272	58.1	16,000	-94.7	44,000	-27.9

Source: S. O. Olayide and D. Olatunbogun, Trends and Prospects of Nigeria's Agricultural Exports, Niser, 1972, pp. 16-38; FD, The Crop Subsector In The Fourth National Development plan 1981-1985, January 1981.

- (Implies negative change from previous year)

VITA 2

Sylvanus Obi Abang

Candidate for the Degree of

Doctor of Philosophy

Thesis: STABILIZATION POLICY: AN ECONOMIC ANALYSIS AND EVALUATION OF ITS IMPLICATIONS FOR NIGERIAN COCOA PRODUCERS

Major Field: Agricultural Economics

Bibliographical:

Personal data: Born in Bendehge-Ekiem, in Ikom division of the Cross River State of Nigeria, September 5, 1953, the son of Mr. and Mrs. T. O. Abang.

Education: Graduated from Mary Knoll Secondary School, Okuku-Ogoja, Nigeria in 1971; Mary Knoll Higher School Okuku-Ogoja, Nigeria (Advanced-level), 1973; received the Bachelor of Arts Degree in Economics at Central State University, Edmond, Oklahoma in May, 1978; Master of Science Degree in Agricultural Economics from Oklahoma State University in December, 1980; completed requirements for the Doctor of Philosophy Degree at Oklahoma State University in May, 1984.

Professional Experience: Teaching, St. Patricks College Ikot-Ansa, Calabar, Cross River State, Nigeria (1973 to 1974) and Comprehensive Secondary School, Obudu, Cross River State, Nigeria (1974 to 1975); Teaching Practicum, Oklahoma State University, Fall, 1982.

Professional Organizations: Member of American Agricultural Economics Association, Southern Agricultural Economics Association, Western Agricultural Economics Association, and Oklahoma Agricultural Economics Association.

Other Organizations and Positions Held: African Student Organization, Oklahoma State University; President 1981/1982, Public Relations Officer, 1979/80; Nigerian Student Union, Oklahoma State University, Vice-President, 1979/80, General Secretary, 1978/79; Nigerian Student Organization, Central State University, Edmond, General Publicity Secretary, 1977/78.

Honors: Central State University, Department of Economics, Best Minority Scholarship award winner, 1977/78: Central State University honors student, 1975 to 1978; Nigerian Student Organization, Central State University, most active Council Member: most active president, African Student Organization, Oklahoma State University, 1981/82; most active Vice-President, Nigerian Student Union, Oklahoma State University, 1979/80; International Student of the year, Oklahoma State University, 1982.