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Evaluation of the Influence of Agricultural Price Policy on Cotton Production in Côte-d'Ivoire

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Abstract

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In this paper the impact of the cotton pricing policy of the marketing board of Côte-d'Ivoire is investigated. A theoretical model is developed to derive the price level which maximizes revenue generated from the marketing board's cotton transactions. A dynamic cotton supply function was estimated and used to compute elasticities. The estimates indicate that farmers in the Country response to price changes and that the pricing policy of the marketing board has been consistent with an objective of generating revenue for the government.

Introduction

Many Sub-Saharan African countries have established state-owned marketing boards or parastatals which are granted the exclusive authority to set producer prices on exportable agricultural commodities (Timmer et al., 1983; Delgado and Meller, 1984; De Wilde, 1984; Josling, 1984; Lele, 1984; Ghai and Smith, 1987). The boards are also charged with the responsibility of collecting, storing, and merchandising the commodities in the world market. An implied, if not explicit, objective of the marketing boards in some countries is to generate revenue from favorable price spreads which can be used to launch industrialization programs or invest in other capital projects. In some instances, the revenue is invested in nonagricultural programs in which case the price policy may result in a tax on the agricultural sector.

The two major agricultural exports of Côte-d'Ivoire are cocoa and coffee. The marketing board of the Country establishes producer prices for all ex-

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portable agricultural commodities, purchases the commodities from the growers, and sells them at world prices in the international market. Revenue generated by the board contributes to the general revenue of the government.

Cotton program

The northern region of Côte-d'Ivoire is not suitable for the production of coffee and cocoa. In 1960 the government established an extension program to introduce cotton as a cash crop in the region (Campbell, 1984). Revenue generated by the Country's marketing board was used to establish the cotton program. The objectives of the program were to (a) integrate peasant producers in the region into the monetized national economy, (b) reduce the regional disparities in income distribution by improving the income in the northern region, (c) supply the domestic textile industry with locally produced raw material, and (d) provide the Country with an additional export crop and thereby increase export earnings for the government from the transactions conducted by the marketing board.

Originally, the French Textile Development Company (CFDT) was granted responsibility over all aspects of the introduction, production, processing and marketing of cotton in the region. However, in 1973, the Ivorian Textile Development Company (CIDT) replaced the CFDT. The price paid to growers for raw cotton is set by the Country's marketing board. Cotton produced in excess of that needed by the domestic textile industry is exported by the marketing board.

Land area seeded to cotton increased from less than 12 000 ha in 1966 to more than 153 000 ha in 1986. Yields increased from less than 800 to more than 1200 kg/ha over the same time period (CIDT, 1986). Originally, marketing board revenues were used to subsidize cotton producer expenditures for fertilizer, pesticides, and technical assistance. However, in 1985 these subsidies were eliminated. Some of the cotton is used by the domestic textile industry. The rest is exported by the marketing board.

To the extent that cotton production has increased, the CIDT program has been very successful. However, now that production is established, the cotton pricing policy of the marketing board is of concern. It has been estimated that the price paid to producers for cotton in Côte-d'Ivoire was 61% of export value in 1978–80 (Ghai and Smith, 1987). However, the extent to which cotton producers in the Country respond to changes in prices for raw cotton, and the extent to which the relatively low domestic cotton price may restrict production, have not been established.

The specific objective of this study is to determine if the cotton pricing policy of the marketing board is consistent with an objective of maximizing income to the marketing board, and to evaluate the potential impact of changes in the cotton pricing policy on cotton production. A model is developed which illus-

trates that an estimate of the price elasticity of cotton supply can be used to evaluate the program. An elasticity estimate is obtained from an estimated supply equation. The elasticity estimate is used to evaluate the pricing policy. Nascimento and Raffinot (1985) conducted similar work to evaluate the influence of government pricing policy on peanut production in Senegal.

For the present analysis the impact of marketing board decisions regarding the domestic price is considered. Externalities associated with impacts of the current policy on the domestic textile industry are not considered.

Theoretical Model

If cotton supply is completely inelastic in the Country, the board could set the market cotton price at the level of minimum variable costs and not alter production. On the other hand, if the producer supply of rice is not perfectly inelastic but rather as depicted in Fig. 1, and if transactions costs are zero or no more than what they would be in a pure market economy, the government revenue from the cotton pricing policy is equal to:

$$R_G = (P_w - P_p)Q_t \tag{1}$$

where R_G is the government revenue, P_w world cotton price, P_p producer price, and Q_t total quality produced at P_p. At $P_p = P_w$, production and export sales are maximized, but government revenue is nil. At a price of P_p, the government gain is depicted in the graph as the area P_wP_pBC, but export revenue drops by $(Q_w - Q_t)P_w$. Assuming that ACQ_tQ_w is the increase in cost due to the production increase from Q_t to Q_w, the potential gain is the triangle ABC when the producer price increases from P_p to P_w.

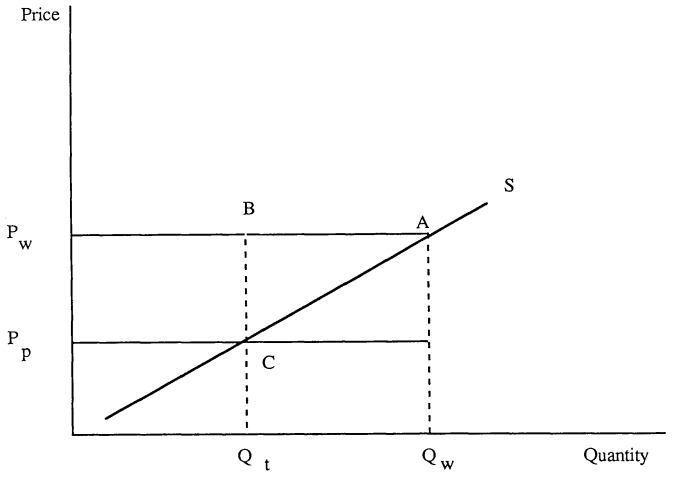

Fig. 1. Theoretical supply curve for raw cotton.

The optimal producer price from the standpoint of the marketing board, that which maximizes revenue for the board, can be determined by equating the first derivative of the revenue function, R_G with respect to the choice variable P_p to zero, and solving for optimal price P_p.

Let the revenue equation be represented as:

$$R_G = P_w Q - P_p Q \tag{2}$$

Totally differentiate the equation to obtain:

$$dR_G = P_w\, dQ + Q\, dP_w - P_p\, dQ - Q\, dP_p \tag{3}$$

Divide by dP_p and set equal to zero:

$$\frac{dR_G}{dP_p} = P_w \frac{dQ}{dP_p} + Q\frac{dP_w}{dP_p} - P_p\frac{dQ}{dP_p} - Q\frac{dP_p}{dP_p} = 0 \tag{4}$$

Assume that the change in world price is independent of the change in producer price, such that $dP_w/dP_p = 0$ and multiply by P_p/Q to obtain:

$$P_w\left(\frac{P_p}{Q}\right)\frac{dQ}{dP_p} - P_p\left(\frac{P_p}{Q}\right)\frac{dQ}{dP_p} - Q\left(\frac{P_p}{Q}\right) = 0 \tag{5}$$

$$P_w e - P_p e - P_p = 0$$

Solve for the optimal price:

$$P_p^* = \frac{P_w e}{(1+e)} \tag{6}$$

where

$$e = \frac{dQ}{dP_p}\frac{P_p}{Q}$$

which is the elasticity of cotton production (supply) with respect to the price of cotton set for producers by the marketing board. P_p^* is the price which will optimize revenue, R_G, to the marketing board. The second-order conditions for a maximum require that:

$$\frac{d^2R_G}{dP_p^2} = P_w\frac{\partial^2 Q}{\partial P_p^2} - P_p\frac{\partial^2 Q}{\partial P_p^2} - \frac{\partial Q}{\partial P_p} < 0 \quad \left(P_w - P_p\right)\frac{\partial^2 Q}{\partial P_p^2} - \frac{\partial Q}{\partial P_p} < 0 \tag{7}$$

Since $P_w - P_p > 0$ and $\partial Q/\partial P_p > 0$, second-order conditions will be fulfilled if $\partial^2 Q/\partial P_p^2 \leqslant 0$.

Thus, an estimate of e, the cotton production supply elasticity, can be used to determine if the pricing policy of the marketing board is consistent with an objective of maximizing revenue to the board from cotton exports.

Empirical Model

A Nerlove (1958) model as described by Askari and Cummings (1977) was used to obtain a dynamic cotton supply equation for the country. The general form of the model is:

$$A_t^D = a_0 + a_1 P_t^e + a_2 Z_t + U_t \tag{8}$$

$$P_t^e = P_{t-1}^e + b\left(P_{t-1} - P_{t-1}^e\right) \tag{9}$$

$$A_t = A_{t-1} + g\left(A_t^D - A_{t-1}\right) \tag{10}$$

where A_t is actual area under cultivation at time t, A_t^D area desired to be under cultivation at time t, P_t actual price at time t, P_t expected price at time t, Z_t other exogenous factors affecting supply at time t, and b and g are expectation and adjustment coefficients. Equation (9) describes a price expectation formation. Equation (10) stipulates that actual area planted in each period is adjusted as a fraction of the difference between the desired (long run) area and the previous period's actual area (partial adjustment). The expected price of cotton is assumed to be a weighted average of the last three year's prices.

$$P_t^e = 0.5P_{t-1} + 0.3P_{t-2} + 0.2P_{t-3} \tag{11}$$

In addition to the cotton price, another major explanatory variable to consider is the price of rice. Rice competes with cotton for land and other factors of production. It is the most common food crop to all producing areas of cotton. The competition between rice and cotton for factors of production is recognized by producers (Savignac, 1977).

The domestic weather cycles are a source of risk. Since cotton is produced by rainfed farming, the previous years rainfall can be considered as a risk indicator to the farmer. To incorporate technological progress and other unidentified variables, a time trend variable is included. the derived model to be estimated is of the form:

$$A_t = a_0(1-a)A_{t-1} + a_1 P_t^e + a_2 \text{ Rice}_{t-1} + a_3 \text{ Rain}_{t-1} + a_4 \text{ Time} + V_t \tag{12}$$

A significant positive response to cotton price would not support the hypothesis that African farmers pay little or no attention to prices; a nonsignificant response may suggest that the farmers have target incomes. If a_2 is positive, it may indicate that the growers prefer to increase cotton acreage and generate cash which can be used to purchase market goods. On the other hand, a significant negative a_2 would suggest that cotton and rice compete for factors of production and that growers respond to price changes by adjusting plantings. A positive a_3 would support the hypothesis that area planted is increased

TABLE 1

Estimated acreage response equation

Variable	Coefficients	T-Statistics
Constant	3.3162	1.708
$\log A_{t-1}$	0..2901	1.333
log(Cotton price)	0.4757	3.263**
log(Rice price)$_{t-1}$	−0.3998	−3.634**
Rain$_{t-1}$	−0.0002	−1.071
Time	0.0618	2.994**
	Adjusted $R^2 = 0.96$	

**, significance at the 1% level.

in years following high rainfall years. The time variable is a proxy for technological change and a_4 is expected to be positive.

Results

Annual time series data were obtained for the period from 1970 to 1986, (CIDT, 1986). The corrected ordinary least squares method (Cochran–Orcutt) and the convenient log-linear functional form was used to estimate equation 12 (Johnston, 1984). The empirical model results are presented in Table 1. All signs are as expected except for the estimate for the rainfall variable. However, even though the sign is negative the estimate for the rainfall variable is close to zero, not statistically significantly different from zero and may be regarded as inconclusive. The coefficients for both cotton and rice price and time are significant at the 1% level. However, the estimate for the lagged dependent variable is not significant. These results support the hypothesis that producers do respond to price changes. The estimates also confirm that cotton and rice compete for factors of production. The positive time trend is consistent with the historical pattern of increasing mechanization of cotton production in the Country.

The estimated coefficient of adjustment (1 − 0.29) indicates that 71% of the discrepancy between the desired and actual area planted is eliminated in a year. The estimated short run price elasticity of supply is 0.48. The long-run elasticity estimate is 0.67 (short-run elasticity divided by the coefficient of adjustment). These elasticity estimates are used to evaluate the pricing policy of the marketing board.

Discussion

In the absence of a unit export price of seed cotton (raw), the unit export price of lint is used in the analysis. The lint-seed cotton price ratio is about

TABLE 2

Cotton prices (CFA Francs/kg)[a]

Year	Price of lint	Derived price of seed cotton	SR[b] P_p^*	LR P_p^*	Actual P_p
1970-71	167	68	22	27	40
1971-72	178	73	23	29	40
1972-73	196	80	26	32	40
1973-74	327	133	42	53	45
1974-75	299	122	39	49	70
1975-76	293	120	38	48	70
1976-77	342	140	45	56	80
1977-78	316	129	41	52	80
1978-79	330	135	43	54	80
1979-80	376	153	49	61	80
1980-81	466	190	61	76	80

[a]CFA Franc = 0.02 French Franc.
[b]SR, Short-run; LR, long-run optimal producer prices calculated with equation (6).

41%. Based on this coefficient, a unit export price of seed cotton is derived. It is assumed that the price of seeds (by-product) covers the cost of ginning. Short and long run producer prices which would maximize marketing board revenue are presented in Table 2. Over the period from 1970–71 to 1979–80, the pricing policy was reasonably consistent with the objective of generating revenue for the government. That is, the price paid to farmers was closer to P_p^* than to the world price.

The objective of the current study was to evaluate the cotton pricing policy of the marketing board. Other related issues were not addressed. For example, the study did not consider the influence of input subsidies which were originally used to establish cotton production. Related factors associated with cotton production such as the extent to which the domestic textile industry, and ultimately textile workers and consumers in the Country, benefit from the relatively low domestic raw cotton price were not considered. For example, the domestic subsidized cotton price may influence the technical efficiency of the domestic textile industry. In addition, the domestic textile industry may be insulated from world textile markets, in which case domestic consumers other than those associated with textile production may not reap any benefits from the subsidized raw material. Additional study would be required to address these issues.

Conclusions

In 1960 the government of Côte-d'Ivoire established an extension program to introduce cotton into the northern region of the Country. The state owned marketing board was given the exclusive authority to set the producer price of

cotton. The specific objective of this study was to determine if the cotton pricing policy of the marketing board has been consistent with an objective of maximizing income to the marketing board.

A model was developed to derive the price level at which revenue generated by the board for the government is maximized. The model demonstrates that an estimate of the cotton supply price elasticity can be used to evaluate the cotton pricing policy of the marketing board. Annual time series data were obtained and a dynamic supply function was estimated. The analysis indicates that cotton producers in Côte-d'Ivoire respond to changes in the price of cotton and rice by adjusting the area planted to cotton. Short run and long run elasticities of 0.48 and 0.67 were obtained. The elasticity estimates were used to evaluate the pricing policy of the marketing board. The pricing policy was reasonably consistent with an objective of generating revenue for the government from the cotton program.

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