

# OUTPUT-INCOME EFFECTS OF AGRICULTURAL EXPORT PRICING IN NIGERIA: A COMMENT

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## I. INTRODUCTION

**A**N ARTICLE BY Dr. D. Olatunbosun and Dr. S. O. Olayide in the *Developing Economies*, Vol. 9, No. 1 (March 1971), examined the cocoa industry of Nigeria's Western State. Specifically, the article analyzed the impact upon the cocoa industry of the producer-price policy of the Western Nigeria Marketing Board (WNMB) for the twenty-year period 1948-67. In their paper the authors present three main arguments. First, they argue that a "continuing decline" in the cocoa industry began in the mid-1950s and that the decline was due to the WNMB's setting too-low a producer price for cocoa. Second, they develop a concept called a "workable equilibrium price." They derive an estimate of this price from time-series data for 1948-67, and then use this estimate to evaluate the actual WNMB producer-price strategy. Third, they devise a "moving-average pricing" strategy and illustrate how it would have worked over the period 1957-67.

This comment presents three arguments. First, the authors have not demonstrated that the cocoa situation was deteriorating. Second, the "workable equilibrium price" concept is not meaningful, and the derivation provided by the authors is erroneous. Third, the "moving-average pricing" strategy does not achieve what the authors claim for it, and in addition has a serious shortcoming.

It is the intent of this paper to argue not that the WNMB's pricing strategy for the period was appropriate, nor that all was well in Nigeria's cocoa industry. Rather, the intent is to show that the authors' paper has serious shortcomings in its interpretation of empirical data, in its statistical analyses, and in its suggestions for an appropriate pricing strategy.

## II. THE COCOA SITUATION 1948-67

Olatunbosun and Olayide claim that the "pricing strategy" of the WNMB led to a "seriously deteriorating cocoa production situation" (p. 66). Let us examine their statements about pricing strategy and the evidence concerning cocoa production.

Table I of their paper (p. 67) shows (col. 2) the price paid to the Nigerian producer of cocoa as a proportion of world price, for each year of the twenty-year period. Olatunbosun and Olayide claim that the data show "that producers have

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been paid a persistently lower percentage of the world price for their cocoa over the twenty-year period" (p. 66). But a close examination of the data fails to support this interpretation. A regression of the producer-price percentages for each of the twenty years upon time reveals a *positive* trend—that is, producer price rises over time as a proportion of the world-market price—but the trend is *not* statistically significant. (The "estimated" trend line rises from 61.5 in 1948 to 68.7 in 1967.) The data for the fifteen years 1953–67 do show a negative trend, but it is not statistically significant either. (This estimated trend line declines from 68.7 in 1953 to 65.5 in 1967.) Whatever might be the problems of the cocoa industry, they cannot be due to a persistent decline in the producers' share of cocoa price.

Olatunbosun and Olayide claim that the producers' share of cocoa export earnings followed "a persistent downward trend" because cocoa taxes, WNMB expenses, and WNMB surpluses all increased. Cocoa taxes "have shown a persistent upward trend"; WNMB expenses "have become a rising percentage of expected income"; and the "WNMB has pursued a consistent policy of making substantial and progressively rising trading surpluses" (p. 66). However, when the sum of these deductions as a proportion of total cocoa export earnings for each of the twenty years is regressed upon time, a negative, not positive, trend (from 41.1 per cent in 1948 to 31.7 per cent in 1967) is apparent, but the trend is not significant. For the fifteen-year period (1953–67) the trend is lightly positive (from 32.7 per cent in 1953 to 35.3 per cent in 1967) but it also is not statistically significant.

Let us turn now from the pricing strategy of the WNMB to the "deteriorating" cocoa production situation. Close examination of the information presented on cocoa export quantities (in the authors' Table II, p. 69) and cocoa export earnings (Table III, p. 70) leads to doubts about the very existence of the alleged "deterioration." A regression analysis of export quantities upon time shows a statistically significant (at the 1 per cent level) *positive* trend for quantities (increasing from 73,000 tons in 1948 to 217,000 tons in 1967). A regression of export earnings upon time shows a statistically significant (at the 1 per cent level) *positive* trend for earnings (increasing from £19.7 million in 1948 to £42.2 million in 1967).

Furthermore, these statistically significant *positive* trends in export quantities and export earnings hold not only for the entire 1948–67 period, but also for the last half (1958–67) of the period, during which the "continuing decline" is alleged to have taken place. The export quantity trend is positive and statistically significant at the 1 per cent level, and the earnings trend is positive and statistically significant at the 10 per cent level.

With the intention of showing a deteriorating cocoa situation, Olatunbosun and Olayide present still other data in Table I, but the data do not demonstrate the authors' point. The data show that Nigeria's relative shares in world cocoa market exports and earnings have been roughly constant. Constancy of Nigeria's shares in a growing world market hardly demonstrates a deterioration of the Nigerian cocoa industry.

In summary, Olatunbosun and Olayide have not demonstrated that the cocoa situation was deteriorating, and their argument that the cause of the alleged deterioration was a declining producer share of cocoa price and earnings cannot be valid

because there was no persistent and significant declining producer share of either price or earnings.

### III. THE "WORKABLE EQUILIBRIUM PRICE"

Using time-series data for 1948-67, Olatunbosun and Olayide specify and estimate what they call a "demand" function and a "supply" function for cocoa. These two functions are then used simultaneously to obtain what the authors call a "workable equilibrium price" for cocoa. This price is then used as a criterion by which the pricing policy of the WNMB is judged.

In the "demand" analysis the quantity of Nigeria's cocoa "exports" is regressed upon average price per ton, mean disposable income of the main cocoa importing countries, mean index of industrial production of the importing countries, an index of competitors' supply, and a trend variable. (The "average price per ton" apparently is the world-market price of cocoa. The only other empirical price that could possibly be used is the price actually paid by the WNMB to the Nigerian cocoa grower, but no one would argue that world demand for Nigeria's cocoa depends on the price paid by the WNMB to the Nigerian cocoa producer.)

There is a serious problem with this specification of the demand equation. Should we expect a relationship between the volume exports of cocoa *from Nigeria* in any given year and world market demand conditions in that year? In any given year Nigeria's *exports* of cocoa are closely related to Nigeria's *production* of cocoa. Roughly speaking, Nigeria's exports equal Nigeria's production. Thus the question reduces to the relationship between the factors influencing world market demand in a given year and Nigeria's production of cocoa in that given year. There probably is little relation. (The authors' own *supply* analysis, discussed below, specifies no relation between world market demand in a given year and Nigeria's production in that given year.) In short, the volume of Nigeria's cocoa exports in a given year is probably much more sensitive to factors not included in this demand analysis than to factors that are included. This is probably the reason why the statistical results are so poor. The variables included in the authors' "demand" analysis may be good explainers of world demand for cocoa but there is no reason to think them good explainers of the volume of Nigeria's cocoa exports.

Three functional forms—linear, log-linear, and exponential—are estimated. The regression results (p. 71) are not impressive. While the  $R^2$ 's of the three equations are high (81-85 per cent), most of the coefficients of the independent variables are not statistically significant. In the exponential equation, only two (price and trend) of the five regression coefficients of the independent variables are significant at the 5 per cent level; in the linear equation, none of the five coefficients is significant; in the log-linear equation, only one (price) is significant. These poor results provide an uncertain foundation for the subsequent equilibrium price analysis.

In the "supply" analysis the estimated quantity of cocoa "produced" is regressed upon producer price lagged seven years, acreage in cocoa production lagged eight years, and a trend variable. Given the lengthy gestation period for cocoa trees between planting and production, some sort of lag for producer-price and acreage

is surely plausible. For example, it seems plausible to argue that a rise in producer price in a given year would influence cocoa planting in the following year, and, depending on the length of the gestation period, cocoa production after several more years. It seems strange that in the present model the authors have specified an acreage lag that is one year *longer*, not shorter, than the producer-price lag.

Three functional forms—linear, log-linear, and exponential—are estimated (p. 72). The  $R^2$ 's are high (81–83 per cent), but again there are serious problems with the coefficients of the independent variables. On *a priori* grounds we expect the producer-price variable and the acreage variable in a supply model to be positively correlated with output. In the authors' analysis the producer-price coefficient is *negative* in all three functional forms, and significant at the 5 per cent level only in the log-linear form. The acreage coefficient is *negative* and significant at the 5 per cent level in all three functional forms. Only the trend variable is consistently significant, and positive. The authors recognize their problem. "The regression coefficients for the price and acreage variables are wrongly signed for a supply relation, which is probably an indication of the use of wrong estimating equations" (p. 72).

Thus both the demand and the supply analyses have serious deficiencies. There is questionable specification of both models, and the statistical regression results show numerous insignificant coefficients and numerous "wrong-signed" coefficients.

Olatunbosun and Olayide next use the "demand" and "supply" models to determine what they call an equilibrium price. They insert into the exponential form of the demand equation the mean values of the income, industrial production, substitution and trend variables, and obtain thereby a reduced-form "demand function" in two unknowns: "quantity of cocoa exported" and "average price per ton."

Similarly, they insert into the exponential form of the supply equation the mean values of the acreage and trend variables, and obtain thereby a reduced-form "supply function" in two unknowns: "quantity of cocoa produced" and "producer-price lagged seven years."

Olatunbosun and Olayide (p. 73) proceed to solve these two equations simultaneously to obtain their "workable equilibrium price." But, in fact, no solution is possible, because there are not two equations and two unknowns, but instead two equations and *four* unknowns: quantity exported, quantity produced, average world-market price per ton, and producer price lagged seven years. Now it is true in the case of Nigeria's cocoa that production and exports are very similar, so perhaps no serious error is introduced by considering these variables to be identical. But average world-market price per ton is definitely not the same thing as producer price, and most definitely not the same thing as producer price lagged seven years. Thus, at best, we have two equations and three unknowns. No solution for price is possible.

If my conclusion is valid, the authors' use of the workable equilibrium price to evaluate the WNMB pricing strategy is a futile exercise. But assume the theoretical objections raised above are invalid. What meaning can be attached to a single number ostensibly measuring the appropriate price, in some sense, for cocoa for the entire period 1948–67, a period during which the world-market demand and

supply forces were such as to bring about very substantial fluctuations in cocoa prices?

Olatunbosun and Olayide state that:

We obtained an *ex post* "workable equilibrium price" of £274.00 per ton for the twenty-year period. The mean annual producer price for the period was £131.95 per ton. If we deduct this from the equilibrium price, we obtain the mean annual price gap or underpayment of £142.05 per ton. This gap is a very interesting evidence of excessive taxation of and deductions from the income of Nigerian cocoa producers by the Marketing Board. (p. 73)

What sense can be found in a price that falls *outside* almost the entire set of actual price data used to develop the demand and supply analyses? Not only does the estimated equilibrium price exceed (by more than 100 per cent on average) the actual producer price for each of the twenty years, but it also exceeds the world market price (converted at Nigeria's official exchange rate) for seventeen of the twenty years. In fact, by referring to the gap between the "workable equilibrium price" and the actual producer price as an "underpayment" the authors seem to imply that cocoa producers in Nigeria ought to have been paid, on average, 28 per cent *more* than the world market price!

#### IV. "MOVING-AVERAGE" PRICING STRATEGY

As their final contribution, Olatunbosun and Olayide present what they term a "realistic and deterministic pricing strategy" based on "moving average pricing" (p. 79). They illustrate how it would have worked from 1957 to 1967. With the authors' suggested formula, the producer price in any given year after 1956 is determined as the average of the actual producer prices for the immediately previous years. Thus, under a four-year moving-average strategy the 1957 producer price is determined by taking the average of actual 1953 to 1956 prices. Subsequently, the 1958 price is the average of actual 1954 to 1957 prices. The five-year moving-average strategy would determine the 1957 price as the average of the actual 1952 to 1956 prices, and so on. The authors illustrate six possible formulations, using four, five, six, seven, eight, and nine year moving averages.

The proposed formula for the determination of producer prices for the years after 1956 has two important implications that are not obvious and therefore need to be mentioned. First, it can be shown that the formula determines the producer price for each and every year after 1956 solely on the basis of the actual producer prices of the few years up to and including 1956. Thus the formula implies that nothing that happens after 1956 should influence producer price. Second, the series of producer prices for the years after 1956 that is computed by means of the formula approaches, after a few years, a constant value. Thus, implicit in the formula is a recommendation for a constant producer price the value of which is determined completely by the actual producer prices of a few years up to and including 1956.

Having proposed a formula for the determination of producer prices, the authors

compare the payments to producers that would have been made during 1957-67 under their moving-average price system with the actual payments that were made. (For illustrative purposes, the authors make the implicit assumption that the quantities offered for sale by the producers under the moving-average price system would have been identical to actual quantities offered.) It so happens that the producer prices generated by the moving-average formula all exceed the actual producer prices paid during 1957-67. This is, of course, due simply to the fact that actual producer prices in the pre-1957 years—the prices that in the sense discussed above determine all subsequent prices—are higher than the prices actually paid.

What these comparisons by Olatunbosun and Olayide prove is unclear. Two points can be made. First, their assertion (p. 81) that “any of the moving average pricing strategy would have made cocoa producers well-off without making the government through the WNMB worse-off” is erroneous. Now it is true that if the producers had received the price per ton determined by the authors’ formula the producer would have been better off, because all of the prices determined by the formula are higher than the prices that were actually paid. But *more* for the producers implies *less* for the government, because the total receipts in each year to be divided between the producers and the government are given by the product of Nigeria’s export quantity (assumed not to be influenced by the suggested pricing scheme) and the world market price (which clearly is not influenced by the pricing scheme). Thus, with a given total to be allocated between producers and government, more for producers implies less for the government. The authors’ statement to the contrary is not correct.

Second, the authors claim that the suggested moving-average pricing strategy is “realistic.” But how realistic is it for the producer price of cocoa to be determined by a mechanistic formula that takes no account of world-market prices? It was noted earlier that under the proposed pricing system the world-market price after 1956 *never* has any impact on producer prices for the years after 1956. Is it “realistic” for Nigeria’s cocoa producers to be paid a price completely unrelated to the world market price for cocoa?