AFRICAN RURAL EMPLOYMENT RESEARCH NETWORK

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THE EFFECTS OF TAXES AND SUBSIDIES ON LAND AND LABOUR UTILIZATION IN NIGERIAN AGRICULTURE

by

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INTRODUCTION

This paper has one main objective: to provide a framework for examining the effects of government and marketing board taxes and subsidies on land and labor utilization in Nigerian agriculture. The framework will help us answer the following questions. What are the effects of these taxes and subsidies on the utilization of the stocks of family labor and land? What are their effects on the entry and exit of farmers and other resources from agriculture?

Previous studies of marketing board policies lack explicit treatment of the effects of these policies on resource employment in Nigerian agriculture. P. T. Bauer's authoritative studies [1954, 1968] of marketing boards focused on the output effects of marketing board taxes. Bauer's studies were followed by numerous arguments over whether these boards could stabilize producer prices or incomes [Bauer, 1954; Helleiner, 1966a, 1966b]. The Consortium for the Study of Nigerian Rural Development (CSNRD) studies [Johnson, et. al., 1969] examined output, foreign exchange and income effects of marketing board policies. Likewise, Olatunbosun and Olayide [1971], in a paper presented at a conference on the Marketing Board System at Ibadan, examined the output and income effects of marketing board policies while Teriba and Olakanpo [1971] at the same conference, examined the fiscal, monetary and investment implications of the boards.[1/] Helleiner [1966],

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[1/] The paper by Teriba and Olakanpo [1971] contains one basic shortcoming: the section on the investment implications of the boards focuses solely on investments of reserves by the boards and neglects the more significant implications of these taxes on investments in both old and new, superior productive resources by the millions of Nigerian farmers.

in his monumental study of Nigeria's marketing boards pays scant attention to the effects of taxes on resource utilization.

There is a need for an understanding of the effects of national policies on land and labor utilization in Nigerian agriculture as a basis for analyzing a number of unresolved problems. For example, unemployment and underemployment of labor resources are currently serious problems of social and economic significance in Nigeria. In recent years, farmers have been reallocating labor away from marketing board crop production to other economic activities. At the same time, out-migration of rural farm youth has been increasing, while suitable additional land for cotton and groundnuts has not been cultivated.[2/] The relationship of government policies to these problems from a farm-sector point of view needs an explicit treatment within a more comprehensive framework of analysis [Byerlee and Eicher, 1972].

This paper is divided into three main sections. In the first section, a multicrop production function model is developed to analyze the effects of taxes on resource allocation where initial quantities of resources on hand are utilized up to the point where their off-farm acquisition prices equal their MVPs. In the second section this model is extended to handle cases in which the initial quantities may, through errors of organization and imperfect foresight, be fixed at a level where their MVP's are between

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[2/] In a recent issue of West Africa, it is stated: "A total of 72,000 tons of groundnuts were produced in the North Eastern State in 1970-71 compared with 204,000 tons the previous season. Cotton production fell from 86,000 tons to 40,000 tons. The State Commissioner for Agriculture and Cooperatives, Alhaji Muhammadu Mai, attributed the decline to the drift of farmers to the towns..." See West Africa, #2871 (London: Times Press, June 23, 1972, p. 810). A correspondent in the same journal writes: "Once again it appears that there has not been sufficient incentive for farmers to plant out a higher acreage and while the present high prices are obtainable for other food crops, a pattern of rather smaller groundnut crops in Nigeria seems likely to continue." West Africa, #2857 (London: Times Press, March 17, 1972, p. 324).

their salvage and acquisition prices. In the final section guidelines are derived within a Cobb-Douglas production function framework for minimizing allocative distortions with respect to resource use in the presence of taxes on marketing board crops.

MULTICROP PRODUCTION FUNCTION MODEL

Nigeria displays great diversity in agricultural resource endowments [Manetsch, et. al., 1971]. The agricultural economy of the northern states can be divided into cropping subregions according to climate and ecology: 1) groundnuts and food crops like guinea corn, millet, beans, etc., 2) cotton and food crops, 3) cotton, groundnuts and food crops and 4) the Middle Belt where mainly food crops are grown. The agricultural economy of the southern states can be divided into four production zones: 1) cocoa and food crops, 2) oil palm and food crops, 3) oil palm, rubber and food crops and 4) land where mainly oil palm, rubber, cocoa or food crops are produced. Much of the land and most of the labor is not crop specific. Therefore, most farms can be represented by a multicrop production function written in implicit form as in Equation (1),

$$F(Y_1,\ldots Y_m, X_1,\ldots,X_n) = 0 \qquad (1)$$

where Y_j, $j = 1,\ldots,m$, is output of the jth crop and X_i, $i = 1,\ldots n$, is quantity of the ith input where some of the X_i's represent service flows per unit of stock or per unit of stock per unit of time coming from changes in the rates of utilization of durable resources.

The state and federal governments impose a produce sales tax and an export tax that is partially on a specific tax basis and partially on an ad valorem basis. Also for most export crops, the marketing boards impose a tax on producers approximated by the so-called "trading surplus" of the

boards. In reality, these taxes are mainly determined by the potential market value of the crops in each year, i.e., the world market value of these crops. We can therefore perceive of the government and marketing board as implicitly deciding each year what proportion of this market value it would collect in taxes and what proportion to give to Nigerian farmers. Let the three components of taxes on a crop therefore be converted to a tax rate as a proportion of this potential market value so that a £N10 tax per ton of groundnuts with a potential producer price of £N50 would amount to a tax rate of 20 percent. Let us call this tax rate τ_j so that the price received per unit of the crop equals $(1 - \tau_j)P_{yj} = \mu_j P_{yj}$ where P_{yj} is the market producer price of the jth crop in the absence of taxes. At the same time, the government subsidizes some inputs like fertilizers, sprays, chemicals, information supplied by extension staff, etc. Let input X_i be subsidized at the rate of t_i per unit so that the price paid per unit of the input by the farmer equals $(1 - t_i)P^a_{xi} = \lambda_i P^a_{xi}$ where P^a_{xi} is the acquisition price of X_i.

The profit equation for a representative farm in the presence of these taxes and subsidies is

$$\Pi = \sum_{j=1}^{m} \mu_j P_{yj} Y_j - \sum_{i=1}^{n} \lambda_i P^a_{xi} X_i \qquad (2)$$

The necessary conditions for profit maximization are:

$$\frac{F_j}{F_r} = \frac{\partial Y_r}{\partial Y_j} = \frac{\mu_j}{\mu_r} \frac{P_{yi}}{P_{yr}}, \qquad j,r = 1,\ldots,m \qquad (3)$$

and

$$P_{yj} \frac{\partial Y_j}{\partial X_i} = MVP_{xi,yj} = \frac{\lambda_i}{\mu_j} P^a_{xi}, \qquad \begin{matrix} i = 1,\ldots,n \\ j = 1,\ldots,m \end{matrix} \qquad (4)$$

Equation (3) says that in equilibrium, the marginal rate of transformation between two crops that are subject to government and marketing board

taxation, holding the quantities of other outputs and inputs constant, equals the ratio of their potential (producer) prices, each weighted by the proportion of the unit crop price received by the farmer net of taxes. From (3) it follows that:

$$\frac{\mu_j}{\mu_r}\frac{P_{yj}}{P_{yr}} \gtreqless \frac{P_{yj}}{P_{yr}} \text{ as } \frac{\mu_j}{\mu_r} \gtreqless 1. \tag{3a}$$

From (4), it follows that

$$MVP_{xi,yj} = \frac{\lambda_i}{\mu_j} P^a_{xi} \gtreqless P^a_{xi} \text{ as } \frac{\lambda_i}{\mu_j} \gtreqless 1, \quad \begin{matrix} i = 1,\ldots,n \\ j = 1,\ldots,m \end{matrix} \tag{4a}$$

Land and labor still produce the bulk of the value added in Nigerian agriculture. Neither of these resources is subsidized on any significant scale to date. For all practical purposes, we can assume these subsidies to be zero (i.e., $\lambda_i = 1$ for both land and labor). Whenever cotton and groundnuts were taxed, $\frac{\lambda_i}{\mu_j} > 1$, which implies that both land and labor were, through induced responses to taxes, being used in lesser amounts than would have been the case in the absence of taxes.[3/]

INVESTMENT-DISINVESTMENT RESPONSES WITH DIFFERING SALVAGE AND ACQUISITION VALUES

The model will develop a sharper focus if we extend it to handle cases in which the initial quanities of resources on hand have differing

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[3/] There is an implicit assumption in this analysis that Nigerian farmers achieve allocative equilibrium with respect to the use of their land and labor. This was hypothesized by T. W. Schultz [1964] and supported by D. W. Norman [1970] and D. Welsch [1965]. Schultz's hypothesis is general enough to cover cases in which the relevant acquisition cost (as in the case of fixed resources) is not the market price of the resource but its on-farm (internal) opportunity cost.

salvage and acquisition values.[4/] To simplify, we use a one crop-two input production function. Let there be a production function relating output of marketing board crop Y to inputs X_1 and X_2. Assume it does not pay to vary the quantity of X_2 on hand, i.e., $P^s_{x2} < \mu_y P_y \frac{\partial Y}{\partial X_2} < \lambda_2 P^a_{x2}$ for all possible changes in taxes on marketing board crops and subsidies on inputs, where $P^s_{x_2}$ is the salvage value of X_2, and $P^a_{x_2}$ is the acquisition price of X_2 in the absence of subsidies.

Effect of Taxes on Investment-Disinvestment Response

In Figure 1, EE is the MVP curve of X_1 in the absence of taxes on Y. If the initial quantity of X_1 on hand happens to be K_1,[5/] it does not pay to invest or disinvest in X_1 (i.e., X_1 is fixed in an economic sense). With the imposition of taxes on Y the adjusted MVP is EE' (i.e., EE' = μ_y'EE). With EE', it still does not pay the farmer to change the level of X_1 employed because at the given level of K_1, its MVP is still bounded by its salvage and acquisition values. Suppose taxes are raised so that the adjusted MVP of X_1 is EE'' (where EE'' = μ_y'' EE). There would be salvaging and disinvestment in X_1 by the amount K_2K_1.[6/] Such salvaging seems to have occurred in Nigerian agriculture especially with respect to labor, as young farmers, attracted by the relatively high expected minimum wages or unskilled workers in the cities, have migrated from rural to urban centers.

[4/] Johnson [1958, 1960, 1972] first pointed out and analyzed the investment-disinvestment implications of salvage and acquisition values of durable productive assets.

[5/] This could result from errors of organization, incorrectly formed expectations, etc.

[6/] Note that $K_2K_1 < K_2'K_1$, the predicted disinvestment using the neo-classical model which assumes equality between acquisition and salvage values.

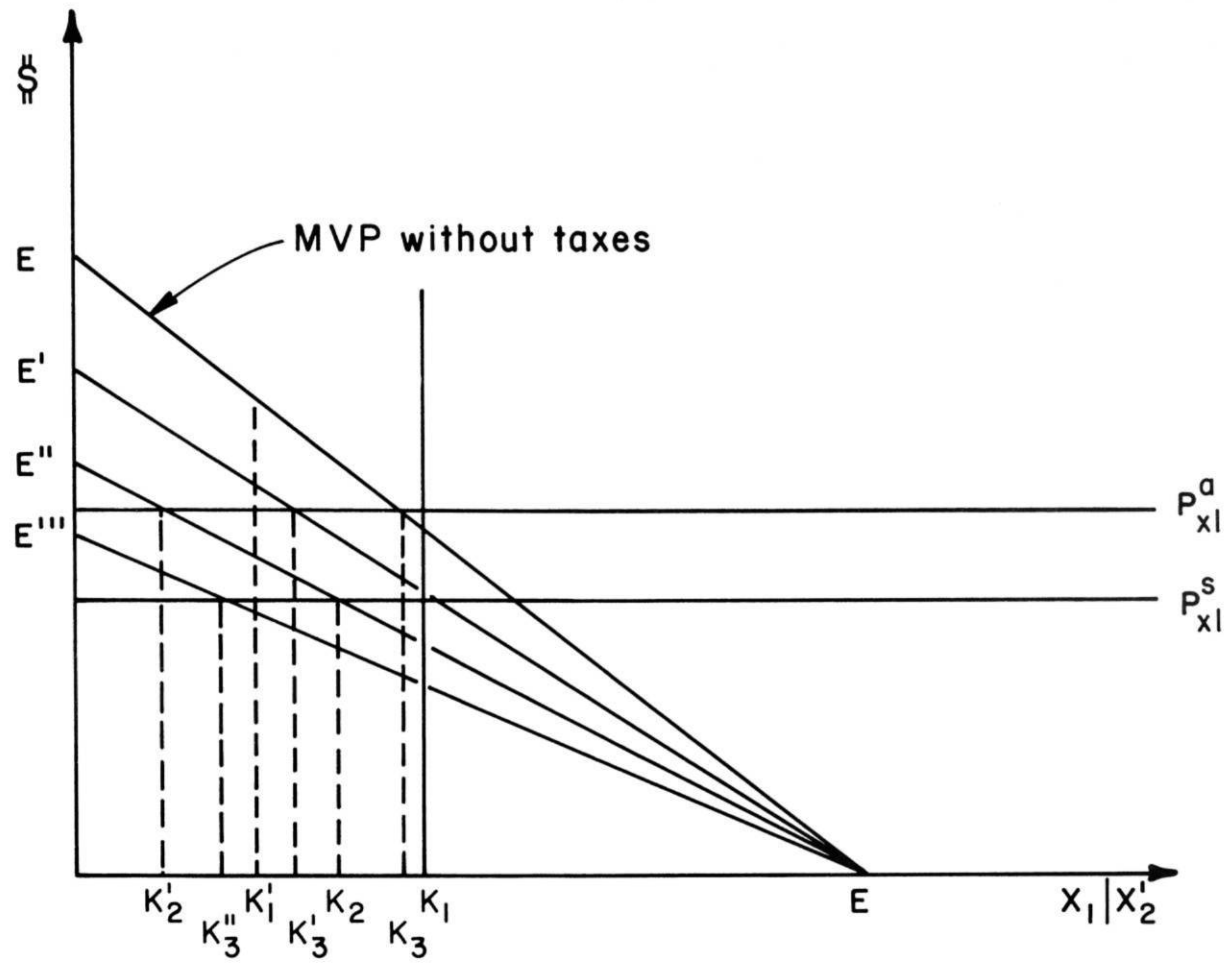

Figure 1. MVP's and Investment-Disinvestment Responses

The following propositions may be derived. For initially fixed resources small taxes may leave resource employment unaffected while large taxes lead to salvaging and disinvestment. A related proposition is that for given tax levels, the higher is the off-farm salvage value (as represented by the secularly rising minimum wage for unskilled workers), the larger is the expected salvaging and disinvestment of the initial quantity of the resource on hand. Minimum wage laws therefore tend to induce an increase in the rate of exit of resources from the farm sector. Furthermore, the larger the differential between the acquisition and salvage values, the larger would taxes on crops have to be to induce any salvaging and disinvestment in productive resources.

These same propositions apply even if the initial quantity on hand of the resource were the narrowly defined equilibrium amount where acquisition price equals MVP. Suppose the initial quantity on hand, through errors of farm organization, etc., happens to be K_1'. Taxes on Y leading to EE' will lead to additional investment in X_1 of $K_1'K_3'$. Taxes leading to EE'' lead to neither investment nor disinvestment in X_1 while taxes leading to EE''' lead to reduction in investment that would have occurred without taxes by the amount $K_1'K_3$ and a disinvestment in X_1 by the amount $K_1'K_3''$. The following proposition can be derived. For those resources that it would have paid to invest in additional units in the absence of taxes, small taxes lead to a reduction in investments while large taxes lead not only to reduced investments but also disinvestments in the initial quantities. That is, farm youth and school-leavers that would have been acquired by the farm sector are not acquired leading to a reduction in investment in human capital on the farms. At the same time established farmers are

salvaged by the farm sector, as off-farm salvage values exceed the net-of-tax on-farm opportunity costs of the farmers.[7/]

Off-farm salvage values could be regarded as the expected minimum wage for unskilled workers. Alternatively, the relevant salvage value could be the present value of expected MVPs in rural nonfarm activities. In this case, as the demand for these off-farm rural services rise with income and population, these salvage values rise relative to the net-of-tax MVPs of established farmers in marketing board crops. Thus, farmers in response to these taxes move not only to urban centers but also into rural nonfarm activities. In total there are more people moving from the rural to the urban sector and moving from farm to rural nonfarm activities or from marketing board crop production to nonmarketing board crop production than would have been the case in the absence of taxes.

Similarly, taxes affect the utilization of land. Suitable additional new land is not cleared for the cultivation of marketing board crops[8/] while existing acreages formerly planted to marketing board crops are, in response to taxes on these crops, either abandoned (a major form of disinvestment in Nigerian agriculture) or reallocated to the production of food crops or other nonmarketing board crops.

Extension of the Analysis to Include Subsidies on Inputs

In Figure 2, let EE, P^a_{x1} and P^s_{x1} have their previous meanings. Let

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[7/] In so far as land is complementary to labor, labor employment is reduced considerably through the nonuse of available suitable land for cotton and groundnuts in the North-East, North-West and North-Central States and also from the abandonment of suitable land previously in cotton and groundnut production.

[8/] Clearing of new land is a major form of investment in Nigerian agriculture.

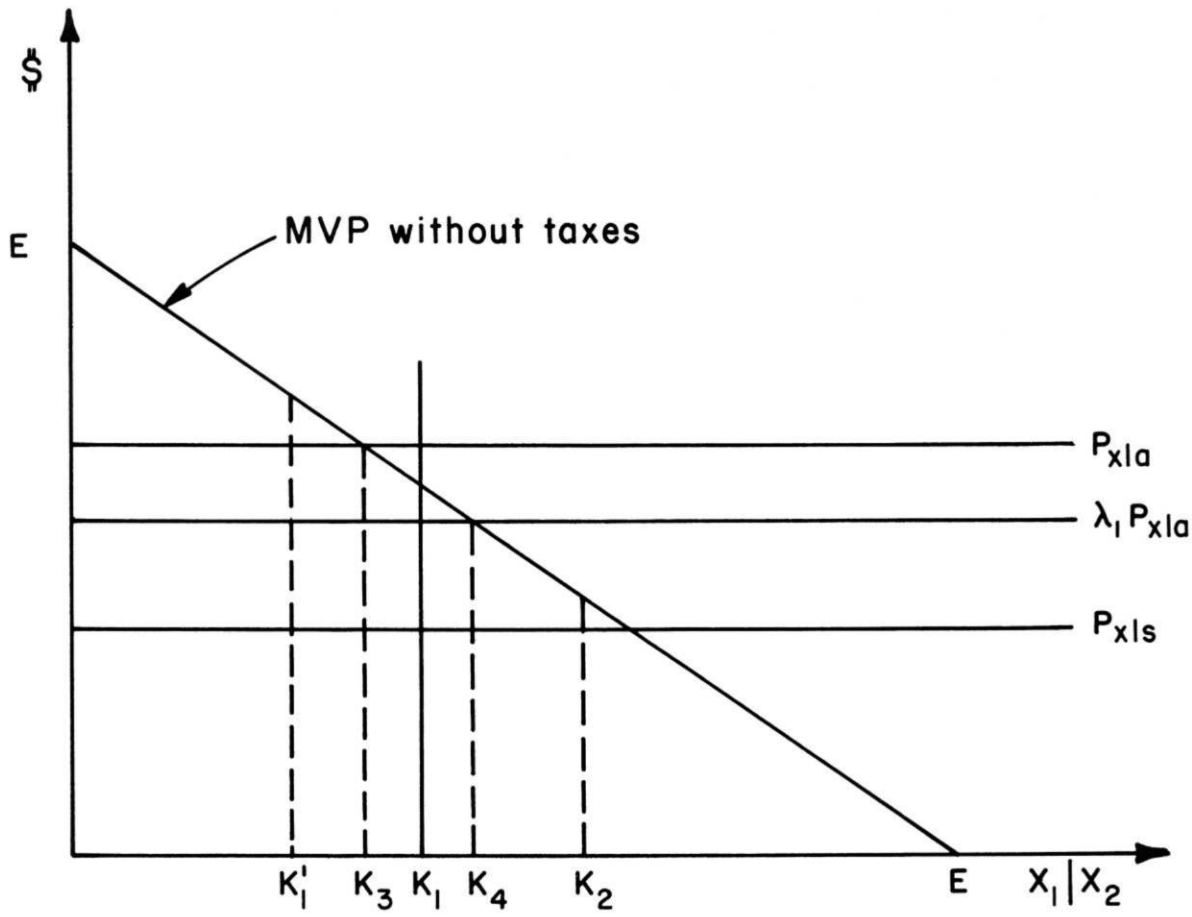

Figure 2. MVP with Subsidized Resources and No Taxes on Product

the subsidy rate by t_1 so that the farmer pays $(1 - t_1)P^a_{x1} = \lambda_1 P^a_{x1}$ a per unit of X_1 where λ_1 is the proportion of the unit acquisition price of X_1 paid by the farmer. The new supply curve of X_1 facing the farmer is $\lambda_1 P^a_{x1}$. Whether the initial quantity on hand is K_1, K_1', or K_3, with subsidies leading to $\lambda_1 P^a_{x1}$ as the new supply line, there will be additional investment in X_1 up to K_4. With initial quantity on hand of K_1, subsidies make variable a resource that was originally fixed. With K_2 as the original quantity on hand, these subsidies have no effect on the employment of X_1.

Let us now assume, simultaneous taxing of Y and subsidizing of X. In Figure 3, EE, EE', EE'', $\lambda_1 P^a_{x1}$ and P^s_{x1} all have their previous meanings. With an initial quantity on hand of K_3, imposition of taxes (EE', EE'') and granting of subsidies ($\lambda_1 P^a_{x1}$) have no effect on the employment of X_1. On the other hand, with K_1 as the initial quantity on hand and with the same subsidies and taxes leading to EE', there is additional investment by K_1K_2'. With taxes leading to EE'', there is disinvestment by K_1K_2. Whether resource employment would be affected by taxes and subsidies therefore depends on the relative sizes of these taxes and subsidies, the initial quantity of the resource on hand and the size of the differential between its acquisition and salvage values.

Some Empirical Results[9/]

The effects of taxes on groundnuts and cotton on the real (relative) prices of land and labor employed in these crops in northern states of Nigeria for 1950-1966 are shown in Tables 1 and 2. A ratio of $\lambda_1/\mu_j > 1$

9/ Available data do not provide a direct test of the extended model. It is hoped that further field work will generate such data. For the case in which farmers may not allocate resources efficiently, see the end of this section.

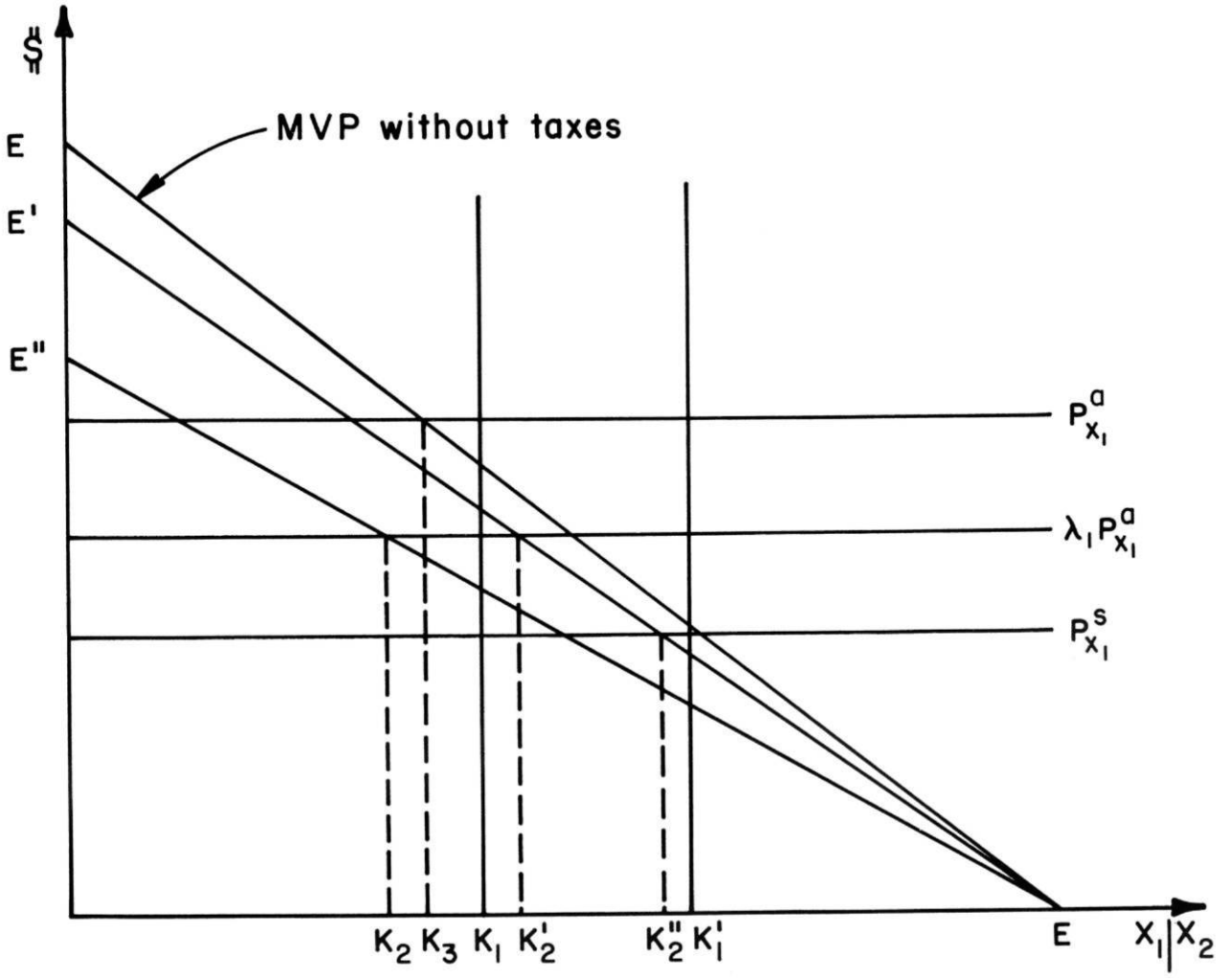

Figure 3. MVP's with Subsidized Resources and Taxed Products

Table 1. Effects of Taxes on Groundnuts on Real (Relative) Prices of Land and Labor Farms in the Northern States of Nigeria, 1950-1965

Year	Total Export Duties	Export Duties Per Ton Purchased	Surplus to the Marketing Board Per Ton Purchased	Produce Tax Per Ton Purchased	Total Tax as Proportion of Potential Producer Price Inclusive of Tax	μ_j: Proportion of Potential Producer Price That was Paid to Farmers	$\frac{\lambda_1}{\mu_j}$ [a/]
	£N '000	---------- £N ----------					
1950	n.a.	n.a.	n.a.	n.a.	.549	.451	2.42
1951	n.a.	n.a.	n.a.	n.a.	.325	.675	1.48
1952	n.a.	n.a.	n.a.	n.a.	.285	.715	1.40
1953	2,905	n.a.	11.00	n.a.	.365	.635	1.57
1954	3,430	n.a.	8.20	1.0	.315	.685	1.45
1955	2,965	n.a.	-3.20	1.0	.143	.857	1.17
1956	3,192	6.2	1.40	1.0	.210	.790	1.27
1957	2,689	7.2	7.60	1.0	.297	.703	1.42
1958	2,987	3.3	-7.80	1.0	-.052	1.052	.95
1959	3,412	5.5	-3.50	1.0	.072	.928	1.08
1960	2,686	5.9	1.20	1.0	.180	.820	1.22
1961	3,658	6.1	-2.20	1.0	.125	.875	1.14
1962	3,722	5.4	-2.40	1.5	.127	.873	1.15
1963	3,770	4.7	.06	1.5	.170	.830	1.20
1964	4,363	5.6	1.20	1.5	.214	.786	1.27
1965	4,831	6.4	1.10	1.5	.215	.785	1.27

[a/] It is assumed that land and labor were not subsidized so that λ_1, the proportion of the unit acquisition price of the resource paid by farmers, equals unity for both land and labor.

Source: For prices and tax figures 1953-1966, see H. Kriesel, The Marketing of Groundnuts in Nigeria, CSNRD 19, p. 68. For prices and tax figures 1950-1952, see G. K. Helleiner, op. cit. For 1950-1952, only total tax figures available.

Table 2. Effects of Taxes on Cotton on Real (Relative) Prices of Land and Labor Farms in the Northern States of Nigeria, 1950-1966

Year	Total Export Duties	Produce Tax	Surplus to the Marketing Board	Composite Tax Per Ton Purchased	Total Tax as Proportion of Potential Producer Price Inclusive of Taxes	μ_j: Proportion of Potential Producer Price That was Paid to Farmers	$\frac{\lambda_i}{\mu_j}$ [a]
	---------- £N '000 ----------			£N			
1950	n.a.	n.a.	1192.4	30.040	.328	.672	1.49
1951	386.0	n.a.	2067.3	58.040	.441	.559	1.79
1952	713.7	n.a.	1166.3	29.500	.349	.651	1.54
1953	812.2	n.a.	1397.0	43.300	.441	.559	1.79
1954	775.1	n.a.	1098.8	24.300	.306	.694	1.44
1955	970.7	92.1	1595.5	27.000	.331	.669	1.49
1956	812.1	75.4	490.6	17.100	.237	.763	11.31
1957	750.6	68.1	199.4	14.100	.204	.796	1.26
1958	851.2	115.6	-1020.9	-0.040	-.001	1.000	1.00
1959	728.0	81.3	-1034.2	-2.600	-.050	1.050	.95
1960	733.1	84.3	- 989.4	-2.000	-.037	1.037	.96
1961	1050.0	211.1	-1255.3	-0.004	.000	1.000	1.00
1962	832.4	118.7	- 548.4	4.700	.095	.905	1.10
1963	910.4	205.1	- 98.4	6.900	.133	.867	1.15
1964	812.8	182.1	465.6	11.200	.194	.806	1.24
1965	684.5	182.1	122.5	7.600	.141	.859	1.16
1966	676.0	180.4	-1023.7	-1.300	.163	.837	1.19

[a] It is assumed that land and labor were not subsidized so that λ_i the proportion of unit acquisition price of the resource paid by the farmer, equals unity of both land and labor.

Source: Price series for 1950-1959: Extended and amended Kriesel series: H. Kriesel, Cotton Marketing in Nigeria, CSNRD 24, p. 73. The price series 1960-1971 to which the composite tax/ton are added to get the potential producer's price are my own constructed series resulting from my dissatisfaction with existing series. Helleiner's Table 11-B-6 (pp. 474-475) used only Grade 1 cotton prices for all the years when a weighted index is clearly better. However, constructing a weighted index is beset with many problems because of the scattered sources. For weights for the price series 1960-1967, see H. Kriesel, op. cit., p. 55; for net taxes after deduction of produce sales tax for different grades of cotton 1960-1967, see M. O. Titiloye and A. A. Ismail, A Survey of the Trends and Problems in the Domestic Arrangements for the Marketing of Groundnuts and Cotton, NISER (Ibadan: International Conference on the Marketing Board System, 1971), pp. 78-80. For prices of different grades of cotton 1968-1971, see National Agricultural Development Conference, Federal Department of Agriculture, Lagos, 1971, p. 7; Weights for prices different grades 1968-1970 from mean weights for the above Report of the Study..., p. 60, while weights for 1971-1972 were assumed to be those of 1970-1971.

implies that less of the labor and land were being used than would have been the case in the absence of taxes, where "less use" here refers to both the reductions in investment in land and labor that would have occurred and disinvestments in quantities of land and labor on hand in the farm sector.[10/]

[10/] From our a priori knowledge of the ease with which much land and most labor are shifted between crop enterprises in Nigerian agriculture, we infer that farmers are allocating those resources that are fixed with respect to their off-farm acquisition and salvage values on the basis of their on-farm opportunity costs. Suppose labor of a given age and farming skill is fixed in the sense that it does not pay to invest or disinvest in it. Suppose this labor is to be allocated between groundnuts and food production. Let L° stand for this fixed labor, g for groundnuts, and f for a food crop. From the production function:

$$L = F(g,f),$$

the necessary conditions for maximum revenue are:

$$\frac{\partial K}{\partial f} = \mu_f P_f - \delta\frac{\partial F}{\partial f} = 0$$

$$\frac{\partial K}{\partial g} = \mu_g P_g - \delta\frac{\partial F}{\partial g} = 0$$

$$\frac{\partial L}{\partial \delta} = L^\circ - F(g,f) = 0$$

from which $\delta = \dfrac{\mu_f P_f}{\frac{\partial F}{\partial f}} = \dfrac{\mu_g P_g}{\frac{\partial F}{\partial g}}$

from which it follows that:

$$\delta = \mu_f P_g \frac{\partial f}{\partial L} = \mu_g P_g \frac{\partial g}{\partial L}$$

where $\frac{\partial f}{\partial L}$ and $\frac{\partial g}{\partial L}$ are the marginal products of the labor in food and groundnut production, respectively, where μ_f and μ_g are proportions of unit producer prices of food and groundnuts, respectively received by the farmer. δ turns out to be the on-farm opportunity cost of the fixed labor. With food not currently taxed and with groundnuts being taxed, $\mu_f = 1$ and $0 < \mu_g < 1$. This induces a reallocation of labor away from groundnut to food production until, in equilibrium, δ has a common value in both. Fixity of a resource in an economic sense does not therefore preclude these allocative responses (with respect to resource use) to changes in these taxes.

So far as farmers pay the full cost of hired labor or bear the full real costs of family labor (where these costs may be represented by the market acquisition prices or the on-farm opportunity costs of resources), i.e., $\lambda_i = 1$, then for any crop subject to government and marketing board taxation and for given prices of other inputs, quantities of other inputs, and product price, farmers would, in equilibrium, be demanding less hired labor and/or family labor than they would have done in the absence of government taxation or salvaging some if salvage values exceed MVPs. Under our stated conditions, this means that for cotton and groundnuts, in the northern states less labor (family and hired) is being used than would have been the case in the absence of taxation. In so far as rates of utilization of family labor and hired labor are explicitly introduced as factors of production in the production function, farmers are being induced by government taxation to work less intensively than they would otherwise have done in the absence of government taxation. In so far as there are imputed real costs (rents, customary dues, etc.) of land that are fully borne by farmers ($\lambda_i = 1$), then for given prices of other inputs, quantities of other inputs and product price, government policy would induce the use of less land than would have been the case without these government policies.[11/]

[11/] Norman [1970, p. 125] has both a lower and an upper bound for the annual rent of an acre of land in Southern Zaria. In gona land (upland field), this lower bound is 17 shillings and the upper bound is 100 shillings. On fadama land (lowland field) the lower bound is 47 shillings and the upper bound is 370 shillings. In all likelihood (in absence of government irrigation and reclamation projects, etc.), the farmer bears the full cost of this land. Bearing the full costs of the land is the common practice in the Northern States. He found the cost of nonfamily labor to be 0.51 shillings/man hour which he also uses to approximate the on-farm opportunity cost of family labor. This is a simplification but it is convenient.

The following conclusions may be drawn using the assumptions of the model. Tables 1 and 2 show that as a result of government taxation policies both land and labor (family and hired) used in groundnut and cotton production over the period were, on the whole, induced through government taxation policies to be employed on a smaller scale than the amounts that would have been employed in the absence of government taxation of groundnuts.[12/]

Our results on the allocative distortions of government and marketing board taxes with respect to resource use in the cotton and groundnut farms in the northern states do approximate reality and have increased validity because only a very small proportion of these farmers use fertilizers and other subsidized inputs. Hence any existing subsidies on fertilizers and chemicals become insignificant when the aggregate of farmers are considered and can be disregarded for practical purposes.[13/] As a practical matter, therefore, there have been no compensating subsidies in the past on any significant scale, though this could become an important policy variable in the future.[14/]

[12/] Only in one year in groundnuts and two years in cotton was government and marketing board taxation such as to induce farmers in the northern states to use more labor and land than they would have done in the absence of government taxation.

[13/] "Although it is difficult to obtain data on the extent to which farmers are changing from their traditional practice, it must be concluded that very few of them are doing so. . .most of the insecticide that is sold is intended for cotton, but total sales. . .are very small in relation to the total acreage. . ." [Federal Department of Agriculture, 1971a].

[14/] Sources of bias in estimating effects on resource use of taxes on marketing board crops are not discussed in this paper. There is an elasticity bias from two sources: first from using a single MVP curve as the demand curve for the input rather than the more general demand curve which allows other resources to vary, and second, from failure to distinguish between acquisition and salvage values for durable resources. Failure to distinguish between salvage and acquisition values of durable resources will lead to an underestimate of the resource utilization response to a lowering of taxes on a given marketing board crop. [Idachaba, 1972].

TAXATION OF CROPS AND SUBSIDIES ON INPUTS: A "SECOND-BEST" PROBLEM

Labor and land produce the bulk of the value added in farming activities in the northern states. If we assume that these inputs are not being subsidized and if policy makers want to minimize distortions in the amounts of labor and land employed, what are the compensating amounts of subsidies on the other factor(s) required to keep the quantities of labor and land employed constant given existing taxes on export crops.[15/] The theory of second-best says that when there is a violation of some of our marginality conditions for an optimum, it cannot be concluded a priori whether we would move towards or further away from the optimum by violating more marginality conditions. For example, with X_1 and X_2 denoting labor and fertilizer, respectively, in a Cobb-Douglas production function, what are the required changes in the net acquisition prices of fertilizers paid by farmers and

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[15/] There are two implicit assumptions: first that the elasticities of demand for resources with respect to the producer prices for marketing board crops are positive and secondly, that Nigerian farmers allocate efficiently in the use of their land and labor resources. The first assumption usually holds true except for inferior inputs. Available evidence is consistent with the second assumption. Letting X_1 and X_2 denote labor and land, respectively in a Cobb-Douglas framework, I have computed the following from Norman's [1970] estimates of output elasticities (b_1, b_2): Millet/guinea corn (gona land); $MVP_{x1} = 0.58$, $P^a_{x1} = 0.51$ from which $\frac{MVP_{x1}}{Pa_{x1}} = 1.14$: Fadama land (all crops); $MVP_{x1} = 0.46$. $P^a_{x1} = 0.51$ from which $\frac{MVP_{x1}}{Pa_{x1}} = 0.90$: Cotton/cowpeas/sweet potatoes (gona land); $MVP_{x1} = 0.62$, $P^a_{x1} = 0.51$ from which $\frac{MVP_{x1}}{Pa_{x1}} = 1.22$. This evidence is consistent with the allocative efficiency assumption.

the net crop price received by farmers to keep the profit maximizing (equilibrium) quantity of labor employed on farms constant?[16/]

For the Cobb-Douglas form, let X_1, X_2, X_3, X_4 denote labor of a given skill, fertilizer, chemicals and land, respectively, i.e.,

$$Y = AX_1^{\beta 1}X_2^{\beta 2}X_3^{\beta 3}X_4^{\beta 4}, \quad \sum_{i=1}^{4} \beta_i < 1; \ \beta_i > 0, \ (i = 1,\ldots,4) \tag{5}$$

From the necessary conditions for equilibrium, the true demand functions[17/] for labor, fertilizer, chemicals and land holding only the net acquisition prices of X_1, X_2, X_3 and X_4 and the net crop price constant are, in log:

$$\log X_i = \frac{1}{1 - \sum_{i=1}^{4} \beta_i} \Big[\log A + \log (\mu_y P_y) + \sum_{r \neq i} \beta_r \log \beta_r + \Big(\sum_{r \neq i} \beta_r - 1\Big) \log (\lambda_i P^a_{xi}) - \Big(\sum_{r \neq i} \beta_r - 1\Big) \log \beta_i - \sum_{r \neq i} \beta_r \log (\lambda_r P^a_{xr}) \Big] \tag{6}$$

$$i, r = 1,\ldots,4$$

From (6) above,

$$\begin{aligned} d\log X_1 = {} & \frac{\beta_2+\beta_3+\beta_4-1}{1-\beta_1-\beta_2-\beta_3-\beta_4} d\log (\lambda_1 P^a_{x1}) + \frac{1}{1-\beta_1-\beta_2-\beta_3-\beta_4} d\log (\mu_y P_y) \\ & - \frac{\beta_2}{1-\beta_1-\beta_2-\beta_3-\beta_4} d\log (\lambda_2 P^a_{x2}) - \frac{\beta_3}{1-\beta_1-\beta_2-\beta_3-\beta_4} d \log (\lambda_3 P^a_{x3}) \\ & - \frac{\beta_4}{1-\beta_1-\beta_2-\beta_3-\beta_4} d\log (\lambda_4 P^a_{x4}) \end{aligned} \tag{7}$$

[16/] There may be better ways to increase rural employment and incomes. We believe that the allocative (and even distributional) consequences of this solution are easier to comprehend. The question is not whether the government should raise a tax revenue in the first place and then turn around to use this revenue to subsidize the same crop and the same farmers. The question is; given the institutional reality of taxes on these crops, what is our second-best solution for minimizing the allocative distortions with respect to resource use induced by these taxes?

[17/] "True" here refers to the fact that only input and crop prices, but not input quantities, are held constant [Friedman, 1962].

Now setting dlog $X_1 = 0$ and solving for

$$\frac{\text{dlog } (\lambda_2 P^a_{x2})}{\text{dlog}(\mu_y P_y)} \text{ , } \frac{\text{dlog } (\lambda_1 P^a_{x1})}{\text{dlog } (\mu_y P_y)} \text{ and } \frac{\text{dlog } (\lambda_3 P^a_{x3})}{\text{dlog } (\mu_y P_y)} \text{ ,}$$

gives

$$\frac{\beta_2}{1-\beta_1-\beta_2-\beta_3-\beta_4} \text{dlog } (\lambda_2 P^a_{x2}) + \frac{\beta_3}{1-\beta_1-\beta_2-\beta_3-\beta_4} \text{dlog } (\lambda_3 P^a_{x3})$$

$$+ \frac{\beta_4}{1-\beta_1-\beta_2-\beta_3-\beta_4} \text{dlog } (\lambda_4 P^a_{x4}) - \frac{\beta_2+\beta_3+\beta_4-1}{1-\beta_1-\beta_2-\beta_3-\beta_4} \text{dlog } (\lambda_1 P^a_{x1})$$

$$= \frac{1}{1-\beta_1-\beta_2-\beta_3-\beta_4} \text{dlog } (\mu_y P_y) \qquad (7a)$$

Then for given net acquisition prices of chemical and land, dlog $X_1 = 0$ implies that[18/]

$$\frac{\text{dlog } (\lambda_2 P^a_{x2})}{\text{dlog } (\mu_y P_y)} = \frac{1}{\beta_2} > 0$$

which says that as the net crop price received by farmers goes down by one percent, the net acquisition price that they would have to pay for fertilizers to keep the quantity of labor constant has to decrease by the inverse of the output elasticity of fertilizers. Fertilizers still contribute a minor share of value added in Nigerian agriculture. It would intuitively appear that the smaller the factor share of fertilizers in northern states agriculture, then the larger would be the required compensating fall in the net acquisition price of fertilizers for a given increase in taxes on a crop if the quantity of labor is to remain unchanged. For the above case we see that the smaller the output elasticity of fertilizers, the larger the "required" percentage reduction in net acquisition

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[18/] The same result holds if it is the quantity of land that we wish to hold constant.

prices of fertilizers to compensate for a one percent fall in the net producer price of a crop produced by both fertilizer and labor. For example, if fertilizers have an output elasticity of 0.05, then a one percent fall in the net producer price of, say, groundnuts would require a "compensating" fall in the net acquisition price of fertilizers of 20 percent.

We do not have the output elasticity of fertilizers either at the farm level or at the State level. But we do have the output elasticity of land in Southern Zaria from Norman's study [1971b]. The government does undertake irrigation projects, reclaims lands, takes conservation measures all of which can be seen as subsidizing land used in production. If we want to minimize distortion in the amounts of labor employed as a result of government and marketing board taxation of crops, what is the compensating amount of subsidy on land through the above projects for given taxes on crops? Using Norman's output elasticity for land, we find for cotton/cowpeas/sweet potatoes crop mixture on gona land that a one percent fall in the net producer price of cotton would "require" a "compensating" decrease in the net acquisition price of land of 1.857 percent; on cotton (gona land), it would require a compensating decrease in net acquisition prices of land of 2.422 percent; in groundnut production (gona land), a one percent decrease in the net producer price of groundnuts imposed by the government and the marketing boards would "require" a "compensating" decrease in net acquisition prices of land of 2.746 percent.[19/] These required compensating investments in land by the government in the presence of government and marketing board

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[19/] These compensating subsidies on land in the face of taxes on cotton and groundnuts are the inverse of the output elasticity of land in each crop obtained from Norman's study [1970].

taxation of cotton and groundnuts are particularly relevant for gona land which requires irrigation for all-season cultivation.[20/]

Considering a variant of the above, if policy makers want to minimize distortion in the employment of labor, what is the "compensating subsidy" on labor to keep the profit maximizing (equilibrium) quantity of labor unchanged? Again, the "special elasticity" we are interested in is the compensating percentage reduction in the net acquisition price paid on labor for a given one percentage reduction in the net producer price of, say, groundnuts.

In the case of using a single MVP curve as the demand curve and assuming only X_1 and X_4 in the production function,

$$\log X_1 = \frac{1}{\beta_1 - 1} \log (\lambda_1 P^a_{x1}) + \frac{1}{1-\beta_1} \log (\mu_y P_y) + \frac{\beta_4}{1-\beta_1} \log X_4 + K$$

where $$K = \frac{1}{1-\beta_1} \log \beta_1 + \frac{1}{1-\beta_1} \log A$$

from which, after setting $d\log X_1 = 0$ and assuming $d\log X_4 = 0$,

$$\frac{d\log (\lambda_1 P^a_{x1})}{d\log (\mu_y P_y)} = \frac{\beta_1 - 1}{\beta_1 - 1} = 1$$

which says that a one percent fall in the net producer price of groundnuts

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[20/] If at the beginning of each marketing period, the marketing board in determining the levels of taxes and subsidies determines that it cannot appreciably influence world market prices, then we can write

$$\frac{d\log (\lambda_2 P^a_{x2})}{d\log (\mu_y P_y)} = \frac{d\log \lambda_2}{d\log \mu_y} = \frac{1}{\beta_2}$$

so that instead of dealing in net crop prices and net input acquisition prices after all taxes and subsidies have been netted out, we can talk directly of percentage changes in proportions of unit crop price received and unit input price paid.

or cotton requires a "compensating" one percent fall in the net acquisition price of all labor employed if the quantity of labor employed is to remain constant. The corresponding "special elasticity"[21/] in the case of the true demand curve for labor, assuming the price of land is fixed but the quantity X_4 varies with only X_1 and X_4 in the production functions:[22/]

$$\frac{d\log(\lambda_1 P^a_{x1})}{d\log(\mu_y P_y)} = \frac{1}{1-\beta_4} > 0 \qquad (8)$$

which says that as the government and marketing boards reduce the net groundnut or cotton producer price by one percent, the compensating fall in the net acquisition price of labor would be the inverse of the one minus the output elasticity of land. Table 3 shows some empirical results.

From Equation (8) and footnote (20), it is evident that the less important the resource is in production (as measured by its output elasticity)

[21/] This "special elasticity," like the ones before it, is not derived from any obvious behavioral postulate. However, we could conceive of government officials who are concerned about distortions introduced by government and marketing board taxation in the amounts of labor employed (including induced off-farm migration) but who are equally conscious of the institutional reality of the marketing boards reasoning along these lines: at the going average rates of taxation imposed by the government and marketing boards, what would be the required compensating subsidies on the price of labor that farmers pay or the price of fertilizers, chemicals, etc. that they pay so as to keep people on the farms and, say, stem the off-farm migration. Such implicit reasoning does indeed exist among Nigerian policy makers today.

[22/] With X_1, X_2, X_3 and X_4 in the production function, the corresponding compensating percentage reduction in net acquisition price of labor for a one percentage reduction in producer price of the marketing board crop is $\frac{1}{1-\beta_2-\beta_3-\beta_4}$. The corresponding elasticities in the case of chemicals, fertilizers and land are, respectively, $\frac{1}{1-\beta_1-\beta_2-\beta_4}$, $\frac{1}{1-\beta_1-\beta_3-\beta_4}$ and $\frac{1}{1-\beta_1-\beta_2-\beta_3}$.

Table 3. Percent of Subsidy on Labor for a One Percent Decrease in Net Price of a Marketing Board Crop in Order to Retain the Quantity of Labor Employed on Required Farms in the Northern States

	Type of Commodity	Percentage Subsidy on Labor[a/]
1.	Cotton $\beta_4 = 0.4128$[b/]	1.702
2.	Groundnuts $\beta_4 = .3641$	1.570
3.	Guinea Corn/Groundnut $\beta_4 = .6695$	3.025
4.	Millet/Guinea Corn/Groundnuts $\beta_4 = .6429$	2.800
5.	Cotton/Cowpeas/Sweet Potatoes $\beta_4 = .5385$	2.166

a/ The compensating percentage subsidy on labor is defined as $\frac{1}{1-\beta_4}$.

b/ β_4 is the output elasticity of land.

Source: For output elasticities of land, see Norman [1970, p. 126].

the more the given resource has to be subsidized for a given percentage fall in the net producer price of the marketing board crop if the quantity of this resource employed is to remain constant. Thus, labor which has a relatively large output elasticity in Nigerian agriculture, will require a relatively small compensating subsidy to keep the quantity of labor employed constant at pre-tax equilibrium levels. State governments could subsidize labor in various ways by: a) providing subsidized or free and effective information services; b) lowering the cost of loans in rural capital markets in the light of the seasonal labor constraint and c) improving health care services and nutrition in the rural areas, etc.

However, it may be the case that in the presence of taxes on marketing board crops, no compensating subsidies are required on labor to keep its quantity on Nigerian farms constant. Suppose, in the one crop two-input case (see Figure 3) the initial quantity of X_1 on hand is K_1 (as may come from errors in farm organization). With taxes leading to the adjusted MVP, EE', no compensating subsidies are required to keep the quantity of X_1 constant since there is no incentive to change the employment of X_1 in the absence of subsidies.

If the initial quantity on hand of X_1 were K_1', the same taxes would require a "tax" on the salvage value of X_1 to prevent $K_2'K_1'$ from being salvaged. In this case, however, it is not clear why policy makers should be interested in keeping resources at production levels where acquisition costs are not being covered! The more likely case is one in which if initial quantities on hand exceed K_3, policy should induce salvaging up to the point K_3, the point where acquisition costs are being covered. Such policies may take the form of a "tax" on off-farm salvage

values--more specifically a lowering of the expected minimum urban wage for unskilled workers.

Finally the application of chemicals in groundnuts has great potential for high payoffs.[23/] If the government wants to subsidize these chemicals (for seed dressing and spraying) to compensate for marketing board taxes on cotton and groundnuts so that the (equilibrium) quantity of labor employed does not change, then from (6) above, the required percentage fall in the net acquisition price of chemicals for a one percent fall in the net price of the marketing board crop is:

$$\frac{d\log(\lambda_3 P^a_{x3})}{d\log(\mu_y P_y)} = \frac{1}{\beta_3} > 0,$$

i.e., the inverse of the output elasticity of chemicals.

[23/] The following table gives some results of groundnuts, Northern States of Nigeria:

Improved Practice	Increase in Output per Acre		Return on Investment (%)
	Quantity (lbs.)	%	
(a) Fertilizer	85	11	250
(b) Seed Dressing	321	38	4,900
(c) Spraying	825	59	264

Source: Report of the Study Group on Groundnuts, Federal Department of Agriculture, Lagos, 1971, p. 14.

SUMMARY

We can summarize our findings. The levels of taxes on cotton and groundnuts induced farmers in the northern states to use less family and hired labor and land than would have been the case in the absence of these taxes. These taxes have therefore diminished the levels of labor employed on these farms because of two main reasons. First, the taxes reduce the rate of entry of new and young farmers and of additional land into farming and secondly, they increase the rate of exit of resources from the farm sector. For those resources that are fixed with respect to off-farm acquisition and salvage values, these taxes have induced a reallocation of resources among competing crops on the basis of their (internal) on-farm opportunity costs. For example, the increasing diversion of labor time and land away from groundnut to food production and the recent suggestion by the Governor of the North Eastern State that farmers are migrating to the towns in large numbers are evidence of the effects of these taxes on labor utilization in Nigerian agriculture. Such reallocation of fixed resources if not only among competing marketing board crops as in the case of cotton and groundnuts but among marketing board and nonmarketing board crops as well as between farming and nonfarming rural activities. The allocative distortions induced by these taxes do indeed adversely affect labor absorption in rural areas. Labor utilization has also been indirectly affected because in so far as land and labor are complementary in production, reductions in investments in land or increases in disinvestments of initial quantities on hand will lead to a reduction in labor absorption. To the extent that some of the labor and land displaced from marketing board crops are used in food production, the total

employment impact of these taxes is less than would have been the case in the absence of competition between food and marketing board crops. We do know from casual observation that thousands of young people are leaving the rural areas for the cities.

Within the framework of the theory of production, the paper attempts to provide guidelines for engaging in compensating subsidies that will minimize the allocative distortions introduced by these taxes with respect to labor absorption or use. If policy makers want to live with the institutional reality of the marketing boards but desire to stem the off-farm migration, what are the compensating subsidies on resources that are required? These compensating subsidies are shown within the Cobb-Douglas framework to depend largely on the output elasticities of these resources. Calculations of the required compensating subsidies to keep the quantity of labor constant are then made using available estimates of output elasticity of land. This "second-best" approach has potential for planning purposes since budget allocations to input subsidies can rationally be related to expected tax rates on marketing board crops.

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