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Small Farmers Supply Response for Cotton: Results from Kenya

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Kenya -- Agriculture

Abstract

Cotton is a critical input into the manufacturing industry of Kenya. To increase cotton production to self-sufficiency, small farmers were provided economic incentives. These incentives led to a doubling of production in three years, but subsequently to drastic declines. This study shows that farmers are still making rational production decisions.

Small Farmers Supply Response for Cotton: Results from Kenya

Introduction

Cotton is critically important to the economy of Kenya. The manufacturing industry uses it extensively for the production of vegetable oil; small farmers depend upon it for a major source of their farm income; and the government recognizes it to be a potentially large earner of foreign exchange. Cotton has been cultivated in Kenya for hundred of years, but production has remained low despite an escalating demand. Production shortfalls have been traditionally met by imported supplies from Kenya's neighboring countries of Uganda and Tanzania. However, political instability in these countries coupled with their deteriorating trade relations with Kenya has caused great uncertainty regarding the reliability of future supplies. Establishing trade relations with other non-neighboring countries for the importation of cotton is considered uneconomical because of the tremendous transportation cost associated with the bulky commodity. Hence, the government of Kenya embarked upon an economic policy to increase cotton production to self-sufficiency.

The economic policy of the government was launched in 1976 as the Cotton Development Program (CDP), oriented and implemented to increased cotton production among small farmers. Components of the program included interest free capital, free planting seeds, and a substantially increased farm gate price for cotton. These incentives were enough to almost double cotton production in the short period of three (3) years. Production increased from 35 thousand bales in 1976 to a 1978 total of 62 thousand bales (Figure 1). Production increases not only met domestic demand but also provided an annual surplus of 10 thousand bales which were exported to generate much needed

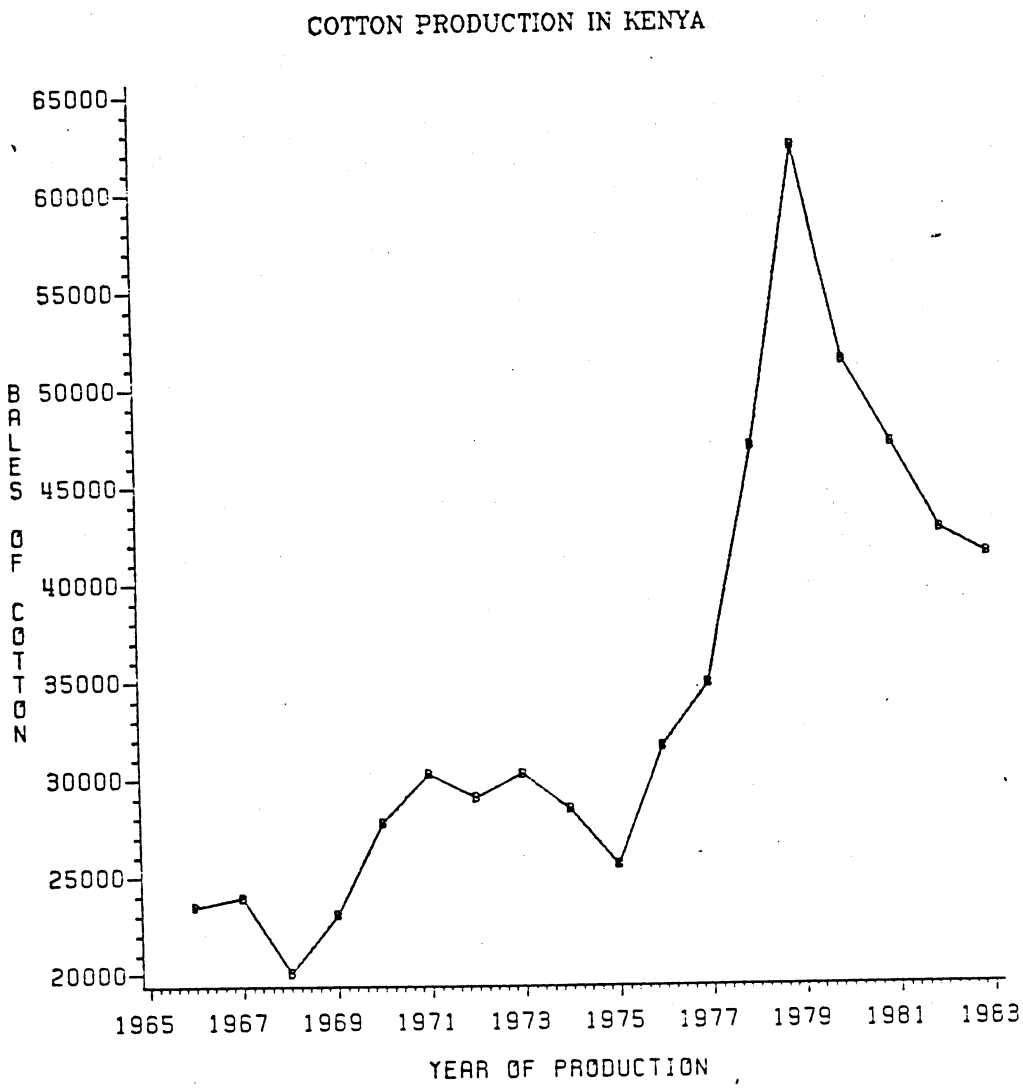

Figure 1. Bales of Cotton Production

foreign exchange. Since 1978, production has fallen approximately to 40 thousand bales while demand has risen to 70 thousand bales annually. This decline in production has occurred despite a continuation of many of the incentives of the CDP.

The cotton industry in Kenya is therefore confronted with instability of cotton production coupled with low production levels. These problems have eroded much needed foreign exchange and created considerable uncertainty among farm producers and policymakers as to the future outlook for cotton as an enterprise. Economic planners are uncertain as to whether abrupt changes in production are due to relative price changes among commodities or to other problems beyond the farm gate. This study is therefore intended to identify and empirically estimate those factors which determine cotton production; examine the relative impacts of these factors; and then offer policy recommendations or suggestions for the cotton production problems.

Theory and Methodology

Economic theory suggests that the planting decision of a farmer is based on the price expected for his output, the price expected for substitute crops, the cost of factors of production, the production capacity of the farmer, and the riskiness of the enterprise (Heady and Dillon, 1972). Neoclassical microeconomic theory further suggests that farmers' profit functions are homogenous of degree one and their input demand functions are homogenous of degree zero in prices (Henderson and Quant, 1977). These conditions indicate that any specified supply function should express commodity prices in real terms. Intuitively, the expansion path for production is simply a ray from the

origin as long as input prices are constant; and the demand for inputs remain unchanged as long as product prices and input prices change in the same proportion (Ferguson, 1975).

Theory also suggests that farmers or other decisionmakers possess full information regarding the consequences of alternative economic decisions. Econometric supply investigators, however, recognize an inconsistency between this theoretical assumption and real world phenomena. Hence, they distinguish between static and dynamic behavior systems. Modelling of dynamic behavioral relations recognize the lag effects of economic behavior, particularly those which exist between output levels and prices (Johnson, et al., 1987).

General economic theory does not suggest a particular functional form for supply relationships. The relationship may take a linear or non-linear form depending on the explicit relationship between the dependent and explanatory variables. Most of the work done in the area of supply response has assumed linear relationships. A linear relationship is a good approximation since it is convenient and is readily estimatable by standard econometric techniques. In the present study, semi-log and double-log models were estimated to test whether they provided better fits to the data than a linear model. Neither model improved upon the simple linear model. Thus, this study uses ordinary least squares (OLS) to estimate a simple linear model.

Model Specification

The model below may be considered a variant of Nerlove's partial adjustment model. Nerlove's expectation formulation is less appropriate for Kenyan farmers because cotton prices are set and announced by the minister of agriculture before the planting season. However, to the extent that farmers

may have some expectations about prices, it is assumed that they respond by varying planted hectarage as opposed to their per hectare use of variable inputs. With planted hectarage as the dependent variable, the initial model was specified as:

(1) $HCT = B_0 + B_1\ PSC + B_2\ PMA + B_3\ PSR + B_4\ PIT + B_5\ DVR + B_6\ HCTL + U$

where HCT = Hectares of cotton in production

PSC = Producer price of seed cotton

PMA = Producer price of maize

PSR = Producer price of sugarcane

PIT = Index of inputs prices

DVR = Dummy variable with 0 value for prompt payment, 1 for delayed payments

HCRL = Hetares of cotton in production lagged one period

$B_0 - B_6$ = Regression coefficients

U = error term

Maize and sugarcane are included in equation (1) because they are alternative crops for small producers. Small farmers are hypothesized to decrease their production of cotton as producer prices of maize and sugarcane increase. Thus, negative parameters are expected for B_2 and B_3. An index of all agricultural inputs, PIT, is specified as a proxy for cotton production costs. As a result, a negative parameter was also hypothesized for B_4. The dummy variable, DVR, is intended to capture delayed payments to farmers, these payment delays are hypothesized to have a negative impact on cotton production. A one year lag of cotton hectares (HCTL) is intended to represent the lag

effect of economic behavior. That is, an increase in cotton production in one year is expected to carry over into increased production during the following year. Finally, farmers are hypothesized to be rational producers and therefore increase cotton production as the price (PSC) of cotton increases.

Estimation of the above equation led to insignificant parameters for sugarcane (PSR) and the dummy variable (DVR). As a result, these variables were dropped and equation (2) below was estimated. PSR was dropped because it was reasonably correlated with the price of seed cotton (PSC). The dummy variable (DVR) was dropped because insufficient information was available on the extent of payment delays to capture their impact on cotton production. That is, farmers may not make an immediate response to payment delays, as suggested by a zero-one dummy variable, but adjust their expectations and planting decisions as a linear or nonlinear function of time.

The final estimated model is a specified below in equation (2). Annual data for 1966 through 1983 are used and all prices are expressed in real terms. A semi-log and double-log form of the model below were estimated, but neither fitted the data as well as a linear model. The model is:

$$(2)\quad HCT = B_0 + B_1\ PSC + B_2\ PMA + B_3\ PIT + B_4\ HCRL + U$$

where the variables are as previously defined.

Empirical Results

Estimated results from equation (2) are reported below in equation (3),

$$(3)\quad HCT = \underset{(-1.07)}{-171.76} + \underset{(5.77)}{1321.75}\ PSC - \underset{(-2.66)}{1615.06}\ PMA - \underset{(-1.80)}{65.00}\ PIT + \underset{(1.98)}{.2436}\ HCRL \qquad R^2 = .93$$

where the numbers in parenthesis are t-ratios. All coefficients not only are signed as hypothesized but also are statistically significant. From a statistical viewpoint, the farm price of seed cotton is the most important factor determining cotton production. The estimated parameter suggests that a $1 increase in the real price of cotton would lead to an increase in planted production of 1322 hectares. The estimated long-run elasticity coefficient suggests that a 1 percent change in PSC would lead to a 1.8 percent change in hectares planted. By comparison, the short-run elasticities suggests a 1.5 percent change in HCT for each 1 percent change in PSC. Short-and long-run elasticities for maize are -.49 and -.64 respectively. These coefficients suggest that cotton producers do switch relatively easily between production of the two commodities.

The coefficient for input prices, although significant at only the 10 percent level, suggests that changing input prices do influence production. The estimated elasticity shows a .18 percent decrease in hectares planted for each 1 percent increase in input prices, and vice versa. The estimated parameter for lagged hectarage suggests that 76 percent (1-.24) of the adjustment toward long-run equilibrium occurs during the first year. This rapid rate of adjustment is theoretically plausible since most of the producers are small with limited fixed investment in cotton.

Not only are all the estimated parameters significant, but Figure 2 shows that the model as specified closely predicts actual changes in hectares planted. A dummy variable included in an earlier model to account for payment delays to farmers proved insignificant, an unexpected result. When this variable was dropped, the t-ratios improved for all variables while the coefficients themselves remain reasonably constant. Moreover, excluding the

dummy variable served to improve predicted values relative to actual values. In sum, the estimated model is considered to be correctly specified based on its results and performance.

Conclusions and Implications

Small farmers in Kenya responded to economic incentives to nearly double cotton production in just three years. Producer prices of cotton, maize, and the cost of inputs are statistically important factors which influence production. Cotton producers seem to easily shift from cotton production to maize as relative prices change. Moreover, the adjustment process toward long-run equilibrium seems immediate, with 76 percent of it occurring during the first year. Such rapid adjustment is theoretically plausible since small farmers have limited fixed investments in cotton production.

Given the ease with which small farmers switch from one crop to another, a sustained increase in cotton production will require some constancy of production costs and commodity prices among commodities. For example, a lower producer price for cotton relative to maize could be compensated by lower input prices for cotton relative to maize. A comparison of producer prices for cotton relative to input prices shows that the latter has risen more rapidly. Although the government of Kenya focused on providing free cotton seeds to producers, other input costs were obviously increasing at a rate rapid enough to change the relative price difference between maize and cotton. Farmers recognized these economic differentials while the government was more concerned with the political scenario that made domestic cotton production desirable.

Clearly the domestic industry has the capacity to meet its needs. Moreover, the supply responsiveness of small producers suggests that it can be

ACTUAL AND PREDICTED VALUES

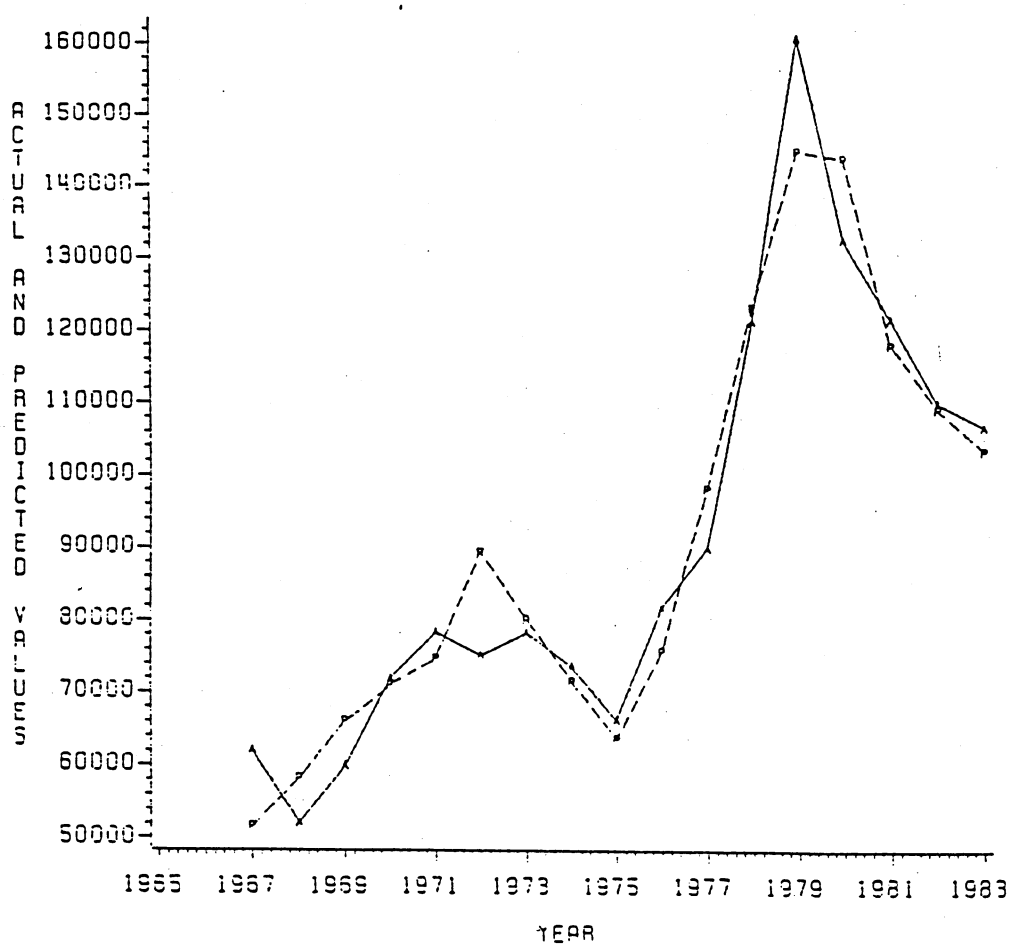

Figure 2. Hectares of Cotton Production

done quickly because of the limited capital required to produce cotton. As the marginal utility of each dollar is likely to be quite high for small producers, the long-run adjustment process that characterize these producers is likely to be far shorter than that which characterize larger producers.

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