WPS 1129

How Policy Changes Affected Cocoa Sectors in Sub-Saharan African Countries

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Ghana's structural adjustment program was very beneficial to its cocoa sector. Although world cocoa prices fell as a result of Ghana's expansion, the decline was much less than that from production expansions by other major producers.
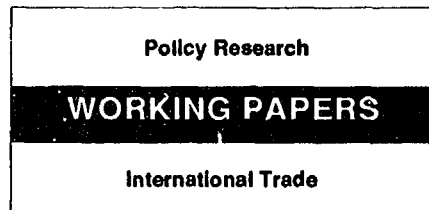
Structural adjustment programs in Sub-Saharan African countries in the 1980s removed trade restrictions, price controls, and export taxes and abolished state-owned commodity marketing bodies. Coleman, Akiyama, and Varangis studied the effects of these policy changes on the cocoa sector, using a global econometric model specifying major producer countries through the vintage-capital approach. They focused on Ghana and Nigeria (major cocoa producers that undertook structural adjustment programs), as well as on Côte d'Ivoire and Cameroon.

The impact on world cocoa prices of structural adjustment programs in Ghana and Nigeria was relatively small. The results imply that, without structural adjustment programs in Ghana and Nigeria, vorld cocoa prices in the late 1980s would have been about US$1,060/ton (in 1985 constant dollars), instead of US$850/ton. So, without the structural adjustment programs, 1989-90 world prices in real terms would have been about 45 percent lower than they were in the early 1980s, compared with an actual decline of 55 percent.

Much more important in depressing prices in this period was the rapid increase in production in Brazil, Côte d'Ivoire, Indonesia, and Malaysia (which together accounted for about 75 percent of the increased production in that decade). That increased production resulted largely from tree planting in response to higher world cocoa prices in the late 1970s — and subsequent increases in productivity.

The results of counterfactual simulations suggest that cocoa production in Ghana would have been at almost half its 1989-90 level if Ghana had not implemented its structural adjustment program. The producers' surplus would have been lower without the program, and the government's budget deficit would have been unsustainable.

The effects of the structural adjustment program in Nigeria are mixed. The simulation results show lower cocoa production but higher government revenue without the reforms. But the program was evaluated only three years after the reforms, so the full effects on production had not been realized.

The structural adjustment programs in Ghana and Nigeria had a negative effect on other cocoa-producing countries in Sub-Saharan Africa and the rest of the world — producing an estimated loss (in government revenue from cocoa exports and producer surplus) of about 15 percent in other Sub-Saharan African countries.

Results show that both Côte d'Ivoire and Cameroon would have been better off had they set export taxes at a higher level (closer to an estimated "optimal" level) at the same time that they depreciated the real exchange rate. Producer prices could have been sustained at their earlier higher level, or even raised, without hurting government revenues.

Structural adjustment programs in Ghana and Nigeria had a negative effect on producers in other countries, but not adopting such policies would have been economically irrational, contend Coleman, Akiyama, and Varangis.

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Contents

I. Introduction*

1.1. Background

During the 1970s and 1980s, the economic performance of many countries in Sub-Saharan Africa (SSA) deteriorated significantly. The growth rate of gross domestic product declined, while inflation and unemployment rates increased rapidly. Over time, these economies became more unstable and less resilient to internal and external shocks. In many cases, the economic decline was the result of poor economic management. For example, in some countries, fiscal and monetary policies allowed large government deficits to accumulate and continue, even in the face of declining government revenues, leading to excessive government borrowing, high rates of interest and accelerating inflation. Domestic price controls were introduced to curb inflation, fuelling the expansion of black markets. Highly interventionist trade and exchange rate policies distorted the terms of trade between traded and non-traded goods.

Over the past several years, many SSA countries have introduced structural adjustment programs (SAPs) aimed at restoring economic growth and stability. These programs have included major policy and institutional reforms designed to improve economic efficiency by imposing fiscal and monetary discipline, liberalizing markets, and removing price controls (especially in foreign exchange and commodity markets). One of the key objectives of these reforms was to create an economic and institutional environment in which the private sector could develop and flourish.

Exports of primary commodities such as cocoa and coffee play a key role in many of the economies of SSA, often providing the major source of foreign exchange, government revenues, and employment. Commonly, the domestic markets for these commodities are subject to strict government controls (often implemented through government-owned marketing boards) over many of the production, marketing, and exporting activities. As part of the SAP, some SSA countries introduced measures to liberalize their commodity export markets. Policy changes have included the removal of trade restrictions, price controls, and export taxes, and in some countries the state-owned marketing boards have been abolished.

In addition to the policy changes directed specifically to the commodity sectors, general economic policies have had a major impact on the production and export of these commodities. For example, exchange rate adjustments have typically improved the competitiveness of SSA commodities in production vis-à-vis other producing countries. Also, measures to control inflation have lowered the costs of labor and other inputs, while credit market liberalization has increased the availability of loans and lowered interest rates. These changes have lowered the costs of producing and marketing export commodities, providing producers and traders with greater incentives to produce and export.

1.2.   Objectives of the Study

These policy changes, however, have led to concern about their impact on world prices of commodities such as cocoa and coffee and, in turn, on the countries exporting them. The policy changes have, in the main, encouraged production and exports of commodities and likely led to lower international commodity prices than would have otherwise occurred. But this is only part of the story.

Now that the policy reforms have been underway for several years in some important SSA producers, it is timely to assess what has been the impact of the SAPs and other policy changes on export commodity sectors in SSA and on world commodity markets. We chose one commodity, cocoa, which is an important export commodity for several SSA countries, some of which hold large shares of the world market. Cocoa production in SSA is concentrated in a few countries--namely Cote d'Ivoire, Ghana, Nigeria, and Cameroon which together produce about 50% of world output (other major producers are Malaysia and Brazil). During the 1980s, structural adjustment programs in all four West African cocoa producers included reforms in their cocoa sectors. However, the reforms in Cote d'Ivoire and Cameroon came into effect in the late 1980s and their impacts are yet to take full effect.

The objective of the study was to evaluate how the SAPs have affected the welfare of cocoa producers and government revenues in each of the four major cocoa producing countries during the 1980s. To meet this objective, an evaluation was made of how past policies have affected certain key variables, including cocoa production, domestic cocoa prices, marketing costs, and government revenues. The impact of the SAPs on the world cocoa market was analyzed by determining what world prices and production would have been if no SAP had been introduced, and how producer and government welfare would have been affected in other major cocoa producing countries.

1.3. Previous Studies

The impact of expanding the commodity exports of developing countries has received considerable attention in the literature. An argument which has received a great deal of attention since the 1950s became known as the "export pessimism" hypothesis (Prebisch, 1950). This was based on the fact that developing countries concentrated on exporting primary commodities, while industrialized countries were the main producers of manufactures. Primary commodity demand tends to be inelastic with respect to income, and therefore, if supply grows faster than demand, this leads to lower prices and deteriorating net barter terms of trade vis-a-vis manufactures. Also, primary commodities tend to be inelastic with respect to price, so that in the short term higher production and productivity lead to relatively greater price declines, such that marginal revenues from additional output are negative, reducing the welfare of the country increasing production as well as of other producing countries. The policy implication of this logical sequence is that developing countries ought to constrain production and diversify out of primary commodities.

In a recent study, Panagariya and Schiff (1990) addressed the case of export pessimism for the cocoa exports of Africa. Using a game theory approach, they estimated tax rates for Cote d'Ivoire, Ghana, Cameroon and Nigeria, as well as for other major non-African cocoa producers. For each, they estimated "myopic" tax rates (profit-maximizing tax rates under the assumption that the rates of other countries are held fixed at their actual levels), and Nash equilibrium tax rates (allowing other countries to adjust their taxes optimally). These were compared with actual tax rates. It was found that, with the exception of Cote d'Ivoire, actual tax rates were substantially higher than both the myopic and Nash tax rates. For example, the actual tax rate for Ghanian cocoa exports in 1982 was 70%, while the myopic and Nash tax rates were estimated to be about 20%.

Their model was simulated to assess the impact of a 100,000 tons increase in production in Ghana. The expansion led to a world price decline of 3.7%, and income losses (defined as the sum of tax revenue and producer surplus) of 8.0%, 12.3% and 5.7% for Cote d'Ivoire, Cameroon and Nigeria, respectively. These losses were almost exactly offset by gains in Ghana. In another simulation, the export tax of Cote d'Ivoire was eliminated altogether, while keeping constant the tax rates in other producing countries. The effect was to increase production in Cote d'Ivoire by 26.3%, leading to an 8% fall in the world cocoa price and to lower profits in all countries, including Cote d'Ivoire. The authors concluded that in providing policy advice and support of investment projects in the case of commodities such as cocoa, the donor community should take into account the effects on and possible reactions of

other producing countries. They concluded that increased productivity would increase profits in those countries, but other countries would lose. However, as a whole, African countries would gain because gains would dominate the losses.

In an earlier study, Godfrey (1984) took issue with the Berg Report (World Bank, 1981) which stated that "Africa's share of world trade in most commodities could be increased with relatively small effects on prices" (p.23). Godfrey tested this hypothesis by comparing the SSA countries' share of world exports with the world price elasticity of demand. He observed that if the latter exceeded the former, then marginal revenues from the expansion of output and exports were positive. Using data for 1982, it was shown that the share of world exports exceeded the elasticity of demand in the cases of coffee and cocoa. A 1% increase in coffee exports led to a 1.14% decline in world price, while for cocoa, a 1% increase in exports led to a 2.17% fall in world price. Therefore, an expansion of coffee and cocoa exports would lead to a decline in SSA countries' export revenues. Sugar and tea were on the margin in that the world export share and demand elasticity were of similar magnitude. In the case of groundnut oil and sisal, demand elasticities were not available; however, given the large share of world exports supplied by SSA countries, it was highly likely that SSA's export shares would exceed the demand elasticities. Godfrey concluded that those calling for an expansion of commodity exports by SSA countries should modify their prescriptions considerably, and that greater emphasis should be placed on diversification from commodities with low income elasticity to high income elasticity products.

The main problem with these approaches is that the models used do not capture the complexity of the commodity markets. In particular, these analyses do not consider the dynamics of the supply response of perennial commodities which cannot be captured adequately with a single-valued supply elasticity (Akiyama and Trivedi, 1987). The approach taken in this study is to use a large simultaneous-equation model of the world cocoa market consisting of mainly three blocks, supply, demand and price determination. (For a more detailed description see Annex II.) The supply side consists of production equations for Cote d'Ivoire, Ghana, Cameroon, Nigeria, Brazil, Malaysia, Ecuador, Indonesia and the Rest of the World. All production equations, except those for the last three countries, were modeled using the vintage-capital approach (Akiyama and Trivedi, 1987), thus capturing the dynamics of supply response to policy changes. The demand block consists of demand equations for consumption (grindings) and for stocks for the world as a whole. Both are modeled in the conventional way. World consumption is a function of real prices and real income in consuming countries and stocks are a function of real prices and lagged production levels. Finally, the real world price for cocoa is determined by the market

4

clearing identity using the Newton algorithm.

The model calculates some additional variables. These are: (i) value of production, calculated as production times the FOB price; (ii) government revenue from the cocoa sector, calculated as production times the level of tax (with the level of tax equal to the tax rate times the FOB price); (iii) the producer surplus, calculated as the area between the marginal cost curve and the producer price (Akiyama and Trivedi, 1992); and (iv) the "total welfare," calculated as the sum of government revenue and the producer surplus.

The results from the base-line simulation were compared with historical data to validate the model. Two sets of validation statistics were calculated, as discussed in Annex II. These cover important aspects of the model's ability to plot historical data and to respond to economic stimuli in a manner consistent with both economic theory and empirical observation. The validation statistics calculated were the Root Mean Square Percentage Error (RMSPE) and Theil's U-statistic, and were based on a simulation period from 1980/81 to 1989/90 (Table A2.2). From these validation statistics it was concluded that the model gives an accurate representation of the world cocoa market and provides a reliable tool for policy analysis and forecasting.

1.4.   Outline of the Paper
This paper is organized into four sections. In section two, the model simulations for the impact of structural adjustments in Ghana and Nigeria are discussed. In section three, the model simulations for the impact of alternative cocoa export taxes and exchange rates in Cote d'Ivoire and Cameroon are discussed. These two sets of simulations evaluate the impacts of SAPs on two countries which implemented substantial policy changes (Ghana and Nigeria) and examine what different policies could have been taken by two countries which face enormous financial difficulties in the cocoa subsectors (Cote d'Ivoire and Cameroon). Finally, in section four, conclusions and recommendations from the analysis are presented.

II. Impact of Structural Adjustments in Ghana and Nigeria

2.1. Introduction

Ghana and Nigeria are the two major cocoa producing countries in SSA that have implemented SAPs over a period of several years. The main focus in this section is to investigate how these policy changes have affected the cocoa subsectors of these countries and the world market. The model of the world cocoa market was simulated over the period 1982/83-1989/90. The initial simulation was carried out with values of the model's exogenous variables set at their actual levels. This (factual) simulation provided base-line values of the model's endogenous variables for comparison with values from counter-factual simulations. The three counter-factual policy simulations undertaken assumed that: (i) Ghana and Nigeria did not undertake the SAPs (Scenario I), (ii) Ghana did not undertake the SAP, while Nigeria did (Scenario II); and (iii) Nigeria did not undertake the SAP, while Ghana did (Scenario III). The impacts of the SAPs were measured by the differences between the actual and adjusted values of the model's endogenous variables. Historical values of some important exogenous variables are reported in Table 2.1. A full discussion of these is given in Annex I. The variables of major interest are the exchange rates and producer prices in Ghana and Nigeria. These can be compared with the assumptions made for the counter-factual scenarios presented in Table 2.2.

2.2. Counter-Factual Simulations

2.2.1. Assumptions

The SAP undertaken in Ghana involved adjustments affecting the economy as a whole as well as policies directly affecting the cocoa sector. Therefore, it was necessary to evaluate what the CPI, exchange rate, cocoa producer price, and marketing costs of cocoa would have been in the absence of the structural adjustments. Given that the devaluation of the Cedi started in the fourth quarter of 1983, assumptions were made for these variables for the period 1983/84 to 1989/90 (see Table 2.2). The equations used to derive these values are presented in Table 2.3.

6

Table 2.1: Model Assumptions For Key Variables, 1982/83-1989/90. With Structural Adjustments in Ghana and Nigeria (Baseline Scenario)

Variable	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90
Cameroon			---------- CFAF / KG ----------					
CPI[1]	69.31	79.05	81.71	82.77	90.28	100.14	99.08	100.00
Exchange Rate[2]	367.40	422.03	467.73	362.73	310.78	293.97	317.70	286.12
Producer Price	330.00	370.00	410.00	420.00	420.00	420.00	420.00	250.00
Marketing Cost	76.60	84.80	86.70	89.20	90.10	89.90	68.80	68.80
Explicit Tax	57.00	57.00	57.00	57.00	57.00	58.30	57.00	0.00
Implicit Tax	116.70	261.50	371.10	348.20	115.70	5.70	-53.20	21.80
Cote d'Ivoire			---------- CFAF / KG ----------					
CPI[1]	79.80	83.91	85.28	90.80	95.71	99.48	100.37	100.00
Exchange Rate[2]	367.40	422.03	467.73	362.73	310.78	293.97	317.70	286.12
Producer Price	350.00	375.00	400.00	400.00	400.00	400.00	400.00	200.00
Marketing Cost	68.30	74.30	75.40	82.70	83.10	84.90	92.30	92.20
Explicit Tax	50.60	80.50	80.50	80.50	100.50	100.50	100.50	50.25
Implicit Tax	131.50	288.60	370.20	225.10	48.60	-87.60	-174.60	-52.50
Ghana			---------- Cedi / KG ----------					
CPI[1]	14.60	24.36	26.26	31.90	44.37	59.12	73.97	100.00
Exchange Rate[2]	2.75	29.07	49.77	81.75	129.92	188.73	254.28	313.88
Producer Price	12.00	20.00	30.00	56.60	83.33	140.00	165.00	174.40
Marketing Cost	24.17	36.31	47.97	55.21	86.40	138.36	90.67	96.73
Implicit Tax	-30.53	17.23	47.51	69.26	93.03	81.92	123.46	143.92
Nigeria			---------- Naira / KG ----------					
CPI[1]	24.4?	34.59	38.80	39.67	44.00	57.31	86.37	100.00
Exchange Rate[2]	0.71	0.75	0.86	1.08	3.89	4.33	6.76	7.83
Producer Price	1.30	1.40	1.50	1.60	6.50	7.50	12.00	9.00
Marketing Costs	0.51	0.73	0.81	0.83	0.77	1.00	1.51	1.75
Implicit Tax	-61.91	-54.58	-26.40	-16.17	-5.13	-19.02	-34.58	-7.76

1/   1989/90 = 100.
2/   Domestic currency per US dollar.

Table 2.2: Model Assumptions For Key Variables, 1982/83-1989/90. Without Structural Adjustment
in Ghana and Nigeria

Variable	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90
Ghana					------ Cedi / KG ------			
CPI[1/]	9.49	13.28	18.59	26.03	36.44	51.02	71.43	100.00
Exchange Rate[2/]	2.75	3.93	5.46	6.49	8.27	10.79	15.22	20.11
Producer Price	12.00	10.86	16.11	22.11	27.74	36.26	45.48	57.29
Marketing Cost	24.17	33.84	47.37	66.32	92.85	129.99	181.99	254.78
Nigeria					------ Naira / KG ------			
CPI[1/]	29.71	42.07	47.19	48.23	57.87	69.44	83.33	100.00
Exchange Rate[2/]	0.71	0.75	0.86	1.08	1.18	1.32	1.60	1.81
Producer Price	1.30	1.40	1.50	1.60	3.06	3.44	3.72	4.03
Marketing Costs	0.51	0.73	0.81	0.83	1.00	1.20	1.44	1.73

1/   1989/90 = 100.
2/   Domestic currency per US dollar.

For Ghana, the consumer price index was increased by 40% in each period, equivalent to the annual average increase in inflation during the five year period prior to 1983/84. The exchange rate was estimated assuming purchasing power parity with 1983/84 as the base year. The Bank's MUV (Manufacturer's Unit Value Index) was used as the measure of inflation in the rest-of-the-world. This mechanism assumes that exchange rates adjust according to the differential between the inflation rate of the country and its trading partners. With the exchange rate adjusting, the purchasing power of the currency stays the same[1] [2]. This assumption assumes that the currency over-valuation of 1982/83 was maintained throughout the rest of the 1980s. The exchange rates and CPIs are assumed not to be affected by the cocoa producer prices and marketing costs.

[1] For example, if the rate of inflation in Ghana is 10% greater than in the rest of the world, then, over the long run, the Cedi will depreciate by 10% against the rest of the world.

[2] Initially, the exchange rate was estimated as a logarithmic function of the ratio of Ghana's CPI and the MUV index, lagged one year, for the period 1975 to 1981. However, purchasing power parity was not supported by the estimated equation because the coefficient of the relative inflation variable was only 0.45. Using a coefficient of this size gave predictions of the exchange rate too low to be credible. Therefore, purchasing power parity was imposed by constraining the coefficient of the relative inflation variable to be equal to unity and the constant term of the equation set to zero. This gave exchange rate assumptions that were much more credible, as reported in Table 2.2.

Table 2.3: Equations Used to Estimate Consumer Price Index, Exchange Rate, Producer Price, and Marketing Cost for Ghana and Nigeria, Without Structural Adjustment

<u>Consumer Price Index</u>

Ghana: $CPI_t = 1.4 * CPI_{t-1}$

Nigeria: $CPI_t = 1.2 * CPI_{t-1}$

<u>Exchange Rate</u>

Ghana: $ER_t = ER_{82/83} * EXP\{ LN(CPI_t / CPI_{82/83}) - LN(MUV_t / MUV_{82/83}) \}$

Nigeria: $ER_t = ER_{85/86} * EXP\{ LN(CPI_t / CPI_{85/86}) - LN(MUV_t / MUV_{85/86}) \}$

<u>Producer Price of Cocoa</u>

Ghana: $LN\ PP_t = -3.72 + 0.41 * LN\ (WP_{t-1} / ER_{t-1}) + 0.56 * LN\ (CPI_{t-1})$
                              (5.06)   (7.82)

        Adjusted R-Squared: 0.99   DW: 1.22   Period of Fit: 1966-81

Nigeria: $LN\ PP_t = -4.59 + 0.37 * LN\ (WP_{t-1} / ER_{t-1}) + 0.74 * LN\ (CPI_{t-1})$
                              (3.38)   (7.77)

        Adjusted R-Squared: 0.96   DW: 0.76   Period of Fit: 1966-85

<u>Marketing Costs</u>

Ghana: $MC_t = MC_{82/83} * (CPI_t / CPI_{82/83})$

Nigeria: $MC_t = MC_{85/86} * (CPI_t / CPI_{85/86})$

Where: CPI_t = Consumer Price Index at time t,
        ER_t = Exchange Rate at time t,
        MUV_t = Manufacturers Unit Value Index at time t,
        PP_t = Producer Price of Cocoa in Ghana at time t,
        WP_t = World Price of Cocoa at time t,
        MC_t = Marketing Cost at time t,
        EXP = Indicates exponential transformed,
        LN = Indicates logarithmic transformed.

The cocoa producer price had been set by the government before the SAPs were implemented. A hypothesis that the international cocoa price and CPI influenced the government's cocoa pricing policies was tested using regression analysis. The results of the analysis show that the coefficients on the independent variables are statistically highly significant and indicate that domestic price changes were

9

influenced in fairly equal proportions by changes in international cocoa prices and by general domestic price increases—with the latter reflecting costs of production. The domestic producer prices prevailing in the absence of structural adjustment were derived from an equation including the actual world price of cocoa and the estimated exchange rate and CPI derived from the respective equations. Finally, marketing costs for the period 1983/84-1989/90 were assumed to be equal to their 1982/83 level in real terms, using the estimated CPI as the deflator.[3]

In the case of Nigeria, it was assumed that the SAP came into effect during 1986/87, although some policy changes were made slightly earlier. Between 1986/87 and 1989/90 the CPI was assumed to increase annually by 20%, equivalent to the average annual inflation rate between 1981/82 and 1985/86 (the period prior to the SAP), while the exchange rate was determined by assuming purchasing power parity. The producer price of cocoa was estimated using the equation reported in Table 2.3. The results show that 96% of variations in the domestic producer price of cocoa can be explained by the previous year's international cocoa price, converted into Naira, and the previous year's CPI. Marketing costs were assumed to remain at the 1985/86 level in real terms for the 1986/87-1989/90 period, and were converted into nominal terms using the estimated CPI.

2.2.2. Impact of Structural Adjustment Programs on the World Cocoa Market

The impacts of the SAPs in Ghana and Nigeria on key variables of the world cocoa market are shown in Table 2.4. Reported are the values for 1989/90 and cumulative effects for the period 1982/83-1989/90. Because impacts of policy changes on perennials take a number of years before they become evident, data for the last year for which we have concrete data, 1989/90, are shown to indicate the long-term effects of the policy changes. A comparison is made between the actual values and the results from the three counter-factual scenarios.

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[3]   Notice that the implicit taxes on producers are not reported in Table 2.2. This is because they become an endogenous variable in the model simulations, since the tax is defined as the difference between the FOB value (i.e., the sum of the producer price, explicit taxes, and marketing costs) and the actual cost at the port. The actual FOB price for cocoa in each of these countries is closely related to the world cocoa price which in turn has been affected by the structural adjustment programs. Therefore, in the counter-factual simulation, the actual cost at the port in each country is linked to the world cocoa price through a price linkage equation. The estimated actual FOB price is then combined with the adjusted cost at the port (i.e., adjusted for changes in the producer price, marketing costs, and explicit tax) to give the implicit tax.

Table 2.4: Impact of Structural Adjustments in Ghana and Nigeria on the World Cocoa Market

Scenarios on SAPs		World Production ('000 tons)	Real Price (1984/85 ¢/kg)	Real Value of Production (million 1984/85 $)	World Stocks ('000 tons)	World Grindings ('000 tons)
Both. Factual[3/]	1989/90	2,435.0	86.01	2,094.3	1,473.0	2,193.0
	Cumulative[1/]	16,145.0	165.50[2/]	25,362.4	6,729.0	15,296.0
Neither. Scenario I[4/].	1989/90	2,279.1	106.93	2,437.1	1,273.7	2,094.6
	Cumulative[1/]	15,604.3	179.30[2/]	26,978.2	6,166.9	14,954.9
Nigeria Only. Scenario II[5/].	1989/90	2,308.5	102.71	2,371.1	1,311.0	2,112.4
	Cumulative[1/]	15,684.4	178.00[2/]	26,828.4	6,242.1	14,997.7
Ghana Only. Scenario III[6/].	1989/90	2,404.4	89.36	2,148.5	1,431.9	2,175.4
	Cumulative[1/]	16,055.2	166.94[2/]	25,531.7	6,638.7	15,247.2

1/ Cumulative for the period 1982/83-1989/90.
2/ Average 1982/93-1989/90.
3/ Factual. Structural Adjustment by both Ghana and Nigeria.
4/ Scenario I. No Structural Adjustment by Ghana or Nigeria.
5/ Scenario II. Structural Adjustment by Nigeria, no Structural Adjustment by Ghana.
6/ Scenario III. Structural Adjustment by Ghana, no Structural Adjustment by Nigeria.

In 1989/90, actual world production was 2.43 millions tons. If Ghana and Nigeria had not undertaken structural adjustment programs, production would have been 2.28 million tons, 6% lower. The model generates this reduction in production because producer prices in Ghana and Nigeria would have been considerably lower if the policy changes had not taken place (see Table 2.1 and Table 2.2) and hence production in these two countries would have been lower. Because of the lower world production, the real world price of cocoa in terms of 1984/85 US dollars would have been about 107¢/kg in 1989/90, compared to the actual price of only 86¢/kg, a difference of about 24%. Although production is lower, due to the inelasticity of world demand, the increase in world price in the counter-factual scenario is such

11

that the value of world production is about 17% higher in 1989/90. The effect of lower production and higher prices causes world stock levels and world grindings to be reduced by 13.5% and 4.5%, respectively.

The cumulative effect of the SAP in Ghana and Nigeria over the period 1982/83-1989/90 is for world production to have been 3.5% higher, world stocks to be 9% higher, and world grindings to increase by 2.3%. On average over this period the real world price of cocoa would have been about 8% higher if Ghana and Nigeria had not made the structural adjustments. Table 2.4 also shows that because of the structural adjustments in the two countries, the value of world cocoa production was reduced by 6% or US$1.6 billion in real terms over the period 1982/83-1989/90 because of the lower world price. Also, the level of production in the rest-of-the-world (i.e., the world excluding Ghana and Nigeria) was 4% less while the value of production in the rest-of-the-world was 11% or US$2.2 billion lower.

In Table 2.4 are also reported the results of simulation of the effects of structural adjustment by Nigeria but not by Ghana (scenario II), and the case of structural adjustment by Ghana but not by Nigeria (scenario III). The impacts of these counter-factual scenarios on the world cocoa market lie within the ranges of the impacts for the factual case and scenario I (no structural adjustment by Ghana and Nigeria). Notice that the impacts are larger for the case where only Ghana undertakes structural adjustment. This is because Ghana is a larger producer of cocoa than Nigeria and began its structural adjustment program earlier.

2.2.3. Impact of Structural Adjustment Programs in Ghana and Nigeria on Ghana's Cocoa Sector

The impacts of structural adjustment by Ghana and Nigeria on Ghana's cocoa sector as measured in terms of producer surplus, government revenues, level of production, and value of production are reported in Table 2.5. The actual Ghanaian producer surplus for 1989/90 was US$17 million, compared to only US$5.4 million in the scenario where Ghana and Nigeria do not undertake structural adjustment programs. This is because two components of the producer surplus calculation--the producer price and the level of production--are lower in the counter-factual case. Government revenue was affected greatly by the structural adjustment programs. For 1989/90, actual government revenue was US$81.8 million, compared to government expenditures (i.e., negative revenues) of US$88.2 million if Ghana and Nigeria had not made structural adjustments. Although the world price of cocoa would have been much higher

12

(implying a higher FOB price and higher tax revenue) if structural adjustment had not taken place, the cedi/US$ exchange rate would have been much lower, resulting in a very low FOB price of cocoa in terms of cedi.

Table 2.5: Impact of Structural Adjustment in Ghana and Nigeria on Ghana

Scenarios on SAPs		Producer Surplus	Government Revenue	Joint Welfare	Value of Production	Production
		——————(1984/85 US$ mill.)————————				('000 tons)
Both. Factual[2].	1989/90	17.0	81.8	98.8	298.1	295.0
	Cumulative[1]	817.0	-763.7	53.3	3,165.8	1,742.0
Neither. Scenario I[3].	1989/90	5.4	-88.2	-82.8	200.9	159.9
	Cumulative[1]	563.5	-2,296.8	-1,733.3	2,575.4	1,236.7
Nigeria Only. Scenario II[4].	1989/90	5.4	-112.8	-107.4	193.0	159.9
	Cumulative[1]	563.5	-2,474.8	-1,911.3	2,556.8	1,236.7
Ghana Only. Scenario III[5].	1989/90	17.0	97.0	114.0	309.7	295.0
	Cumulative[1]	817.0	-735.9	81.1	3,199.8	1,742.0

1/ Cumulative for the period 1982/83-1989/90.
2/ Factual. Structural Adjustment by both Ghana and Nigeria.
3/ Scenario I. No Structural Adjustment by Ghana or Nigeria.
4/ Scenario II. Structural Adjustment by Nigeria, no Structural Adjustment by Ghana.
5/ Scenario III. Structural Adjustment by Ghana, no Structural Adjustment by Nigeria.

Although the producer price would have been lower without the structural adjustment, the FOB price would have been even lower because of the exchange rate effect. As a result, the tax per ton would

have been negative for much of the 1980s if Ghana had not adjusted.[4] In fact, to maintain the producer price, the government would have had to subsidize the cocoa sector by US$88.2 million, and by as much as US$2.3 billion over the period 1982/83-1989/90. Joint income realized for 1989/90, given by the sum of producer surplus and government revenue was US$98.8 million, compared with a joint income loss of US$82.8 million if no structural adjustment had taken place. Production in Ghana was 295,000 tons in 1989/90; if no adjustment had taken place it would have been about 45% lower at 160,000 tons. The value of production is also lower in the counter-factual simulation because of the lower production, despite an increase in the world cocoa price.

Levels of some key variables for 1982/83-1989/90 are reported in Table 2.6.[5] Of particular importance is to compare the producer price and FOB price with and without structural adjustment programs. Without the devaluation of the exchange rate, the FOB price of cocoa in Ghana would have been about 29 cedi/kg in nominal terms in 1989/90, compared to 415 cedi/kg with the programs. Comparing these with the producer price shows that in the absence of structural adjustment there would have been a considerable subsidy to producers. For example, in 1989/90, it is estimated that the producer price of cocoa would have been 57.3 cedi/kg, appropximately one-half of the FOB price in that year.

These results indicate that the exchange rate assumptions are crucial to certain results. Recall that the exchange rate does not affect the producer price and producer surplus. However, changes in the exchange rate will affect the export tax and government revenue. To test the sensitivity of the results to the exchange rate assumptions an analysis was undertaken with the exchange rate set at double the level assumed in the base case (e.g., in 1989/90 the assumed exchange rate was 40 cedi/US$ instead of 20 cedi/US$). In this scenario, it was found that the government revenue and export tax were 11% to 12% higher than in the base scenario. Therefore, the result that if the SAP had not been implemented in Ghana the government would have incurred large revenue losses is robust with respect to the exchange rate assumption.

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[4] The tax per ton is calculated as the FOB price less the producer price less marketing costs (see Table A2.1 in Annex II).

[5] These tables combine data from Tables 2.1. 2.2, and A1.1-A1.3.

14

Table 2.6: Key Variables for Ghana, 1982/83-1989/90. With and Without Structural Adjustments in Ghana and Nigeria

Variable	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90
Producer Price (nominal cedi/kg)								
With	12.0	20.0	30.0	56.6	83.3	140.0	165.0	174.4
Without	12.0	10.9	16.1	22.1	27.7	36.3	45.5	57.3
Marketing Cost (nominal cedi/kg)								
With	24.2	36.3	48.0	55.2	86.4	138.4	90.7	96.7
Without	24.2	33.8	47.4	66.3	92.9	130.0	182.0	254.8
Cost at Port (nominal cedi/kg)								
With	36.2	56.3	78.0	111.8	169.7	278.4	255.7	271.1
Without	36.2	44.7	63.5	88.4	120.6	166.2	227.5	312.1
FOB Price (nominal cedi/kg)								
With	5.6	73.5	125.3	181.1	262.8	360.3	379.2	415.0
Without	5.4	8.9	12.3	13.9	16.7	17.7	20.6	28.8
Implicit Tax (%)								
With	-546.4	23.4	37.7	38.3	35.4	22.7	32.6	34.7
Without	-573.4	-401.6	-417.2	-536.0	-620.3	-840.7	-1002.1	-982.8
Production ('000 tons)								
With	225.0	178.0	159.0	175.0	219.0	228.0	188.0	300.0
Without	183.0	152.0	131.9	136.0	169.6	119.8	184.4	159.9

The impact on producer surplus and production in scenario II is the same as in scenario I, because the production and producer price levels are the same in each. The government revenues are even more negative and the value of production is lower in scenario II, because of the reduction in the world price of cocoa (see Table 2.4). If Nigeria had not had a structural adjustment program (scenario III), producer surplus and production would not have been affected, while government revenues and the value of production would have been higher because of the higher world cocoa price. These simulations show that Ghana benefitted greatly in terms of the country's welfare from the structural adjustment, especially compared with the case where Nigeria implemented the adjustment and Ghana did not.

2.2.4. Impact of Structural Adjustment Programs in Ghana and Nigeria on Nigeria

The impacts of structural adjustment programs by Ghana and Nigeria on Nigeria's cocoa sector are reported in Tables 2.7 and 2.8. With Nigeria undertaking a structural adjustment program, producer surplus and the level of production in Nigeria were US$35.9 million and 160,000 tons, respectively, in 1989/90 (see Table 2.7). If adjustment had not occurred, producer surplus would have been only US$6.3 million and production only 129,300 tons, because the producer price of cocoa would have been lower (see Tables 2.1 and 2.2). These results apply whether or not Ghana undertakes an adjustment program.

Table 2.7: Impact of Structural Adjustment in Ghana and Nigeria on Nigeria

Scenarios on SAPs		Producer Surplus	Government Revenue	Joint Welfare	Value of Production	Production
		————————(1984/85 US$ mill.)————————			('000 tons)	
Both. Factual[2].	1989/90	35.9	0.0	35.9	147.2	160.0
	Cumulative[1]	417.4	-334.5	82.9	1,858.0	1,082.0
Neither. Scenario I[3].	1989/90	6.3	93.7	100.0	148.0	129.3
	Cumulative[1]	259.2	145.2	404.4	1,902.6	995.7
Nigeria Only. Scenario II[4].	1989/90	35.9	0.0	35.9	175.8	160.0
	Cumulative[1]	417.4	-322.6	94.8	1,998.6	1,082.0
Ghana Only. Scenario III[5].	1989/90	6.3	72.1	78.4	123.6	129.3
	Cumulative[1]	259.2	31.8	291.0	1,777.8	995.7

1/ Cumulative for the period 1982/83-1989/90.
2/ Factual. Structural Adjustment by Both Ghana and Nigeria.
3/ Scenario I. No Structural Adjustment by Ghana or Nigeria.
4/ Scenario II. Structural Adjustment by Nigeria, no Structural Adjustment by Ghana.
5/ Scenario III. Structural Adjustment by Ghana, no Structural Adjustment by Nigeria.

However, if Nigeria had not introduced a structural adjustment program, its government revenues would have been higher because of a tax on exports. This is because the world price would have been higher and the producer price would have been lower, while the exchange rate adjustment would not have been sufficiently strong to counteract these effects, as was the case for Ghana (see Table 2.8). This gives the rather anomalous result that Nigeria would have been better off if it had not had a structural adjustment program.

Table 2.8: Key Variables for Nigeria, 1982/83-1989/90. With and Without
Structural Adjustments in Ghana and Nigeria

Variable	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90
Producer Price (nominal naira/kg)								
With	1.3	1.4	1.5	1.6	6.5	7.5	12.0	9.0
Without	1.3	1.4	1.5	1.6	3.1	3.4	3.7	4.0
Marketing Cost (nominal naira/kg)								
With	0.5	0.7	0.8	0.8	0.8	1.0	1.5	1.7
Without	0.5	0.7	0.8	0.8	1.0	1.2	1.4	1.7
Cost at Port (nominal naira/kg)								
With	1.8	2.1	2.3	2.4	6.9	7.1	10.0	10.0
Without	1.8	2.1	2.3	2.4	4.1	4.6	5.2	5.8
FOB Price (nominal naira/kg)								
With	1.1	1.4	1.8	2.1	6.9	7.4	10.0	10.0
Without	1.1	1.4	1.9	2.3	7.7	8.1	12.0	12.4
Implicit Tax (%)								
With	-61.6	-54.3	-26.2	-16.3	0.0	0.0	0.0	0.0
Without	-63.2	-54.0	-18.9	-3.5	47.0	42.9	57.2	53.6
Production ('000 tons)								
With	156.0	115.0	151.0	110.0	80.0	150.0	160.0	160.0
Without	156.0	115.0	151.0	110.8	69.2	129.0	135.5	129.3

This result is due to a particular characteristic of perennial crop supply—it takes several years for perennials to start producing after planting and it also takes several years before production declines in a significant way following a price decline. An illustrative example is Ghana's production in the 1970s. Although real producer prices were reduced sharply during the late 1960s, a deterioration in production did not become evident until the late 1970s. Higher taxes can be imposed on perennials without a significant decline in production for a few years and this increases government revenue and producer surplus during the period. Effectively, this is equivalent to "consuming" the past investments on cocoa. In the Nigerian scenario considered here, the sum of government revenue and producer surplus is increased by the high export taxes. However, were this policy of high export taxes to continue, production would decline to considerably less than 100,000 tons by the mid-1990s. Conversely, under the SAP its production should increase beyond 1989/90. Indeed, actual cocoa production for 1990/91 is reported to be 170,000 tons. Thus, if the accumulated government revenue and producer surplus were calculated up to the mid-1990s, it would be lower in the case where there was no structural adjustment.

2.2.5. Impact of Structural Adjustment Programs in Ghana and Nigeria on Cameroon

The impacts of structural adjustment programs by Ghana and Nigeria on Cameroon's cocoa sector are reported in Table 2.9. If Ghana and Nigeria had not undertaken structural adjustment programs the value of production would have been US$150.1 million in 1989/90, compared to the actual value of US$120.7 million—a decrease of almost 20%. Government revenue would also have been higher because the higher world price would have caused the tax on exports to be greater. If either Ghana or Nigeria had not undertaken the adjustments, Cameroon would have been better off—although by less than if both had not adjusted.

2.2.6. Impact of Structural Adjustment Programs in Ghana and Nigeria on Cote d'Ivoire

The impacts of the structural adjustment programs in Ghana and Nigeria on Cote d'Ivoire are shown in Table 2.10. As in the case of Cameroon, it was assumed that no macro-economic adjustments were made by Cote d'Ivoire itself, and that reforms to its cocoa sector were made late in the 1980s. The results show that Cote d'Ivoire was made worse off by the structural adjustment programs in Ghana and Nigeria, through the impact of a lower world cocoa price. For example, government revenue for 1989/90 was actually US$51.0 million and the value of cocoa production US$653.5 million, respectively. If Ghana and Nigeria had not undertaken structural adjustment programs, it is estimated that these would have been US$132.1 million and US$812.5 million, respectively.

18

Table 2.9: Impact of Structural Adjustments in Ghana and Nigeria on Cameroon

Scenarios on SAPs		Producer Surplus	Government Revenue	Joint Welfare	Value of Production	Production
		(1984/85 constant US$ mill.)				('000 tons)
Both. Factual[2].	1989/90	51.3	7.4	58.7	120.7	125.0
	Cumulative[1]	594.2	504.6	1,098.8	1,744.3	955.0
Neither. Scenario I[3].	1989/90	51.3	21.5	72.8	150.1	125.0
	Cumulative[1]	594.2	614.7	1,208.9	1,896.9	955.0
Nigeria Only. Scenario II[4].	1989/90	51.3	18.6	69.9	144.2	125.0
	Cumulative[1]	594.2	606.6	1,200.8	1,882.3	955.0
Ghana Only. Scenario III[5].	1989/90	51.3	8.5	59.8	125.4	125.0
	Cumulative[1]	594.2	514.7	1,108.9	1,760.6	955.0

1/ Cumulative for the period 1982/83-1989/90.
2/ Factual. Structural Adjustment by Both Ghana and Nigeria.
3/ Scenario I. No Structural Adjustment by Gha... or Nigeria.
4/ Scenario II. Structural Adjustment by Nigeria, no Structural Adjustment by Ghana.
5/ Scenario III. Structural Adjustment by Ghana, no Structural Adjustment by Nigeria.

Table 2.10: Impact of Structural Adjustments in Ghana and Nigeria on Cote d'Ivoire

Scenarios on SAPs		Producer Surplus	Government Revenue	Joint Welfare	Value of Production	Production
		---------------(1984/85 constant US$ mill.)-----------------				('000 tons)
Both. Factual[2].	1989/90	148.7	51.0	199.7	653.5	710.0
	Cumulative[1]	2,900.3	1,908.3	4,808.6	7,757.3	4,707.0
Neither. Scenario I[3].	1989/90	148 7	132.1	280.8	812.5	710.0
	Cumulative[1]	2,900.3	2,612.5	5,512.8	8,537.3	4,707.0
Nigeria Only. Scenario II[4].	1989/90	148.7	115.9	264.6	780.4	710.0
	Cumulative[1]	2,900.3	2,532.6	5,432.9	8,453.1	4,707.0
Ghana Only. Scenario III[5].	1989/90	148.7	64.1	212.8	679.0	710.0
	Cumulative[1]	2,900.3	1,987.9	4,888.2	7,843.6	4,707.0

1/ Cumulative for the period 1982/83-1989/90.
2/ Factual. Structural Adjustment by Both Ghana and Nigeria.
3/ Scenario I. No Structural Adjustment by Ghana or Nigeria.
4/ Scenario II. Structural Adjustment by Nigeria, no Structural Adjustment by Ghana.
5/ Scenario III. Structural Adjustment by Ghana, no Structural Adjustment by Nigeria.

2.2.7. **Impact of Structural Adjustment Programs in Ghana and Nigeria on the Combined Cocoa Sectors of Ghana, Nigeria, Cameroon and Cote d'Ivoire**

The combined impacts of the structural adjustment programs carried out by Ghana and Nigeria on the four major cocoa producers in SSA are reported in Table 2.11. Over the period 1982/83-1989/90, the level of cocoa production in these four countries was 7% higher as a result of the adjustment programs. However, because of the impact of the increased production on the world price, the accumulated value of production was reduced by 3%. The other important effect is on producer surplus and government revenues, which increased 12% as a result of the SAPs because of the higher producer surplus in Ghana and Nigeria. However, the four governments received lower revenues because the world price was less following the adjustment programs.

20

Table 2.11: Impact of Structural Adjustment Programs in Ghana and Nigeria on Cameroon, Cote d'Ivoire, Ghana, and Nigeria Combined

Scenarios on SAPs		Producer Surplus	Government Revenue	Joint Welfare	Value of Production	Production
		————————(1984/85 constant US$ mill.)————————				('000 tons)
Both. Factual[2].	1989/90	252.9	140.2	393.1	1,219.5	1,290.0
	Cumulative[1]	4,728.7	1,314.7	6,043.6	14,525.4	8,486.0
Neither. Scenario I[3].	1989/90	211.7	159.1	370.8	1,311.5	1,124.2
	Cumulative[1]	4,317.2	1,075.6	5,392.8	14,912.2	7,894.4
Nigeria Only. Scenario II[4].	1989/90	241.3	21.7	263.0	1,293.4	1,154.9
	Cumulative[1]	4,475.4	341.8	4,817.2	14,890.8	7,980.7
Ghana Only. Scenario III[5].	1989/90	223.3	˷41.7	465.0	1,237.7	1,259.3
	Cumulative[1]	4,570.7	1,798.5	6,369.2	14,581.8	8,399.7

1/ Cumulative for the period 1982/83-1989/90.
2/ Factual. Structural Adjustment by Both Ghana and Nigeria.
3/ Scenario I. No Structural Adjustment by Ghana or Nigeria.
4/ Scenario II. Structural Adjustment by Nigeria, no Structural Adjustment by Ghana.
5/ Scenario III. Structural Adjustment by Ghana, no Structural Adjustment by Nigeria.

III. Impact of Alternative Export Tax and Exchange Rate Policies by Cote d'Ivoire and Cameroon

3.1. Introduction

While Ghana and Nigeria implemented significant policy changes to make their cocoa subsectors competitive in the 1980s, the other two major SSA cocoa producing countries, Cote d'Ivoire and Cameroon, suffered large government deficits due to their fixed producer price policy, appreciation of the CFA, and the decline of world cocoa prices. This led to decisions to reduce cocoa producer prices by one-half in 1990, which caused a sharp reduction in farmers' income in these countries. Cocoa production in Cote d'Ivoire increased sharply over the past decade or so; from 230,000 tons in 1972 to 820,000 tons in 1989--an annual average growth rate of 7.7%.[6] To put this in perspective, the incremental production of Cote d'Ivoire of 480,000 tons was approximately equal to the sum of the incremental production of Brazil, Indonesia, and Malaysia--the only other major cocoa producing countries to experience significant expansion in cocoa production during the 1977-90 period.[7] This rapid expansion in production by Cote d'Ivoire was a major factor contributing to the decline of world cocoa prices during the late 1980s. Here, we examine what differences there would have been if Cameroon and Cote d'Ivoire had pursued different export tax and exchange rate policies.

3.2. Assumptions

In order to examine the impact of Cote d'Ivoire's policies on its cocoa production, it is necessary to look at its producer tax and price policies during the 1970s and early-1980s period. These are discussed in detail in Annex I. These issues can be examined using a framework developed for estimating the optimal export tax on perennial crops in countries holding large shares of the world market (see Akiyama, 1992). The rationale of an export tax in such cases is to put a wedge between world prices and producer prices so as to maximize the country's welfare. The optimal tax makes the farmers' expected marginal revenues equal to the country's marginal revenues. A formula for the optimal tax is (Akiyama, 1992, eq.19, p.14):

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[6] For 1991/92, cocoa production in Cote d'Ivoire is forecast to be 770,000 tons.

[7] Between 1977 and 1990 Brazil increased its production from 240,000 tons to 370,000 tons, Malaysia's rose from 21,000 tons to 240,000 tons, and Indonesia's rose from 3,000 tons to 120,000 tons.

$$TXR_o = 1 - \frac{\sum \beta^i Y_i E_o^g (WP_i) (1 - SH_i / e_i)}{\sum \beta^i Y_i E_o^f (WP_i)}$$

Where:

TXR_o	=	optimal tax rate at time zero;
β^i	=	discount factor equal to $1/(1 + r)^i$,
r	=	rate of discount;
Y_i	=	yield at time i;
$E_o^g (WP_i)$	=	expectations of the world price (WP) held at time i by the government;
$E_o^f (WP_i)$	=	expectations of the world price held at time i by farmers;
SH_i	=	the country's share of the world market at time i; and
e_i	=	sum of the world demand elasticity and the supply elasticity of the rest of the world.

As seen from the formula, the optimal tax rate depends critically on the assumptions made about government and farmer price expectations. For example, suppose farmers are assumed to hold naive expectations (i.e., their expected price is the current price), and that the government was able to forecast the price decline in the 1980s (0.65 times the prevailing price during the late 1970s). Also, assume that Cote d'Ivoire's market share at time i is 0.31 (its actual share during the late-1980s) and that the combined world demand elasticity and medium-term supply elasticity of the rest of the world is 0.80. Then, using the formula, the optimal export tax for Cote d'Ivoire during the 1977-83 period would have been about 60%, almost double the actual rate in this period (about 30%).

If, more realistically, farmers and government are assumed to have the same price expectations, the optimal tax rate changes substantially. In this case the price expectation terms in the equation cancel out (i.e., $E_o^g (WP_i) = E_o^f (WP_i)$), and using identical assumptions about other components of the formula, the optimal rate becomes 40%.

Three counter-factual scenarios were investigated. First, the model was run for the 1982/83-1989/90 period assuming that an export tax of 60% had applied in Cote d'Ivoire in the 1978-83 period. A justification for the 60% tax scenario is that, even though farmers and government may have had the same price expectations during that period, the Ivorian Government provided input subsidies (e.g.,

23

fertilizers and spray materials) to the cocoa sector, giving additional incentives to producers.[8] In the model, these subsidies are not otherwise taken into account.

The second scenario analyzed was with the export tax set at 40% during the 1977-83 period. The third scenario is with a 40% export tax rate and maintaining the real exchange rate at its 1985 level after 1985 (its lowest level over the 1980-90 period, see Table A1.11), in order to predict what would have been the combined effect of using a higher export tax and CFA real depreciation after 1985. This case is of interest because the large appreciation of the French Franc vis-a-vis the US dollar since 1985 caused a reduction in the FOB price of cocoa in terms of CFA. As a result, to maintain producer prices at the same level, the government significantly reduced its revenues drawn from the cocoa sector and provided ineffective production subsidies (e.g., in 1989) before halving the price in 1990.

In all scenarios, other cocoa producing countries were assumed not to change their export taxes in response to the tax changes in Cote d'Ivoire. Finally, cocoa producer prices were assumed not to have been changed by the other three major West African cocoa producers, and therefore that their production would not have been affected.[9] The simulation results are presented in Tables 3.1-3.6.

A similar exercise to that applied to Cote d'Ivoire was applied to Cameroon. The optimal tax for Cameroon was determined using the formula shown above, and assuming (i) that government and farmers have the same price expectations, (ii) that Cameroon's world market share at time i is 7.3%, and (iii) that the elasticity (e_i) is 0.8. This gives an optimal tax of about 9%. This tax rate is significantly lower than the tax rates actually applied during the period of the late 1970s and 1980s (with the exception of 1989), during which period the rate of cocoa taxation in Cameroon was between 30% and 45%.

In the second Cameroon scenario, we applied the 9% export tax rate during the period 1977-90 and assumed that the CFA remained at its 1985 real level for the period 1985-1990. As in the case of

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[8]See "Ivory Coast Continues to Expand Production", Foreign Agriculture Circular, USDA, January 1980. Also see USDA, Cocoa, October 1981.

[9]These two assumptions are necessary to keep the analysis relatively simple. Also, it is not necessarily true that other cocoa producers would have responded had Côte d'Ivoire imposed a higher tax and/or devalued. For a game-theoretical application of export taxes on cocoa see Panagariya and Schiff (1990).

Cote d'Ivoire it was assumed that other producing countries would not have changed their export taxes or producer prices in response to the changes in Cameroon. This assumption may be more justifiable for Cameroon than in the case of Cote d'Ivoire, since Cameroon produces a much smaller share of world production.

3.3. Impact of Alternative Export Tax and Exchange Rates Policies by Cote d'Ivoire

3.3.1. Impact on the World Cocoa Market

The impacts of alternative export tax rates in Cote d'Ivoire for key variables of the world cocoa market are shown in Table 3.1. As in section II, values are reported for 1989/90 and for the cumulated totals for the period 1982/83-1989/90. A comparison is made between actual values and the results from the counter-factual scenarios.

If Cote d'Ivoire had set its export tax at 60% during the 1977-83 period, world production would have been 2.35 million tons--3.3% lower than actual production in 1989/90. This is because a higher tax rate puts a larger wedge between the producer and world prices, forcing the producer price lower. The small reduction in world production increases the world price of cocoa in terms of 1984/85 US dollars to about 96¢/kg--11.7% higher than the actual price of 86¢/kg. Because of the inelasticity of world demand, the value of world production of US$2.26 billion is 8% higher in the counter-factual scenario. Lower production and higher prices cause world stocks and grindings levels to be reduced by about 8% and 2.3%, respectively.

The cumulative effect of the 60% export tax rate in Cote d'Ivoire over the period 1982/83-89/90 is for world production to be about 1.7% lower. Since producer prices of the other major West African cocoa producing countries are assumed not to be linked to the world price, there is no off-setting supply response to higher world prices. Stocks and grindings would have been 4% and 1% lower, respectively, over the 1982/83-89/90 period, and on average, the real world price of cocoa would have been about 3% higher. Finally, the cumulative value of production would have been about 2.5% higher with the 60% export tax rate.

In scenario II, with the tax rate in Cote d'Ivoire set at 40%, the producer price is lower than its actual level was and, as a result, production in Cote d'Ivoire is below its actual level but not by as much as in scenario I. Therefore, all the effects on the world market are the same in terms of the direction

of change, but are smaller in magnitude. In 1989/90, world production would have been 2.4 million tons--1.4% lower than the actual level. As a result, the world price would have been 90¢/kg in terms of constant 1984/85 US dollars--about 4¢/kg higher than the actual price. This increase in the world price causes the demand for cocoa by consumers and stock-holders to fall by 1% and 3.7%, respectively. Finally, the value of production is about US$70 million higher in 1989/90.

In Scenario III with a 40% tax rate and a real depreciation of the CFA, the producer price of cocoa in Cote d'Ivoire is lower than the actual price but higher than in the two other scenarios. Therefore, the directions of the changes in world market variables are the same, but are the smallest in magnitude.

Table 3.1: Impact of Alternative Export Tax and Real Exchange Rate Policies in Cote d'Ivoire
on the World Cocoa Market

Scenario		World Production ('000 tons)	Real Price (1984/85 ¢/kg)	Real Value of Production (1984/85 Mil. $)	World Stocks ('000 tons)	World Grindings ('000 tons)
Factual[3/]	1989/90	2,435.0	86.01	2,094.3	1,473.0	2,193.0
	Cumulative[1/]	16,145.0	165.50[2/]	25,362.4	6,729.0	15,296.0
Scenario I[4/].	1989/90	2,354.5	96.05	2,261.4	1,358.0	2,142.5
	Cumulative[1/]	15,870.0	170.10[2/]	26,005.9	6,450.7	15,136.2
Scenario II[5/].	1989/90	2,404.1	90.03	2,164.5	1,419.0	2,172.0
	Cumulative[1/]	16,017.8	167.40[2/]	25,649.2	6,598.2	15,222.5
Scenario III[6/].	1989/90	2,412.6	89.30	2,153.8	1,425.6	2,175.0
	Cumulative[1/]	16,029.4	167.30[2/]	25,634.5	6,606.5	15,227.9

1/   Cumulative for the period 1982/83-1989/90.
2/   Average 1982/83-1989/90.
3/   Actual case.
4/   Optimal tax (60%). Government has rational price expectations, farmers have naive price expectations.
5/   Optimal tax (40%). Government and farmers have the same price expectations.
6/   Optimal tax (40%). Real depreciation of CFA (i.e., real exchange rate at 1984/85 level). Government and farmers have the same price expectations.

Table 3.2: Impact of Alternative Export Tax and Real Exchange Rate Policies
in Cote d'Ivoire on Cote d'Ivoire

Scenarios		Producer Surplus	Government Revenue	Total Welfare	Value of Production	Production
		-----------------(1984/85 US$ mill.)-----------------				('000 tons)
Factual[2]	1989/90	148.7	51.0	199.7	653.5	710.0
	Cumulative[1]	2,900.3	1,908.3	4,808.6	7,757.3	4,707.0
Scenario I[3].	1989/90	129.7	78.6	208.3	636.5	619.3
	Cumulative	2,374.1	2,531.2	4,905.3	7,694.3	4,410.5
Scenario II[4].	1989/90	141.7	63.4	205.1	650.1	674.7
	Cumulative	2,567.1	2,348.7	4,916.0	7,732.9	4,570.4
Scenario III[5].	1989/90	253.1	298.7	551.8	653.2	683.8
	Cumulative	3,342.1	4,792.0	8,134.1	7,736.8	4,582.6

1/ Cumulative for the period 1982/83-1989/90.
2/ Actual case.
3/ Optimal tax (60%). Government has rational price expectations, farmers have naive price expectations.
4/ Optimal tax (40%). Government and farmers have the same price expectations.
5/ Optimal tax (40%). Depreciation of CFA (i.e., real exchange rate at 1984/85 level). Government and farmers have the same price expectations.

3.3.2. Impact on Cote d'Ivoire

The impacts of alternative tax rates on Cote d'Ivoire are shown in Table 3.2. Actual producer surplus in 1989/90 was US$148.7 million, compared to US$129.7 million in the scenario where Cote d'Ivoire sets a tax rate of 60%. This is because both the level of production and producer price are lower. Government revenue changes from US$51 million to US$78.6 million, an increase of about 54%, because of the larger wedge placed between the producer and world prices and because the world price is higher. The increase in government revenue overwhelms the decline in producer surplus, so that total

28

welfare increases to US$208.3 million in 1989/90, about 4% above the level actually realized. Production in Cote d'Ivoire in 1989/90 was 710,000 tons; if the tax rate had been set at 60% it would have been about 13% lower at 619,300 tons. The value of production is slightly lower in the counter-factual case, because of lower production, despite the increase in the world price.

In scenario II, producer surplus is lower than what actually occurred because both production and the producer price are lower. However, government revenue is higher because of the higher tax rate. The sum of the two is higher but by less than 3%. Although the world price is higher than the realized price, the lower production causes the value of production to be lower, although by only about 0.5%.

The simulated effect of CFA real depreciation on the cocoa sector in Cote d'Ivoire was important as shown by the results for scenario III. The real depreciation of the CFA causes the FOB price to be higher than its actual level, and, although the tax rate is higher (40% instead of about 30%), the producer price is higher.[10] As a result, for 1989/90, producer surplus increases from US$148.7 million to US$253.1 million, an increase of more than 70%. The higher FOB price causes government revenue to be considerably higher also--almost six times its actual level. Interestingly, production for 1989/90 is lower at 683,800 tons (compared to 710,000 tons actual) despite higher producer prices in the post-1985 period. Production is lower because the tax rate was higher in the 1977-83 period, resulting in fewer new plantings. The higher producer prices in the post-1985 period are not in place long enough in the simulation for production to recover because of the lags in the response of production to price increases (see Annex II). If the simulation had been continued into the early-1990s period, a positive supply response would have been observed.

3.3.3. Impact on Cameroon

The impacts of different export tax rates in Cote d'Ivoire on Cameroon are shown in Table 3.3. With actual export tax levels in Cote d'Ivoire, producer surplus and the level of production in Cameroon

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[10]For these scenarios, the producer price for Côte d'Ivoire was determined by the following relationships:

Producer Price	=	FOB Price - Marketing Cost - Export Tax;
Tax	=	Tax Rate * FOB Price;
FOB Price	=	f(Exchange Rate, World Cocoa Price).

In this case, the tax rate is determined exogenously and the producer price is endogenous. For the rest of the West African producers, the producer price is specified as in Annex II. That is, the producer price is exogenous and the tax rate is endogenous.

were Us\$51.3 million and 125,000 tons, respectively, in 1989/90. If the tax rate had been increased to 60%, no changes would have occurred in these variables because they are determined by the producer prices which are not affected by policy changes in Cote d'Ivoire directly or by changes in world cocoa market conditions. However, the higher world price leads to an increase in government revenue (because of higher taxes) and in producer surplus. As well, the increase in the world price causes the value of production to increase from US\$120.7 million to US\$134.8 million.

For scenarios II and III, production and producer surplus are the same as in the actual case. Government revenue is higher because of the increase in the world cocoa price resulting from the lower production. The sum of producer surplus and government revenues is about 5% and 4% higher, respectively, for scenarios II and III, compared to the actual level. The value of production is higher in these scenarios because of the higher world price of cocoa. In scenario II, the value of production is about 5% higher than the base case, and in scenario III it is 4% higher.

Table 3.3: Impact of Alternative Export Tax and Real Exchange Rate Policies
in Cote d'Ivoire on Cameroon

Scenario		Producer Surplus	Government Revenue	Total Welfare	Value of Production	Production
		------------(1984/85 US$ mill.)------------				('000 tons)
Factual[2]	1989/90	51.3	7.4	58.7	120.7	125.0
	Cumulative[1]	594.2	504.6	1,098.8	1,744.3	955.0
Scenario I[3].	1989/90	51.3	14.1	65.4	134.8	125.0
	Cumulative	594.2	544.4	1,138.6	1,805.0	955.0
Scenario II[4].	1989/90	51.3	10.1	61.4	126.4	125.0
	Cumulative	594.2	521.8	1,116.0	1,771.1	955.0
Scenario III[5].	1989/90	51.3	9.6	60.9	125.3	125.0
	Cumulative	594.2	521.1	1,115.3	1,769.6	955.0

1/ Cumulative for the period 1982/83-1989/90.
2/ Actual case.
3/ Optimal tax (60%). Government has rational price expectations, farmers have naive price expectations.
4/ Optimal tax (40%). Government and farmers have the same price expectations.
5/ Optimal tax (40%). Real depreciation of CFA (i.e., real exchange rate at 1984/85 level). Government and farmers have the same price expectations.

3.3.4. Impact on Ghana

The impacts of alternative tax rates in Cote d'Ivoire on Ghana are shown in Table 3.4. No changes in production or producer surplus are shown in the counter-factual scenarios because the tax rates in Cote d'Ivoire are assumed to have no effect on producer prices in Ghana. The results show that Ghana

31

Table 3.4: Impact of Alternative Export Tax and Real Exchange Rate Policies in Cote d'Ivoire on Ghana

Scenario		Producer Surplus	Government Revenue	Total Welfare	Value of Production	Production
		------------------(1984/85 US$ mill.)------------------				('000 tons)
Factual[2]	1989/90	17.0	87.8	104.8	298.1	295.0
	Cumulative[1]	817.0	-763.7	53.3	3,165.8	1,742.0
Scenario I[3].	1989/90	17.0	117.3	134.3	332.9	295.0
	Cumulative	817.0	-659.8	157.2	3,293.0	1,742.0
Scenario II[4].	1989/90	17.0	100.6	117.6	312.1	295.0
	Cumulative	817.0	-717.2	99.8	3,222.6	1,742.0
Scenario III[5].	1989/90	17.0	98.7	115.7	309.4	295.0
	Cumulative	817.0	-719.8	97.2	3,218.9	1,742.0

1/ Cumulative for the period 1982/83-1989/90.
2/ Actual case.
3/ Optimal tax (60%). Government has rational price expectations, farmers have naive price expectations.
4/ Optimal tax (40%). Government and farmers have the same price expectations.
5/ Optimal tax (40%). Real depreciation of CFA (i.e., real exchange rate at 1984/85 level). Government and farmers have the same price expectations.

is made better off by the higher tax rates in Cote d'Ivoire, through the impact of the higher world cocoa price. Government revenue and the value of production in 1989/90 were actually US$87.8 and US$298.1 million, respectively. If Cote d'Ivoire had set its export tax rate at 60%, these would have been as much as US$117.3 million and US$332.9 million.

For scenarios II and III, production and producer surplus are the same as in the actual case. Government revenue is higher because of the increase in the world cocoa price. Total welfare is about 12% and 10% higher, respectively, for scenarios II and III, compared to the actual level. The value of

production is higher in these scenarios because of the higher world price of cocoa. In scenario II, the value of production is about 5% higher than in the base case, and in scenario III it is 4% higher.

3.3.5. Impact on Nigeria

The impacts of alternative export tax policies in Cote d'Ivoire on Nigeria are reported in Table 3.5. If the tax rate had been set at 60%, the value of production would have been US$164.4 in 1989/90,

Table 3.5: Impact of Alternative Export Tax and Real Exchange Rate Policies
in Cote d'Ivoire on Nigeria

Scenario		Producer Surplus	Government Revenue	Total Welfare	Value of Production	Production
		----------(1984/85 US$ mill.)----------				('000 tons)
Factual[2]	1989/90	35.9	0.0	35.9	147.2	160.0
	Cumulative[1]	417.4	-334.5	82.9	1,858.0	1,082.0
Scenario I[3].	1989/90	35.9	24.6	60.5	164.4	160.0
	Cumulative	417.4	-239.9	177.5	1,922.3	1,082.0
Scenario II[4].	1989/90	35.9	15.6	51.5	154.1	160.0
	Cumulative	417.4	-268.8	148.6	1,886.7	1,082.0
Scenario III[5].	1989/90	35.9	14.6	50.5	152.8	160.0
	Cumulative	417.4	-270.2	147.2	1,884.8	1,082.0

1/ Cumulative for the period 1982/83-1989/90.
2/ Actual case. Tax rates at their actual levels.
3/ Optimal tax (60%). Government has rational price expectations, farmers have naive price expectations.
4/ Optimal tax (40%). Government and farmers have the same price expectations.
5/ Optimal tax (40%). Real Depreciation of CFA (i.e., real exchange rate at 1984/85 level). Government and farmers have the same price expectations.

compared to the actual value of US$147.2 million--an increase of almost 12%. Government revenue would also have been higher because the higher world price would have caused the tax collected on

exports to be greater. Total welfare in this counter-factual case is US$60.5 million for 1989/90, compared to only US$35.9 million actually.

For scenarios II and III, production and producer surplus are the same as in the actual case. Government revenue is higher because of the increase in the world cocoa price as a result of lower production. Total welfare is about 43% and 41% higher, respectively, for scenarios II and III, compared to the actual level. The value of production is higher in these scenarios because of the higher world price of cocoa. In scenario II, the value of production is about 5% higher than in the base case, and for scenario III it is 4% higher.

3.3.6. Impact on Cote d'Ivoire, Cameroon, Ghana, and Nigeria

The combined impacts of alternative export tax policies in Cote d'Ivoire on the four major SSA cocoa producers are reported in Table 3.6. Over the 1982/83-89/90 period, the level of cocoa production in Cote d'Ivoire was 11% lower as a result of the reduced production induced by the higher tax rate. However, because of the impact of lower production on the world price, the accumulated value of production was slightly higher (1.3%). This is not a surprising result given the price-inelastic nature of cocoa demand. Total welfare increased by 5.5% as a result of imposing the 60% tax (because of the higher government revenue in all four countries) despite the small decline in combined producer surplus.

3.4. Impact of Alternative Export Tax and Exchange Rate Policies in Cameroon
3.4.1. Impact on the World Cocoa Market

The impacts of alternative export tax rates in Cameroon for key variables of the world cocoa market are shown in Table 3.7. In 1989/90 actual world production was 2.43 million tons. If Cameroon had reduced its export tax to 9% during the 1977-83 period (scenario IV), world production would have been 2.47 million tons (1.6%) higher. The small increase in world production reduces the world price of cocoa in terms of 1984/85 US dollars to about 82¢/kg--4.5% lower than the actual price of 86¢/kg. Because of the inelasticity of world demand, the value of world production of US$2.0 billion is 3.3% lower than in the actual case. Higher production and lower prices cause world grindings levels to be increased by about 1.0%.

34

Table 3.6: Impact of Alternative Export Tax and Real Exchange Rate Policies in Cote d'Ivoire on Cameroon, Cote d'Ivoire, Ghana, and Nigeria Combined

Scenario		Producer Surplus	Government Revenue	Total Welfare	Value of Production	Production
		------------------------(1984/85 US$ mill.)------------------------				('000 tons)
Factual[2]	1989/90	252.9	140.2	393.1	1,219.5	1,290.0
	Cumulative[1]	4,728.7	1,314.7	6,043.6	14,525.4	8,486.0
Scenario I[3].	1989/90	233.9	234.9	468.8	1,268.6	1,199.3
	Cumulative	4,202.7	2,175.9	6,378.6	14,714.6	8,189.5
Scenario II[4].	1989/90	245.9	189.7	435.6	1,242.7	1254.7
	Cumulative	4,395.7	1,884.5	6,280.2	14,613.3	8,349.4
Scenario III[5].	1989/90	357.3	421.6	778.9	1,240.9	1,263.8
	Cumulative	5,170.7	4,323.1	9,493.8	14,610.1	8,361.6

1/	Cumulative for the period 1982/83-1989/90.
2/	Actual case.
3/	Optimal tax (60%). Government has rational price expectations, farmers have naive price expectations.
4/	Optimal tax (40%). Government and farmers have the same price expectations.
5/	Optimal tax (40%). Real depreciation of CFA (i.e., real exchange rate at 1984/85 level). Government and farmers have the same price expectations.

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Table 3.7: Impact of Alternative Export Tax and Real Exchange Rate Policies in Cameroon on the World Cocoa Market

Scenario		World Production ('000 tons)	Real Price (1984/85 ¢/kg)	Real Value of Production (1984/85 Mil. $)	World Grindings ('000 tons)
Factual[3]	1989/90	2,435.0	86.0	2,094.3	2,193.0
	Cumulative[1]	16,145.0	165.50[2]	25,362.4	15,296.0
Scenario IV[4].	1989/90	2,466.2	82.1	2,024.2	2,214.8
	Cumulative[1]	16,301.9	160.6[2]	24,795.4	15,407.2
Scenario V[5].	1989/90	2,491.6	79.8	1,988.4	2,227.9
	Cumulative[1]	16,362.2	159.8[2]	24,694.2	15,438.6

1/   Cumulative for the period 1982/83-1989/90.   2/   Average 1982/83-1989/90.
3/   Actual case.
4/   Optimal tax (9%). Government and farmers have the same price expectations.
5/   Optimal tax (9%). Real depreciation of CFA (i.e., real exchange rate at 1984/85 level). Government and farmers have the same price expectations.

The cumulative effect of the 9% export tax rate in Cameroon over the period 1982/83-1989/90 is for world production to be about 1% higher, because of higher production in Cameroon. Since producer prices of the other major west African cocoa producing countries are assumed not to be linked to the world price, there is no off-setting supply response to lower world prices. Grindings would have been 0.7% higher over the 1982/83-1989/90 period and, on average, the real world price of cocoa would have been about 3% lower. Finally, the cumulative value of production would have been about 2.2% lower.

In scenario V, the tax rate in Cameroon was set at 9% and a real depreciation of the CFA was assumed. This increases the producer price more than in scenario IV. As a result, all the effects on the world market are the same in terms of the direction of change but are larger in magnitude.

36

In 1989/90, world production would have been 2.47 million tons--2.3% higher than the actual level. As a result, the world price is 80¢/kg in terms of constant 1984/85 US dollars--about 6¢/kg lower than the actual price. This decline in the world price causes the demand for cocoa by consumers to increase by 1.6%. Finally, the value of production is about US$106 million lower in 1989/90.

3.4.2. Impact on Cameroon

The impacts of different export tax rates in Cameroon on Cameroon itself are shown in Table 3.8. Actual producer surplus in 1989/90 was US$51.3 million, compared to US$65.8 million in the scenario where Cameroon sets a tax rate of 9%. This is because both the level of production and producer price are higher. Government revenue declines from US$7.4 million to US$6 million. The increase in producer surplus overwhelms the decline in government revenue, so that total welfare increases to US$71.9 million in 1989/90--about 22% above the level actually realized for 1989/90. Production in Cameroon in 1989/90 was 125,000 tons; if the tax rate had been set at 9% it would have been about 28% higher at 160,500 tons. The value of production is higher in the counter-factual case because of the higher production, despite the fall in the world cocoa price.

The real depreciation of the CFA has an important impact on the cocoa sector in Cameroon as shown by the results for scenario V. This causes the FOB price to be higher than its actual level so that the producer price is higher. As a result, for 1989/90, producer surplus increases from the realized level of US$51.7 million to US$76.8 million--an increase of almost 50%. The higher FOB price causes government revenue to be considerably higher as well.

The combined impacts of alternative export tax policies in Cameroon on the four major SSA cocoa producers can be expected to be fairly small because Cameroon is a relatively small contributor to the world cocoa market. The kinds of policy changes considered here would cause the world price to change by less than 3%.

Table 3.8: Impact of Alternative Export Tax and Real Exchange
Rate Policies in Cameroon on Cameroon

Scenario		Producer Surplus	Government Revenue	Total Welfare	Value of Production	Production
		------------------(1984/85 US$ mill.)---------------------				('000 tons)
Factual[2]	1989/90	51.3	7.4	58.7	120.7	125.0
	Cumulative[1]	594.2	504.6	1,098.8	1,744.3	955.0
Scenario IV[3].	1989/90	65.8	6.0	71.9	147.9	160.5
	Cumulative	696.7	162.8	859.5	1,957.5	1,126.9
Scenario V[4].	1989/90	76.8	15.8	92.6	167.8	187.3
	Cumulative	728.4	217.7	946.1	2,012.2	1,189.1

1/   Cumulative for the period 1982/83-1989/90.
2/   Actual case.
3/   Optimal tax (9%). Government and farmers have the same price expectations.
4/   Optimal tax (9%). Real depreciation of CFA (i.e., real exchange rate at 1984/85 level). Government and farmers have the same price expectations.

IV. Conclusions and Discussion

The paper reports an analysis of the impacts of macroeconomic and sector-specific policies in major SSA cocoa producing countries on the cocoa subsectors of these countries and on the world market for cocoa. We chose to study cocoa because it is an important commodity in several countries in SSA, including Ghana and Nigeria, both of which recently undertook structural adjustment programs. Also, SSA countries have significant market shares in world cocoa production and hence policy changes in these countries can have a considerable impact on the world cocoa market. This aspect is relevant because of the questions raised about the flow-on effects from countries undertaking SAPs which lead to increases in production of perennial export crops.

To evaluate the effects of the policy changes, we used a global econometric model of the cocoa market with supply of major producing countries specified by the vintage-capital approach. Choice of the analytical tool is of great importance. It is important for the analysis to be global to take into account the reactions by other producing countries and by consumers. Also, it is important to use the vintage-capital approach to modeling supply because the effects of policy changes only become evident in the perennial sector several years after they are implemented. The long gestation period for perennials is a key factor to be taken into account when designing and analyzing policies affecting perennial crops.

The simulation results show that world cocoa prices would have been on average 8% higher and the value of world cocoa production 6% higher on average had there not been any structural adjustment programs in Ghana and Nigeria over the period 1982/83-1989/90. This result is not surprising because world demand for cocoa is inelastic. It should be noted that the impact of the SAPs in Ghana and Nigeria on world cocoa prices was relatively small when viewed against the sharp decline in world prices that took place during the 1980s. World cocoa prices in constant 1985 dollar terms declined from about US$1,900/ton in the early 1980s to about US$850/ton in the late 1980s--a decline of 55%. According to the simulation results, world cocoa prices would have been about US$1,060/ton in the late 1980s had there not been SAPs in Ghana and Nigeria--45% lower than prices which prevailed in the early 1980s. The major part of the world cocoa price decline in the 1980s can be attributed to the rapid production increases in other countries--Cote d'Ivoire, Indonesia, and Malaysia. These countries, encouraged by the high world cocoa prices in the late 1970s and the introduction of new high-yielding varieties, increased their production sharply throughout the 1980s--Malaysia increased production by about 200,000 tons,

Indonesia's production increased by about 85,000 tons, and Cote d'Ivoire's production increased by about 400,000 tons. By comparison, it is estimated that Ghana's production increased from 159,000 tons to 295,000 tons due to its SAP.

The benefits to Ghana from the adjustment program were large. Had Ghana not implemented the program, its production would have been almost one half of what it actually was in 1989/90. Producers' welfare (measured as producers surplus) would have been substantially lower in the absence of the program and the government's budget deficit would have been at an unsustainable level. Given the continuing efforts to reduce marketing costs through the liberalization of its cocoa marketing system, Ghana's production is likely to increase even further. The impacts on the cocoa sector are only part of the story, of course. The SAP should have positive impacts on other sectors, particularly export sectors—albeit with a lag because of investor wariness about the staying power of the policy changes.

The effects of the adjustment program in Nigeria up to 1989/90 are mixed. The simulation results show lower production but higher total welfare without the adjustments. The main reason for these results is that we are able to evaluate the effects only three years after the implementation of the program. Given the lagged response of perennial crop production to changes in incentives, it is most likely that Nigeria's total welfare would be seen to be higher under the SAP if the evaluation were made in the mid-1990s.

The simulation results also show that for the four major SSA cocoa producing countries combined, the structural adjustment programs in Ghana and Nigeria increased what we have called total welfare of the four SSA producers by 12% over the period 1982/83-1989/90 and total production in 1989/90 was 15% higher. Thus, the effects of the programs on SSA as a whole have been positive, while having adverse effects in other cocoa producing countries such as Brazil, Indonesia and Malaysia.

The structural adjustments in Ghana and Nigeria have also had negative effects on Cameroon and Cote d'Ivoire, because they led to lower world prices. However, problems of greater significance for the cocoa sectors in these countries have been their real exchange rate and producer pricing policies. As discussed by Trivedi and Akiyama (1992), it is very difficult for these countries to maintain competitive cocoa subsectors when their real exchange rates are over-valued. The simulation results on Cote d'Ivoire and Cameroon suggest that the cocoa sectors in the two countries would have fared better had the

40

government implemented export taxes closer to their "optimal" level, jointly with a depreciation of the real exchange rate. From the simulation runs on Cote d'Ivoire we have the result that had the export tax on cocoa been higher and closer to what is estimated to have been the optimal level in the 1980s, Ivorian total welfare would have been about the same but with lower cocoa production. In spite of the lower production, Ivorian export revenue from cocoa would have been about the same due to higher world prices. It is to be noted too that probably total agricultural production and export revenue would have been higher because labor and land not engaged in cocoa production would have been used to produce other agricultural commodities for domestic consumption or export.

The results also suggest that the world cocoa market is, in a sense, not different from industrial goods markets where market share is lost if productivity is not increased in line with that of competitors. The recent production increases in Indonesia and Malaysia have shown vividly that SSA countries cannot base their competitiveness on favorable climate and cheap labor alone. SSA countries should aim at increasing productivity or reducing production and marketing costs to keep cocoa production competitive with other major producers.

The impact of Ghana and Nigeria's policies on other producers raises the question as to whether such policies can be justified; what if similar policies are also implemented by other producers? To put the situation in context as far as Ghana and Nigeria are concerned, it should be remembered that their earlier poor policies led to declines in production and to world prices being higher than they would be otherwise. This upward pressure on prices no doubt made some contribution to the expansion of production in Cote d'Ivoire and in other countries. Should Ghana and Nigeria therefore not have adopted these SAPs or adopted policies leading to diversification out of cocoa, thereby permanently forfeiting a larger share of the world market? It makes no economic sense for Ghana and Nigeria to have done so as they would be forfeiting comparative advantage in cocoa production which they clearly possess.

Our view is that all cocoa producing countries' interests would be best served if they adopt market-based real exchange rates, free up producer prices, privatize their marketing and distribution channels, and adopt sensible policies on export taxes. If this means that world prices would be lower on average, this has to be accepted as unavoidable and countries have to compete within such a market. Lower prices would not preclude profitable production, but some countries would be forced to reduce production and to move into other activities. The issues to be faced up to, especially by SSA producers,

41

include: how to improve the rate of growth of productivity; how to lower marketing costs and improve quality; and how to improve the supply response of other export activities, whether agricultural, manufacturing or services.

The issue of what rate of export tax to adopt is a vexing one. If all large countries adopted their optimal tax rate[11] and if such countries used marginal revenues[12] in planning production expansion, the so-called "adding up" problem would disappear. Until recently, export taxes levied on cocoa worldwide were likely much higher than the optimal level in aggregate; nearly all producers levied export taxes as this is a major form of taxation for small, commodity-dependent economies. Recent structural adjustment programs and the low level of cocoa prices have led to a substantial reduction of export taxes. It is likely that if prices rise, export taxes will be increased; but whether they will go back to their earlier high levels is questionable.

Other issues relevant to the appropriate level of the export tax are: whether even large producers have any monopoly power in the long run, because of the impact of substitutes; and the use of such taxes for strategic purposes. History suggests propping up prices through use of export taxes or international agreements eventually leads to loss of markets. The experiences of jute, tin, and possibly coffee, give support to this view. Without similar action by other large producers, implementation of an export tax may simply lead to loss of market share as Ghana's pre-1983 experience in cocoa and Cote d'Ivoire's experience with withholding cocoa from sale in 1990 would attest. If export taxes are applied, it is important that the rates are reviewed in the light of changes in the market and changes in tax rates by other countries.

Finally, if a large cocoa producing country is to increase its production, it may be preferable to do so through production cost reduction measures rather than through area expansion measures. If a large

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[11] Using a rule-of-thumb measure for estimating the optimal export tax rate and assuming world cocoa production to be about 2.75 million tons and the share of Côte d'Ivoire, Ghana, Nigeria and Cameroon to be 26%, 13%, 7%, and 4%, respectively, in the year 2000, the optimal export tax rates for these countries are: 33% for Côte d'Ivoire; 17% for Ghana; 8% for Nigeria; and 5% for Cameroon.

[12] When a "large" cocoa producing country expands its production, its marginal revenue is not the world price because of the price-depressing effect through the inelastic world demand. The marginal revenue from increased exports is lower the larger the country's market share. For example, if a country holds nearly 30% of the world market, its marginal revenue would be less than one half of the world price.

producing country increases its production through area expansion while maintaining the same production cost structure, the welfare of existing growers declines because of the lower world prices caused by increased production. The impact on existing producers is considerably reduced if production expansion is achieved through production cost reduction.

Annex I

Structural Adjustment Programs of Major Cocoa Producing Countries in SSA

A1.1. Ghana's Cocoa Sector and the Structural Adjustment Program

A1.1.1. Background

Following a series of internal and external shocks, compounded by poor economic management, Ghana's economy deteriorated considerably during the 1970s and early-1980s. The government bureaucracy grew enormously and became highly inefficient, budget deficits ballooned and inflation increased. Also, the real value of the cedi appreciated considerably, causing the terms of trade to move sharply against the export sector. A foreign exchange crisis followed as exports became uncompetitive and as manufacturers lost market share to cheaper imports.

To address these problems, the government introduced quantitative restrictions on imports and limited the supply of foreign exchange. However, these measures only exacerbated the decline in the rate of economic growth. As the economy declined, government tax revenues fell, forcing major cuts in recurrent and capital public expenditures. In addition to these measures, the government tried to control inflation by imposing price controls and introducing a system of rationing. This distortion of price signals and market incentives led to growth of the black market, corruption, smuggling, and tax evasion.

In addition to the effects of poor policies, Ghana's economy suffered from a series of internal and external shocks. A drought in the early-1980s caused severe food shortages which sent food prices to unprecedented levels. During this period international commodity price movements led to a sharp adverse movement in Ghana's terms of trade. In particular, the higher price of crude oil led to a serious deterioration in the balance of trade, which was worsened by falling revenues from lower international cocoa prices.

The impact of these events on Ghana's economy are well illustrated by comparing leading indicators for 1970 and 1982. Between these years, per capita income fell 30% in real terms, while domestic saving and investment declined from 12% and 14% of GDP, respectively, to almost nothing. Prices increased at an annual average rate of 44%, while real export earnings fell 52%.

Since 1983, the government has pursued a program of structural adjustment. This has included a number of phases: the Economic Recovery Program (1983-86); SAP Phase I (1987-89); and SAP Phase II (1989-90). The objectives of the reforms were to: (i) shift relative prices in favor of production for exports; (ii) restore fiscal and monetary discipline and stability; (iii) initiate rehabilitation of Ghana's

productive base and economic infrastructure; and (iv) restore incentives for private savings and investment. These measures included significant institutional reform in the areas of trade and exchange rate policy, cocoa sector restructuring, state-owned enterprises, and public resource and sector management.

A1.1.2.Performance of Ghana's Cocoa Sector During the 1980s

A number of policy changes were introduced within the cocoa sector as part of the SAP covering the production, marketing, and export of cocoa. Among the major objectives of the reforms were to: (i) increase production by improving producer price incentives; (ii) reduce the size and operating costs of the Ghana Cocoa Board (COCOBOD); (iii) remove the barriers to entry placed on the private sector in input supply, marketing, and processing; and (iv) intensifying research on new technology and disease control.

The production of cocoa in Ghana was highly variable during the 1980s. This is shown in Table A1.1. Production fell by more than 100,000 tons between 1980/81 and 1983/84 as a result of poor producer incentives, combined with severe climatic conditions. Since the SAP was introduced, increases in cocoa production have been achieved, with production reaching 300,000 tons in 1988/89 and 295,000 tons in 1989/90.

Table A1.1: Ghana: Cocoa Production and Export Values, 1980/81-90/91

	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
				---------- '000 tons ----------							
Production	258	225	178	159	175	219	228	188	300	295	295
				---------- Nominal Cedi Bn. ----------							
Export Value	1.1	1.1	6.3	12.9	18.3	41.6	80.3	93.6	112.2	116.7	129.9
				---------- 1989/90 Cedi Bn. ----------							
Export Value (constant terms)1/	20.0	14.2	43.1	52.9	69.7	130.4	181.0	158.3	151.7	116.7	99.9

1/ CPI Deflated.
Source: IMF, Financial Statistics, and Gill & Duffus, London.

A1.1.3.Impact of Changes in Exchange Rates and Inflation on Ghana's Cocoa Sector

Under the structural adjustment program, major reforms took place in exchange rate policy. Beginning in 1983, the currency was devalued from cedi 2.7 per US dollar to cedi 90 per US dollar by the beginning of 1986. In September of that year, an auction system was established covering almost two-thirds of all external transactions. By February 1987, the auction rate was cedi 150 per US dollar, and by the beginning of 1989 it had fallen further to cedi 230 per US dollar. In early 1988, the auction system was widened to cover almost all external transactions, and most foreign exchange controls on imported items were removed. The government also established a number of non-governmental foreign exchange bureaus which are permitted to buy and sell foreign exchange independent of the market rate. By 1990, the auction exchange rate was cedi 326 per US dollar, close to the rate established in the foreign exchange bureaus and in the parallel foreign exchange market. The differential between these rates is expected to become even smaller in the future, as the coverage of external transactions using the auction market is widened.

Ghana experienced high rates of inflation throughout the 1980s (see Table A1.2). In the early-1980s, widespread production shortages and the oil price shock caused prices to rise considerably; while the rapid devaluation of the cedi in the mid- and late-1980s fuelled this inflation. The rapid inflation of the early-1980s, together with the fixed nominal exchange rate, caused a rapid appreciation of the real

exchange rate (see Table A1.2). Between 1980 and 1983 the real exchange rate index increased almost five-fold. With the devaluation of the cedi between 1983 and 1984 the real exchange rate index fell from 470 to only 64. Since then, the real exchange rate has been on a steady downtrend. The main impact of the massive devaluation in 1984 was to dramatically alter the terms of trade, increasing the competitiveness of the export sector.

Table A1.2: Ghana: Inflation Rate, and Nominal and Real Exchange Rate, 1980-90

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Nominal Exchange Rate (cedi/$)	2.7	2.7	2.7	3.4	35.3	54.4	89.2	153.7	202.3	270.0	326.1
Consumer Price Index	100.0	216.5	264.8	590.1	824.1	909.1	1,132.7	1,583.7	2,080.0	2,604.6	3,601.9
Real[1/] Exchange Rate	100.0	216.5	264.8	470.4	64.1	46.0	34.9	28.3	28.3	26.5	30.4

Source: IMF, Financial Statistics.
[1/]   Real exchange rate is calculated with the formula,
           $RER_t = (NER_{80}/NER_t) * (CPI_t/CPI_{80})$
           RER_t = Real exchange rate at time t,
           NER_{80} = Nominal exchange rate in 1980,
           NER_t = Nominal exchange rate at time t,
           CPI_t = Consumer price index at time t, and
           CPI_{80} = Consumer price index in 1980.

A1.1.4. The Impact of Producer Pricing and Taxation in Ghana's Cocoa Sector

Cocoa marketing in Ghana is controlled by the Cocoa Board (COCOBOD) which organizes all stages of marketing, from purchases at the farmgate through exports or domestic sales. The COCOBOD sets producers' prices and taxation, determines the terms and conditions of purchase, and the dates of opening and closing of the cocoa season (Varangis, Akiyama, and Thigpen, 1990). Cocoa prices, marketing costs, and export taxes for the 1980s are reported in Table A1.3.

48

Table A1.3: Ghana: Domestic and Export Cocoa Prices, Marketing Costs,
and Export Taxes, 1981/82-90/91

	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
				---------- Cedi/KG ----------						
Producer Price[1/] (a)	12.0	12.0	20.0	30.0	56.6	83.3	140.0	165.0	174.4	224.0
Real Producer Price[2/]	155.5	82.2	82.1	114.2	117.4	187.8	236.8	223.1	174.0	172.3
Marketing Costs (b)	12.8	24.2	36.3	48.0	55.2	86.4	138.4	90.7	96.7	123.2
Cost at the Port (c)=(a)+(b)	24.8	36.2	56.3	78.0	111.8	169.7	278.4	255.7	271.1	347.2
Actual CIF Price (d)	5.3	6.0	77.4	132.5	196.0	286.6	391.9	413.1	459.6	518.2
Freight & Insurance (e)	0.4	0.4	3.9	7.2	14.9	23.8	31.6	33.9	44.6	54.8
Actual FOB Price (f)=(d)-(e)	4.9	5.6	73.6	125.5	181.1	262.8	360.3	379.1	415.0	463.4
Implicit Tax (g)=(f)-(c)	-19.8	-30.5	17.2	47.5	69.3	93.0	81.9	123.5	143.9	116.2
Tax Rate (%) (h)=(g)/(f)	-402.7	-541.	23.4	37.9	38.2	35.4	22.7	32.6	34.7	25.1

[1/] Includes Premium 1984/85-1988/89.
[2/] Deflated by CPI (1989/90 = 100).
Source: ICCO and World Bank.

In 1981/82, Ghana's cocoa producers received a price of cedi 12/kg which, added to marketing costs of cedi 4.6/kg, gave a cost at the port of cedi 16.6/kg. Given the highly over-valued exchange rate, the actual cost at the port was only cedi 4.9/kg, giving an implicit subsidy to growers of cedi 11.7/kg, or 237% of the actual cost at the port. After the 1982/83 crop season, the cedi depreciated significantly, with the result that the actual cost at the port (measured in cedi) increased in each year up to and including 1990/91, despite the decline in international prices of cocoa. Producer prices increased in real terms between 1983/84 and 1987/88, but thereafter declined, as nominal producer price increases were less than inflation. Marketing costs also declined (in nominal terms) in 1988/89 as COCOBOD made cuts in its expenditures. The overall impact of these price changes on tax rates is shown in Table A1.3. Between 1983/84 and 1990/91 tax rates ranged between 20% and 40% of the actual cost at the port.

A1.2.Nigeria's Cocoa Sector and the Structural Adjustment Program

A1.2.1.Background

In the 1970s, large oil revenues provided the government of Nigeria with the opportunity to increase expenditures on improving infrastructure and non-oil productive capacity. The rapid growth of the public sector altered relative internal prices and wages, changing the underlying structure of the economy. The exchange rate appreciated substantially during the 1970s which, together with higher domestic costs, led to a loss of competitiveness of its major exports in international markets. Especially hard hit was the agricultural sector, with its share of non-oil GDP falling from 50% in the early 1970s to 30% in 1980. In an attempt to protect domestic industries from foreign competition and to curb inflation, the government introduced widespread trade restrictions through import licensing and quotas.

During the oil boom years, government expenditure kept pace with oil revenues. However, when the oil price fell in the early-1980s, expenditures were not reduced in line with declining revenues. As a result, large deficits accrued which were paid for by public sector borrowing, a run-down of international reserves, and a large-scale accumulation of arrears on external trade payments. In 1984, the government responded by making spending cuts and introducing additional import restrictions. While these cuts lowered the fiscal and external deficit, the economic infrastructure of the economy was severely damaged. Production in most sectors fell and unemployment rose. By 1985, investment had fallen to about one-third of its level in real terms in 1981. The economic woes of the country were worsened in 1983 and 1984 by a severe drought which dramatically lowered agricultural production and sent food prices to record levels.

In August 1985, the government embarked on a major structural adjustment program aimed at redressing the economic decline. The program included an exchange rate and trade reform, designed to foster economic efficiency and long-term economic growth. The program was also aimed at maintaining economic stability and restoring balance of payments equilibrium.

A1.2.2. Performance of the Nigerian Cocoa Sector During the 1980s

Nigeria's cocoa production declined from about 250,000 tons in the early-1970s to around 80,000 tons in 1986/87 (Table A1.4). Since then, production has rebounded, reaching 160,000 tons in 1989/90. This improvement followed a number of adjustments made to the cocoa marketing system, in addition to the devaluation of the naira.

50

In 1986, the Nigerian Cocoa Board (NCB) was abolished and the crop purchasing system was deregulated. Produce inspection and quality control procedures employed by the NAB were abandoned and the licensing system for crop buyers was dissolved. Export trade licenses were also abolished.

Table A1.4: Nigeria: Cocoa Production and Export Values, 1980/81-90/91

	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
				---------- '000 tons ----------							
Production	156	183	156	115	151	110	80	150	160	160	160
				---------- Nominal Naira Bn. ----------							
Export Value	102	134	210	203	184	408	654	1,294	1,327	1,271	NA
				---------- 1989/90 Naira Bn. ----------							
Export Value (constant terms)1/	535	637	850	587	474	1,028	1,486	2,258	1,535	1,271	NA

1/ Deflated by CPI.
Source: IMF, Financial Statistics; and Gill & Duffus, London.
        FAO, Trade Yearbook.

The new marketing system relies exclusively on private traders and exporters. At first there was a deterioration of quality of the cocoa beans marketed, in part because there were no provisions for grading and quality control. However, the main reason for quality deterioration was the existence of exchange rate controls which created a high premium for foreign exchange. This led exporters to enter the cocoa business in order to get access to hard currency which could be exchanged in the parallel market for huge profits. This distortion of the marketing system was largely removed when the foreign exchange market was liberalized (Varangis, Akiyama, and Thigpen, 1990).

A1.2.3.Impact of Exchange Rate and Inflation Changes on Nigeria's Cocoa Sector

Before the structural adjustment program started, the exchange rate was set by the government and foreign exchange was allocated in an arbitrary way. In September 1986, the government introduced the Second-Tier Foreign Exchange Market (SFEM). This established a floating exchange rate system

51

in which a price mechanism was used to allocate foreign exchange among competing users. In July 1987, the official First-Tier rate and the market-determined rate were unified into one system, the Foreign Exchange Market (FEM). This system allocated foreign exchange by auction.

Changes in the value of the naira during this period are shown in Table A1.5. Between 1980 and 1985, the naira was maintained at a high level vis-a-vis the US dollar. However, in 1987 (the first full year of exchange rate reform), the naira was devalued to naira 4.02 per US dollar, compared to naira 0.89 per US dollar in 1985. Since the reforms were put in place, the naira has devalued in each year up until 1991. By 1990, the naira had fallen to naira 8.04 per US dollar.

Table A1.5: Nigeria: Inflation Rate, and Nominal and Real Exchange Rate, 1980-90

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Nominal Exchange Rate (Naira/$)	0.55	0.61	0.67	0.72	0.77	0.89	1.76	4.02	4.54	7.36	8.04
Consumer Price Index	100.0	120.8	130.1	160.3	223.8	236.1	248.8	274.1	378.9	571.6	614.6
Real[1/] Exchange Rate	100.0	107.6	105.6	121.1	159.5	144.3	77.5	37.3	45.6	42.4	41.8

Source: IMF, Financial Statistics.
[1/]   Real exchange rate is calculated with the formula,
        $RER_t = (NER_{80}/NER_t) * (CPI_t/CPI_{80})$
        RER_t = Real exchange rate at time t,
        NER_{80} = Nominal exchange rate in 1980,
        NER_t = Nominal exchange rate at time t,
        CPI_t = Consumer price index at time t, and
        CPI_{80} = Consumer price index in 1980.

The rate of inflation was high throughout the 1980s. The consumer price index is determined mainly by food prices which have a 75% weight in the index. This explains the rapid rise in inflation during 1983 and 1984, as food prices soared in response to lower food production following the drought. It also explains why the inflation rate did not increase dramatically after the devaluation of the exchange rate in the 1986 to 1987 period, as food imports remained under tight licensing control. The rapid

inflation at the end of the decade is also related to food price increases.

The real exchange rate is also reported in Table A1.5. High levels of inflation led to the appreciation of the real exchange rate in the early-1980s, reaching a peak in 1984. Between 1985 and 1987, the real exchange rate devalued considerably, and by 1987 the naira was about one-quarter of its 1985 value. Since then, the exchange rate has remained fairly stable.

A1.2.4. Producer Pricing and Taxation in Nigeria's Cocoa Sector

Until its abolition in 1986, prices paid to cocoa producers were set by the Cocoa Marketing Board. Between 1980 and 1986, prices were nearly constant in nominal terms, resulting in a decline in real terms (see Table A1.6).

Table A1.6: Nigeria: Domestic and Export Cocoa Prices,
Marketing Costs, and Export Taxes, 1981/82-90/91

	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
	--------- Naira/KG ---------									
Producer Price[1] a/	1.30	1.30	1.40	1.50	1.60	6.50	7.50	12.00	9.00	9.00
Real Producer Price[2]	6.20	5.30	4.10	4.30	4.00	14.80	13.30	14.50	9.00	8.70
Marketing Costs b/	0.44	0.51	0.73	0.81	0.83	0.77	1.00	1.51	1.75	2.10
Explicit Tax c/	0.00	0.00	0.00	0.00	0.00	-0.35	-1.36	-3.47	-0.77	-0.41
Cost at the Port d=a+b+c/	1.74	1.81	2.13	2.31	2.43	6.92	7.14	10.04	9.98	10.69
Actual FOB Price e/	1.03	1.12	1.38	1.83	2.09	6.92	7.14	10.04	9.98	10.69
Implicit Tax f=e-d/	-0.71	-0.69	-0.75	-0.48	-0.34	0.00	0.00	0.00	0.00	0.00
Tax Rate (%) h=(f+c)/e /	-69.08	-61.91	-54.58	-26.40	-16.17	-5.13	-19.02	-34.58	-7.76	-3.84

[1] Includes Premium 1984/85-1988/89.
[2] Deflated by CPI (1989/90 = 100).

Between 1986 and 1987, the price of cocoa was increased sharply, from naira 1.6/kg to naira 6.5/kg. Since then, the nominal price increased to naira 12/kg in 1989 but fell to naira 9.0/kg in 1990.

With the high rate of inflation, real cocoa prices fell significantly during the late-1980s, declining one-third between 1986 and 1990. Between 1981/82 and 1984/85, actual FOB prices increased, following the trend of international cocoa prices. However, the value of the naira was maintained at very high levels vis-a-vis the US dollar, such that export prices, expressed in naira, were very low during this period. As a result, producers were highly subsidized.

After the abolition of the marketing board in 1986, no taxes or subsidies were incurred by producers. The depreciation of the naira increased the actual cost of cocoa at the port. In the absence of data on marketing costs during this period, in Table A1.6 these costs have been set equal to the actual cost at the port less the producer price. This gives reasonable results for some years, except in 1986/87 and 1988/89, when it gives rise to negative marketing costs. A possible explanation is that in the post-liberalization period, distortions in the exchange rate regime led to increases in the producer price. This is because traders were competing strongly for cocoa in order to export it and exchange the foreign exchange in the black market. This caused the producer price to exceed the FOB price after accounting for domestic marketing costs. Basically, the exchange rate regime led to a subsidy of the cocoa sector equal to the difference between the FOB price and the producer price plus the domestic marketing costs.

A1.3. Cameroon's and Cote d'Ivoire's Cocoa Sectors and their Structural Adjustment Programs
A1.3.1.Background

SAPs in Cameroon and Cote d'Ivoire included reforms in the cocoa sector. As discussed later, both countries relied on a centralized marketing system based on what is called the Caisse de Stabilization. This system provides the producer with a fixed price. The difference between this system and the marketing board systems in Ghana and Nigeria is that domestic marketing and exports are handled by private agents, working on behalf of the Caisse. If the FOB price determined by the Caisse is higher than the actual FOB price, the exporters pay the difference to the Caisse. If the price is lower, they receive the difference from the Caisse.

In Cote d'Ivoire, the agricultural sector adjustment program (ASAP) of 1989/90 for cocoa mainly called for a reduction of the producer price due to the persistent decline in world cocoa prices and the inability of the domestic stabilization fund to continue supporting producer prices at the existing levels.In concert, payments along the domestic marketing chain were reduced. The ASAP also called for improvements in the efficiency and increased transparency in the operation of the Caisse. Measures were

54

proposed to streamline operations, improve management, transfer commercial activities to the private or cooperative sector and increase the exposure of the Caisse to market forces.

In Cameroon, cocoa prices were reduced in 1989/90 for the same reason as in Cote d'Ivoire. In addition, in 1990/91 ONCPB was abolished and replaced by a smaller organization called ONCC. The stabilization fund was also abolished in 1990/91 and replaced by another stabilization fund whose purpose is to fix cocoa producer prices within a certain year, as opposed throughout a number of years, with producer prices adjusting to market forces from one year to another.

In this paper it was not possible to evaluate the reforms in the cocoa sectors of Cote d'Ivoire and Camerou... as they took effect only at the end of 1980s, and some time is needed before we can evaluate their full impact.

A1.3.2. Performance of Cameroon's Cocoa Sector During the 1980s

Throughout the 1980s, Cameroon's cocoa production was fairly stable but fell sharply in 1991 (see Table A1.7). In 1980/81, production was 124,000 tons but fell to 106,000 tons in 1982/83. Production increased slowly to 131,000 tons in 1987/88, averaging around 122,000 tons in the second half of the decade. Real producer prices have fallen quite sharply throughout the period (see Table A1.9). The decline in production after 1989 is obviously partly due to the low levels of real prices in the late-1980s.

Table A1.7: Cameroon: Cocoa Production and Export Values, 1980/81-1990/91

	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
					--------- '000 tons ---------						
Production	120	122	106	108	120	118	123	131	129	125	100
					--------- Bn. Nominal CFAF ---------						
Export Value (current dollars)	53.6	43.9	57.1	89.0	106.5	95.3	87.3	72.4	56.2	57.7	60.7
					--------- Bn. 1989/90 CFAF ---------						
Export Value (constant terms)1/	100.8	72.4	82.4	112.5	130.4	115.1	96.7	72.3	56.7	57.7	60.1

Source: World Bank.
1/ Deflated by the CPI.

Table A1.7 also contains data on the value of cocoa exports. Given that production has been fairly stable and domestic consumption is negligible, export volumes also have been fairly stable during the 1980s. Therefore, movements in the value of exports have been determined largely by the international price of cocoa. As can be seen, export revenues doubled from CFAF 53.6 billion in 1980/81 to CFAF 106.5 billion in 1984/85. Since 1984/85, export values have declined substantially in both nominal and real terms.

A1.3.3.Impact of Changes in Real Exchange Rates and Inflation on Cameroon's Cocoa Sector

During the 1980s, Cameroon experienced rapid inflation, with the consumer price index doubling over this time (see Table A1.8). The real exchange rate depreciated during the first half of the 1980s, but after 1985 the trend was reversed, with an appreciation of almost 75% in real terms between 1985 and 1989. This rate of appreciation was greater than that of many of Cameroon's competitors in the international cocoa market (e.g., Brazil, Cote d'Ivoire, Ghana, and Nigeria), leading to a decline in Cameroon's competitiveness in producing and exporting cocoa.

56

Table A1.8: Cameroon: Inflation Rate, and Nominal and Real Exchange Rates, 1980-90

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Nominal Exchange Rate (CFA/$)	211.3	271.7	328.6	381.1	437.0	449.3	346.3	300.5	297.5	319.0	272.3
Consumer Price Index	100.0	110.6	124.2	145.1	161.5	163.6	176.2	186.8	203.3	202.8	204.0[1]
Real[2] Exchange Rate	100.0	86.0	79.9	80.5	78.1	76.9	107.5	131.4	144.4	134.4	147.5[1]

Source: IMF, Financial Statistics.
[1]   Forecast.
[2]   Real exchange rate is calculated with the formula,
RER$_t$ = (NER$_{80}$/NER$_t$) * (CPI$_t$/CPI$_{80}$)
RER$_t$ = Real exchange rate at time t,
NER$_{80}$ = Nominal exchange rate in 1980,
NER$_t$ = Nominal exchange rate at time t,
CPI$_t$ = Consumer price index at time t, and
CPI$_{80}$ = Consumer price index in 1980.

A1.3.4. Changes in Producer Pricing and Taxation in Cameroon's Cocoa Sector

During the period under investigation (1980-90), producer prices for cocoa in Cameroon were set each year by the government, under the direction of the Office National de Commercialization des Produits de Base (ONCPB), a parastatal overseeing pricing and exporting of major export commodities. The ONCPB was setting 'equilibrium' prices for each stage of the production/marketing chain, including the price paid to growers. When the domestic price was set below the world cocoa price, a tax was imposed equal to the difference between domestic and international prices. When the domestic price was set above the international price, producers were paid an export subsidy out of a stabilization fund. As of the cocoa year 1990/91, certain important changes were put into effect. ONCPB was abolished and replaced by a small successor organization, ONCC, and the inter-annual stabilization fund was replaced by a seasonal stabilization fund. The difference between the two funds is in the function they serve: the inter-annual fund aimed at stabilizing producer prices for a number of years while the seasonal fund aims at stabilizing producer prices within a certain year only.

Cocoa prices, marketing costs, and export taxes for cocoa are presented in Table A1.9. Between 1981/82 and 1985/86 producer prices increased from CFAF 310/kg to CFAF 450/kg. The costs of marketing increased steadily during this period, while an explicit tax of CFAF 57/kg was imposed. Combining the producer price, marketing cost, and explicit tax gave a cost at the port for cocoa which increased from CFAF 430.9/kg in 1981/82 to CFAF 596.2/kg in 1985/86. During this time period, international cocoa prices were increasing rapidly in terms of the CFAF as the CFAF depreciated against the US dollar. As shown in Table A1.9, the actual FOB price (i.e., the CIF price adjusted for freight and insurance) almost doubled in nominal terms from CFAF 523.6/kg in 1981/82 to CFAF 954.8 in 1984/85. Comparing the cost at the port and the actual FOB price shows that a large implicit tax was levied on cocoa exports, increasing from 17.7% in 1981/82 to 38.9% by 1984/85.

Table A1.9: Cameroon: Domestic and Export Cocoa Prices, Marketing Costs, and Export Taxes, 1981/82-1990/91

	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
					--------- CFAF/KG ---------					
Producer Price[1/] (a)	310.0	330.0	370.0	440.0	450.0	450.0	450.0	435.0	250.0	220.0
Real Producer Price[2/]	511.6	476.8	467.8	538.6	543.5	498.3	449.6	439.0	250.0	217.8
Marketing Costs (b)	63.9	76.6	84.8	86.7	89.2	90.1	89.9	68.8	68.8	51.3
Explicit Tax (c)	57.0	57.0	57.0	57.0	57.0	57.0	58.3	57.0	0.0	0.0
Cost at the Port d=a+b+c	430.9	463.6	511.8	583.7	596.2	597.1	598.2	560.8	318.8	271.3
Actual CIF Price (e)	564.0	627.9	829.8	1,021.2	1,010.5	769.7	653.2	550.0	383.0	370.0
Freight & Insurance (f)	40.4	47.6	56.5	66.4	66.1	56.9	49.3	42.4	42.4	42.4
Actual FOB Price (g)=(e)-(f)	523.6	580.3	773.3	954.8	944.4	712.8	603.9	507.6	340.6	327.6
Implicit Tax (h)=(g)-(d)	92.7	116.7	261.5	371.1	348.2	115.7	5.7	-53.2	21.8	56.3
Tax Rate (%) (i)=(h+c)/(g)	28.6	29.9	41.2	44.8	42.9	24.2	10.6	0.7	6.4	15.2

Source: World Bank, Etude Diagnostic de l'ONCPB. Febrier, 1989. AGRER
[1/] Includes Premium 1984/85-1988/89.
[2/] Deflated by CPI (1989/90=100).

Starting in 1985/86, international cocoa prices declined. Between 1985/86 and 1989/90 the CIF price of cocoa fell from CFAF 1,010/kg to CFAF 383/kg. Despite this decline, producer prices were fixed in nominal terms at CFAF 450/kg and the explicit tax remained unchanged. However, marketing had begun to be reduced. As a result, the cost at the port was kept constant in nominal terms at about CFAF 600/kg between 1985/86 and 1987/88 and declined by a small amount in 1988/89 as a result of slightly lower marketing costs. The combined effect was to reduce the implicit tax on exports, which fell from 38.9% in 1984/85 to 0.9% in 1987/88, and by 1988/89 the FOB price had fallen to such an extent that the tax rate turned negative, representing subsidy payments of CFAF 53.2/kg in 1988/89 (a rate of 10.5%). By the 1989/90 season, the financial crisis faced by ONCPB led to a lowering of producer prices to CFAF 250/kg, a decline of 43% in real terms from the previous year's level. Also at this time, the explicit tax was removed, while the cut-back in marketing costs continued. These measures led to a substantial reduction in the cost at the port, falling from CFAF 561/kg in 1988/89 to CFAF 319/kg in 1989/90.

A1.3.5. The Performance of Cote d'Ivoire's Cocoa Sector During the 1980s

Cote d'Ivoire is by far the world's largest supplier of cocoa, contributing about 30% of total production in 1989/90. Production for the period 1980/81 through 1990/91 is shown in Table A1.10. Production grew steadily in the 1980s, increasing from 360,000 tons in 1982/83 to 849,000 tons in 1988/89. This growth was spawned by high producer prices, low labor costs, and the adoption of higher-yielding cocoa varieties. The producer price was reduced substantially in the late-1980s, leading to a decline in production.

Cocoa is Cote d'Ivoire's largest foreign exchange earner, providing 30% of the value of total merchandise exports in 1985 when the international cocoa price was $2,250/ton, and more than 28% in 1990. Cocoa export values are shown in Table A1.10. Despite the sharp increase in export volumes

59

Table A1.10: Cote d'Ivoire: Cocoa Production and Export Values, 1980/81-90/91

	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
				---------- '000 tons ----------							
Production	403	465	360	418	571	563	620	674	849	710	785
				---------- Bn. Nominal CFAF ----------							
Export Value (current dollars)	199.7	163.3	162.7	396.6	398.4	392.9	312.6	242.2	208.9	213.6	194.0
				---------- Bn. 1989/90 CFAF ----------							
Export Value (constant dollars)1/	284.1	215.2	203.9	472.7	467.1	432.7	326.6	243.4	208.1	213.6	256.0

Source: IMF, Financial Statistics; and Gill & Duffus, London.
1/ Deflated by the CPI.

over the period, the value of exports increased only up until the mid-1980s, with close to CFAF 400 million earned in 1983/84, 1984/85, and 1985/86. Since then, lower international cocoa prices have reduced export earnings, and by 1990/91 cocoa is estimated to have earned less than CFAF 200 million, the lowest level (in nominal terms) since 1979/80.

A1.3.6.Impact of Changes in Real Exchange Rates and Inflation on Cote d'Ivoire's Cocoa Sector

Cote d'Ivoire is one of the CFA zone countries and therefore the nominal value of its currency is linked to the French Franc (CFAF 50 = FF 1) (Table A1.11). As with Cameroon, the over-valued real exchange rate in recent years has substantially decreased the competitiveness of Cote d'Ivoire cocoa. The real exchange rate, which provides a useful measure of international competitiveness is shown in Table A1.11. As seen there, the real exchange rate depreciated sharply during the first half of the 1980s but after 1985 this trend was reversed just as sharply, with the real exchange rate appreciating more than 70% between 1985 and 1988.

A1.3.7.Impact of Changes in Producer Pricing and Taxation in Cote d'Ivoire's Cocoa Sector

The stated purpose of the government's cocoa pricing policy has been to: (i) provide cocoa farmers with relatively attractive, stable financial returns in order to increase production; (ii) maximize the contribution made by the cocoa sector to the economy; and (iii) to provide substantial revenues to the

government. Cocoa is purchased by private traders operating on behalf of the stabilization fund (CSSPPA) at the fixed producer price. It is then sold by private exporters on behalf of the CSSPPA or directly by the CSSPPA to the world cocoa market. Taxation on cocoa sales has been a crucial source of revenue for the government.

Cocoa prices, marketing costs and export taxes for Cote d'Ivoire are shown in Table A1.12. The trends of these data for the 1981/82-1990/91 period are very similar to those of Cameroon (see Table A1.9). Between 1981/82 and 1984/85, FOB cocoa prices increased in nominal terms from CFAF 554.6/kg to CFAF 926.5/kg. During this period the cost at the port was kept significantly below the FOB price, with producer prices increasing only 25% in nominal terms between 1981/82 and 1984/85. The margin between the FOB price and cost at the port increased from CFAF 134.9/kg in 1982/83 to CFAF 370.6/kg in 1984/85, representing implicit tax rates of 22.3% and 40%, respectively.

Since 1984/85, however, the nominal FOB price of Cote d'Ivoire cocoa has fallen in each year up to and including 1990/91. Despite this decline, producer prices and marketing costs were not adjusted downwards to reflect changing international market conditions through 1988/89. The cost at the port was kept within a range of CFAF 550/kg to CFAF 600/kg. As a result, the implicit tax fell after 1984/85 and by 1987/88 CSSPPA was paying a subsidy to growers equal to about 12% of the FOB price. The continued decline of international cocoa prices led to the subsidy rate increasing to 32% in 1988/89. With the 1989/90 agricultural sector adjustment program (ASAP), producer prices for cocoa were reduced from CFAF 400/kg to CFAF 250/kg for the mid-crop (summer of 1989), and were reduced further to CFAF 200/kg for 1989/90. This price reduction was necessary due to the high and unsupportable deficit incurred by the CSSPPA and the declining world cocoa prices.[1] The 1989/90 ASAP also tried to improve marketing efficiency by reducing the domestic operating costs of CSSPPA and the domestic marketing costs for cocoa.

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[1] During 1988/89 a large number of cocoa farmers were paid with IOUs due to the lack of funds in the CSSPPA.

Table A1.11: Cote d'Ivoire: Inflation Rate, and Nominal and Real Exchange Rates, 1980-90

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Nominal Exchange Rate (F/$)	211.3	271.7	328.6	381.1	437.0	449.3	346.3	300.5	297.5	319.0	272.3
Consumer Price Index	100.0	108.8	116.8	123.7	129.0	131.3	140.9	141.4	151.4	152.9	154.0[1]
Real[2] Exchange Rate	100.0	84.6	75.1	68.6	62.4	61.8	86.0	99.4	107.5	101.2	119.5[1]

Source: IMF, Financial Statistics.
[1] Forecast.
[2] Real exchange rate is calculated with the formula,

$RER_t = (NER_{80}/NER_t) * (CPI_t/CPI_{80})$
RER_t = Real exchange rate at time t,
NER_{80} = Nominal exchange rate in 1980,
NER_t = Nominal exchange rate at time t,
CPI_t = Consumer price index at time t, and
CPI_{80} = Consumer price index in 1980.

Table A1.12: Cote d'Ivoire: Domestic and Export Cocoa Prices, Marketing Costs, and Export Taxes, 1981/82-1990/91

	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
				---------- CFAF/KG ----------						
Producer Price[1] (a)	300.0	350.0	375.0	400.0	400.0	400.0	400.0	400.0	200.0	200.0
Real Producer Price[2]	401.7	431.6	448.4	470.4	444.0	435.3	413.0	403.9	200.0	199.0[3]
Marketing Costs (b)	61.3	68.3	74.3	75.4	82.7	83.1	84.9	92.3	92.2	49.2
Explicit Tax (c)	50.6	50.6	80.5	80.5	80.5	100.5	100.5	100.5	50.3	0.0
Cost at the Port d=a+b+c	411.9	468.9	529.8	555.9	563.2	583.6	585.4	592.8	342.5	249.2
Actual CIF Price (e)	595.0	651.4	876.5	992.9	864.3	705.9	571.5	491.9	361.6	340.0
Freight & Insurance (f)	51.0	51.0	58.1	66.8	76.0	73.7	73.7	73.7	71.7	71.0
Actual FOB Price (g)=(e)-(f)	544.0	600.4	818.4	926.1	788.3	632.2	497.8	418.2	289.9	269.0
Implicit Tax (h)=(g)-(d)	132.1	131.5	288.6	370.2	225.1	48.6	-87.6	-174.6	-52.5	19.8
Tax Rate (%) (i)=(h+c)/(g)	33.6	30.3	45.1	48.7	38.8	23.6	2.6	-17.7	-0.8	7.4

Source: World Bank; CSSPPA.
[1] Includes Premium 1984/85-1988/89.
[2] Deflated by CPI (1989/90 = 100).
[3] Forecast.

Annex II
The Cocoa Model

The model consists of demand (for consumption and stocks) and supply components, with the market price for cocoa determined by the market clearing identity (see Table A2.1).

A2.1. Production Side

The supply block consists of eight separate major producing countries and the rest of the world. The major producing countries are: Brazil, Cameroon, Côte d'Ivoire, Ecuador, Ghana, Indonesia, Malaysia, and Nigeria. For all countries except Ecuador and Indonesia, supply is modeled using the vintage capital approach developed by Akiyama and Trivedi (1987). A brief discussion of this approach is presented in the paragraph below. For Ecuador, Indonesia, and the rest of the world, supply is modeled in the conventional way: with supply as a function of real producer prices (current and lagged) and a time trend.

In the case of perennial tree-crops such as cocoa and coffee, special attention should be paid to three features of the production process: (i) the output; (ii) the dependence of current output on current and, more significantly, on previous levels of inputs; (iii) the existence of significant costs of adjustment with respect to planting and removal of the trees. Conditions (i) and (ii) imply that the relevant supply specification for perennial tree-crops is dynamic. The dynamics arise from the fact that the productivity of perennial tree-crops varies with the age (and variety) of the tree. The age structure and varietal composition of a tree-crop plantation determines the production capacity or the maximum feasible level of production. Actual production can vary from the production capacity due to climatic reasons, intensity of application of fertilizer and pesticides and the level of husbandry.

The vintage capital approach to modeling supply is applied as follows: first, the new plantings are evaluated as a function of real producer prices (current and lagged) and a time trend. Using the new plantings and the yield curve the production potential is evaluated. Finally, production is a function of the production potential and current real producer prices.

A2.2. Demand Side

Total world grindings is used as the measure of the demand for cocoa. On a global level this is fine, if one assumes that exports and imports of cocoa beans and products combined are equal on a global level. In fact, there is only a small difference between the two.

World grindings is specified to be a log-linear function of the deflated world price (the ICCO indicator price) and the constant dollar GDP of the G7 countries. The corresponding elasticities are -0.22 for the price and 0.47 for the GDP.

The low price inelasticity of demand for cocoa is mainly due to the low impact of cocoa prices on confectionery products, where cocoa products are mostly used. Cocoa prices account for around 10-30% of the cost of producing chocolate. Milk and sugar prices, and advertising costs, have a greater impact on chocolate bar prices.

The stock demand equation is modeled as a function of the deflated world price level and the one and two year lagged moving average of the world production level.

<u>Table A2.1: Overview of the Cocoa Model</u>

<u>A. Production</u>

New Plantings = f (real producer prices current and lags)

Production Potential = New Plantings X Yields

Production = f (real producer prices (current), Production Potential)

<u>Production for Ecuador, Indonesia and the Rest of the World</u>

Production: f (real producer prices currents and lags)

PD WOR (World Production) = Σ Productions + Rest of the world

<u>Producer Prices and other Variables in the Supply Side</u>

FOB = f (world price, exchange rate)	FOB = f (world price, exchange rate)
Producer price = exogenous	Producer price = (FOB - tax - marketing costs)
Tax = (FOB - producer price - marketing costs)	Tax = tax rate x FOB
	Tax rate = exogenous
Real producer price = nominal/cpi	Government revenue: tax x production

<u>B. Demand Side</u>

GRWOR (world grindings) = f (GDPG7, real world price)

STKWOR (stock demand) = f (real world price, .5 x (PDWOR (-1) + PDWOR (-2))

<u>C. Price Determination</u>

PDWOR + STKWOR (-1) = STKWOR + GRWOR

This equation solves for real world price

A2.3.   <u>Price Determination</u>

The price determination in a commodity market largely depends on the structure of the market in which that commodity is traded. For the case of cocoa there is a widespread presumption that price determination follows the paradigm of competitive markets, at least as a good first approximation. According to the competitive market paradigm, the "price equation" of the model should conform to the law of "supply and demand" in which price changes should be a function of the gap between supply and demand.

67

The present model conforms with the paradigm of the competitive market outlined above. It consists of a demand and a supply group of equations which yield world demand and supply. An inventory demand equation is also added so that the level of stocks at the end of each period have to be equal to the demand for stocks. According to this equilibrium condition, the price must be such that the excess supply over demand must be willingly held. With consumption, production, and stocks determined, the model then searches for the price that equilibrates the market clearing identity:

$$PD + ES(-1) = ES + CS$$

where: PD is world production, ES the level of stocks, and CS is world consumption.

A2.4. Model Validation

The results from the base-line simulation can be compared with historical data to validate the model. Two sets of validation statistics were calculated. These cover important aspects of the model's ability to plot historical data and to respond to economic stimuli in a manner consistent with both economic theory and empirical observation. The validation statistics include: (i) Root Mean Square Percentage Error (RMSPE), which provides a single value measuring the average percent difference between predicted and actual values of the endogenous variables, and (ii) Theil's U-statistic, which is related to the RMSPE and is scaled so that U will lie between 0 and 1 (U = 0 represents a perfect fit). The validation statistics presented in Table A2.2 are based on a simulation period from 1980/81 to 1989/90.

At the world level, the RMSPEs for cocoa production and stocks are 1.61% and 3.72%, respectively. The RMSPE for the cocoa price is 11.83%. Thus, the model's tracking of the quantity variables tends to be better than it is for price. This can be explained by the inelasticity of the supply and demand curves in which inaccuracies have a greater effect on price than quantity. For Cameroon, Côte d'Ivoire, and Ghana, the RMSPEs for production are less than 6%, indicating that the model predicts values very close to their actual levels.

Table A2.2: RMSPEs and Thiel U-statistics for Selected Cocoa Model Variables

Variable	RMSPE[1/]	U-stat.[2/]
World		
Production	1.61	0.008
Grindings	1.09	0.005
Stocks	3.72	0.013
Price	11.83	0.060
Cameroon		
Production	6.08	0.028
Value of Production	13.57	0.062
Côte d'Ivoire		
Production	2.57	0.014
Value of Production	9.00	0.043
Ghana		
Production	2.52	0.012
Value of Production	11.63	0.052
Nigeria		
Production	14.12	0.061
Value of Production	23.57	0.095

[1/] $RMSPE = 1/n\Sigma_t((A_t-P_t)/A_t)^2$

[2/] $U = \dfrac{[1/n\Sigma_t((P_t-A_t)^2]^{1/2}}{[1/n\Sigma_t(P_t)^2]^{1/2} + [1/n\Sigma_t(A_t)^2]^{1/2}}$

Where: A_t = the actual value of an endogenous variable;
P_t = the simulated value of an endogenous variable; and,
n = the number of periods in the simulation.

The RMSPE for Nigeria's production, at 14.12%, is moderately high. However, careful inspection of the actual and simulated results shows that this RMSPE is heavily influenced by a few large discrepancies in certain years, when Nigeria's cocoa sector experienced major external shocks (e.g., drought in 1984), and that otherwise, the model tracks fairly well and captures most of the important turning points in the actual data. The RMSPEs for the value of production capture errors in both

production and price variables. Cameroon, Côte d'Ivoire, and Ghana have values below 14%. The high RMSPE for Nigeria can be explained by the inaccuracies in production forecasts already discussed. The U-statistics reported in Table A2.2 support the RMSPE results. That is, in general, the quantity variables out-perform the price variables, with the exception of Nigeria's production. Nonetheless, all the U-statistics presented are close to 0, indicating that the model performs well. Based on these validation statistics it can be concluded that the model gives a fairly accurate representation of the actual world cocoa market, and provides a reliable tool for policy analysis and forecasting.

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