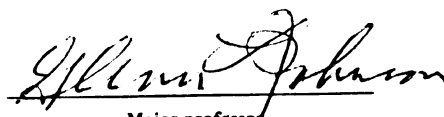


MARKETING BOARD TAXATION
OF NIGERIAN AGRICULTURE:
SOME IMPLICATIONS

Thesis for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY
FRANCIS SULEMANU IDACHABA
1972



This is to certify that the
thesis entitled
**Marketing Board Taxation
of Nigerian Agriculture:
Some Implications**
presented by
Francis Sulemanu Idachaba
has been accepted towards fulfillment
of the requirements for
Ph.D. degree in Agricultural Economics


Major professor

Date 11/6/72

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ABSTRACT

MARKETING BOARD TAXATION
IN AGRICULTURE: SOME IMPLICATIONS

By

Francis Guillemain Leclerc

This study had three main aims: first, to develop a framework for analyzing the effects of taxes on marketing board crops and of subsidies on input transactions; second, to examine what the quantitative impact would have been on tax revenue from cotton and groundnuts if buyers farmers higher prices than the actual prices they received; and third, to examine whether revenue contributions from marketing boards and allied statutory corporations can be trusted to stabilize State Government revenues for planning purposes.

A model was developed to explain the effects of these taxes on the scale of farming in the Northern States (1950-56) measured either in terms of acreage or labor. When the model was extended to account for the differential between off-farm acquisition and salvage values, the investment-disinvestment responses to changes in taxes and subsidies differed, in many cases, from those predicted by the model.

ABSTRACT

MARKETING BOARD TAXATION OF NIGERIAN
AGRICULTURE: SOME IMPLICATIONS

By

Francis Sulemanu Idachaba

This study had three main aims: first to provide a framework for analyzing the effects of taxes on marketing board crops and of subsidies on input (resource) use; second, to examine what the quantitative impact would have been on tax revenue from cotton and groundnuts of paying farmers higher prices than the actual prices they received and third, to examine whether revenue contributions from marketing boards and allied statutory corporations can be trusted to stabilize State Government revenues for planning purposes.

A model was developed to explain the effects of these taxes on the scale of farming in the Northern States (1950-66) measured either in terms of acreage or labor. When the model was extended to account for the differential between off-farm acquisition and salvage values, the investment-disinvestment responses to changes in taxes and subsidies differed, in many cases, from those predicted. It was found that in many years in the 1950's and 1960's,

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by the neoclassical model that fails to differentiate between acquisition and salvage values for durable inputs. At the empirical level, these taxes induced cotton and groundnut farmers in the Northern States (1950-66) to use less labor and land than would have been the case in the absence of these taxes. These adverse effects operate at two levels: by reducing the rate of entry of new resources and investments and by increasing the rate of exit of initial quantities on hand. It is shown, within a Cobb-Douglas framework, that compensating subsidies on inputs required to minimize the allocative distortions of taxes are related to the output elasticities of these inputs. This provides a rational basis for relating subsidies on inputs to expected tax rates on marketing board crops.

Sales supply equations for cotton and groundnuts were estimated by ordinary least squares. The elasticities of sales of groundnuts and cotton (to the board) with respect to the marketing board's producer price were estimated to be 1.3139 and .9028 respectively. Predictions of sales to the board were made assuming the board paid farmers higher prices than they actually received. These predicted sales exceeded actual sales whenever the hypothetical prices were higher than actual prices. These larger volumes of sales together with the implied lower taxes on cotton and groundnuts were used to estimate the (crop tax) revenue impact of paying farmers higher prices. It was found that in many years in the 1950's and 1960's,

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these higher prices would have increased farmers' monetary income without substantially effecting tax revenue from the crops. In some years, there were substantial reductions in tax revenue coupled with substantial increases in farmers' monetary income. This offset to tax revenue loss from the positive effect on sales to the board of paying farmers higher prices has not been analyzed by previous writers.

When sales to the board of marketing board crops are treated as random variables, tax revenues from them become random variables. It is shown with evidence on variances and covariances of sales of crops to the Northern States Marketing Board that grounds for expecting revenue contributions from these boards to stabilize State Government revenues are very tenuous indeed. Using budget data, it is shown that this reliance did in fact destabilize State Government revenues (1956-66) and that the degree of destabilization was consistent with our expectations from apriori knowledge of the supply and demand factors influencing the sales of these crops to the boards. The analysis signals the danger of relying on revenue contributions from these boards particularly for planned capital expenditures of the States.

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MARKETING BOARD TAXATION OF NIGERIAN
AGRICULTURE: SOME IMPLICATIONS

By

Francis Sulemanu Idachaba

Dedicated to

Aya

who made it all possible.

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agriculture Economics

1972

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ACKNOWLEDGMENTS

I am very grateful to the Rockefeller Foundation for financially supporting my graduate studies in the United States. I am particularly grateful to the officials who have been very cooperative and nice in every way.

Dedicated to

My indebtedness to Professor Henrik L. Johanson, my Major Professor and Thesis Supervisor, extends beyond this study. His intellectual stimulation, decisive direction, personal encouragement and his confidence in me have greatly influenced my entire graduate program at Michigan State University. It is hard for me to adequately express my gratitude to him. I want to thank the following: Professors Lester V. Manderscheid and George K. Dike who read earlier drafts of the thesis; Professor Robert L. Gustafson who was very helpful in the early stages of this study and to Professor Carl K. Richter who was generally helpful.

My greatest debt is to my wife, Aye, on whose shoulders fell the responsibility of looking after a frequently frustrated man and also of looking after our two little girls, Achenyo and Qada. I want to thank them for their patience and understanding.

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CHAPTER I

INTRODUCTION

This introductory chapter briefly examines the place of agriculture in the Nigerian economy, the role of agricultural exports in total Nigerian exports and the past and expected future roles of the marketing boards, including the past and future revenue contributions of marketing boards and allied statutory corporations to state government revenues. With this background, objectives of this study will be stated. Finally, an outline of this study will be presented.

The Role of Agriculture in the Nigerian Economy

Agriculture is still the dominant sector in the Nigerian economy. In 1950, agriculture alone constituted 56 per cent of the Gross Domestic Product (GDP); in 1967, it constituted 41.8 per cent. In 1950, agriculture, livestock, fishing, and forestry constituted 67.5 per cent of the GDP; in 1967 they constituted 55.9 per cent (see Table 1.1). From Table 1.1, even when agriculture alone

TABLE 1.1.—COMPOSITION OF AGRICULTURE, LIVESTOCK, FORESTRY, AND FISHING IN GROSS DOMESTIC PRODUCT, 1950-1955						
Year	Agriculture Livestock, Forestry, and Fishing	Agriculture	Agriculture, Livestock, Forestry, and Fishing as a Proportion of GDP		Index of Contribution of Agriculture, Livestock, Forestry, and Fishing	
			Proportion of GDP	Proportion of GDP	Agriculture	Livestock and Fishing
bN Mill			Per Cent		1950 = 100	
1950	185.8	185.8	67.5	56.0	100	100
1951	185.8	185.8	67.8	57.1	102	100
1952	185.8	185.8	67.8	57.1	102	97
1953	185.8	185.8	67.8	55.3	102	97

TABLE 1.1.--Contribution of Agriculture, Livestock, Forestry, and Fishing to Gross Domestic Product, Nigeria, 1950-1968.

Year	Agriculture Livestock, Forestry, and Fishing		Agriculture Livestock, Forestry, and Fishing as a Proportion of GDP		Index of Contribution of Agriculture Livestock, Forestry, and Fishing	
	£M Mill	Per Cent	Agriculture as a Proportion of GDP	Per Cent	Agriculture	1950 = 100
1950	465.0	385.8	67.5	56.0	100	100
1951	502.7	423.2	67.8	57.1	102	100
1952	511.2	438.7	64.4	55.3	99	95
1953	529.6	454.2	65.3	56.0	100	97
1954	557.8	479.5	64.0	55.0	100	95
1955	572.3	492.1	63.2	53.0	96	94
1956	585.2	496.6	62.1	52.7	94	92
1957	561.2	476.6	65.7	51.2	91	97
1958	672.2	524.2	63.9	50.0	89	95
1959	704.5	551.6	64.0	51.4	92	95
1960	779.9	642.2	61.9	49.3	88	92
1961	776.9	618.6	61.2	48.4	88	91
1962	804.8	649.6	61.1	48.4	88	91
1963	870.8	704.0	61.1	48.4	88	91
1964	876.9	682.3	56.4	45.5	79	84
1965	878.9	675.5	54.9	42.7	76	81
1966	869.5	675.5	55.9	41.8	75	83
1967	817.3	540.5	n.a.	n.a.	n.a.	n.a.
1968	706.2	547.0	n.a.	n.a.	n.a.	n.a.

Sources: Figures for 1950-57 inclusive, Annual Abstract of Statistics, Nigeria, 1964, Federal Office of Statistics (F.O.S.), Lagos, 1964; 1958-1967, Annual Abstract of Statistics, Nigeria, 1969; 1968-1969, Digest of Statistics, F.O.S., Lagos, Vol. 20, April, July, 1971.

Notes: GDP figures for 1950-57 inclusive were at 1957 prices; 1958-69 figures were at 1962 constant factor cost. Figures for 1960-68 were at 1968 prices. The 1950-57 figures were at 1957 prices; 1958-69 figures were at 1962 constant factor cost. Figures for 1960-68 were at 1968 prices. The 1950-57 figures were at 1957 prices; 1958-69 figures were at 1962 constant factor cost. Figures for 1960-68 were at 1968 prices. The 1950-57 figures were at 1957 prices; 1958-69 figures were at 1962 constant factor cost. I have chosen 1950 as the base year since we want to observe the trend, if any, in the share of agriculture in GDP. "n.a." means "not available."

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is considered (excluding livestock, forestry, and fishing), its dominant position becomes evident. As indicated by the constructed indices of the share of agriculture and allied activities, there is a declining trend in the importance of agriculture. Yet, agriculture is still the mainstay of the economy, employs about 70 per cent of the labor force and it is projected that at the end of the current plan period, agriculture, livestock, forestry, and fishing will still account for 44.2 per cent of the projected GDP.¹

The export component of the agriculture sector has been historically important and is still important. In 1950, exports originating in agriculture, livestock, and forestry sector totaled £N80.345 million; in 1960, at Independence, those exports totaled £N141.478 million and by 1965, they had reached an all-time high of £N163,663,000 (see Table 1.2). The items underlying Table 1.2 are cocoa, palm kernels, palm oil, beniseed, goat skins, cattle hides, cotton (raw), rubber, fresh bananas (mainly up to 1960), timber logs, sawn timber, plywood and veneers, groundnuts and groundnut oil and groundnut cake where the last two items are included for completeness. These exports as a percentage of total value of agriculture in GDP were 20.8 per cent in 1950, 27.1 per cent in 1954, 21.6 per cent in 1966, and 24.5 per cent in 1967 (GDP valued at 1962 factor cost), maintaining a proportion of

Table 1.2. - Total Value, and Contribution of Agriculture* - to the Agricultural Sector - 1950-1955						
Year	Value of All Reports of Agriculture, Livestock, and Forestry	Percentage of Value of Agriculture, Livestock, and Forestry, and Fishing in		Percentage of Value of Agriculture in GDP		Index of Value of Agriculture, Livestock, Forestry, and Fishing 1950 = 100
		(1)	(2)	(1')	(2')	

Table 1.2. Total Value, and Contribution of Agriculture, Livestock, and Forestry to the Agricultural Economy of Nigeria, 1950-1959.

TABLE 1.2.--Total Value, and Contribution of Agricultural^a Exports to the Agricultural Economy of Nigeria, 1950-1968.

Year	Value of All Exports of Agriculture, Livestock, and Forestry	Exports as a Percentage of Value of Agriculture, Livestock, and Forestry		Exports as a Percentage of Value of Agriculture, Livestock, and Forestry		Index of Value of Exports from Agriculture, Livestock, Forestry, and Fishing
		(1)	(1')	(2)	(2')	
	£N Mill			Per Cent		1950 = 100
1950	80.345	17.3	17.3	20.8	20.8	100
1951	102.862	20.5	20.5	24.3	24.3	128
1952	112.319	22.0	22.0	25.6	25.6	140
1953	107.167	20.2	20.2	23.6	23.6	133
1954	130.163	23.3	23.3	27.1	27.1	162
1955	110.895	19.4	19.4	22.5	22.5	138
1956	105.396	18.6	18.6	22.4	22.4	134
1957	107.396	18.6	18.6	22.4	22.4	134
1958	118.713	17.7	17.7	22.6	22.6	148
1959	143.136	20.3	20.3	25.9	25.9	178
1960	141.478	17.7	17.7	22.0	22.0	176
1961	138.546	17.8	19.0	22.4	24.0	172
1962	126.362	15.7	15.7	19.5	19.5	157
1963	158.190	18.2	18.9	22.5	23.4	197
1964	151.969	17.5	18.1	22.1	22.9	189
1965	142.381	18.1	18.3	21.6	21.2	182
1966	146.234	18.1	18.3	21.6	21.2	182
1967	132.250	16.2	16.9	24.5	21.5	165
1968	131.838	n.a.	n.a.	n.a.	n.a.	164

^a"Agricultural" here includes Agriculture, Livestock, Forestry, and Fishing.

Source: Value of Exports figures computed from Annual Abstract of Statistics, 1964, 1969. For value of agriculture, livestock, forestry, and fishing in GDP used as base for calculation of the share of exports from these sources, see Table 1.1. (1') and (2') differ from (1) and (2) respectively in that the value of agriculture, livestock, forestry, and fishing in GDP used as base for calculations for 1958-69 was at current factor cost for (1') and (2') rather than factor cost at constant 1962 prices.

Note: "n.a." means "not available."

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about one-fifth for the period of nearly two decades; as a proportion of total value of agriculture, forestry, livestock, and fishing in GDP, these exports amounted to 17.3 per cent in 1950, 23.3 per cent in 1954 (partly reflecting the boom periods for primary products in world markets around this time), 16.8 per cent in 1966 and 16.2 per cent in 1967. In this latter series, there appears to be a declining trend in the share of agricultural exports.

Table 1.3 shows the share of exports from agriculture, livestock, and forestry in total exports (including re-exports) for the years 1950-68. Up until 1960, these exports accounted for well over 80 per cent of all Nigerian exports annually, with an all time high of 89.1 per cent. As from 1960, there is evidence of a declining trend, reaching only 51.5 per cent of all exports in 1966. We expect this decline to continue with increasing exports of petroleum² and increasing domestic use of some agricultural exports.

Nigeria displays great diversity in agricultural resource endowments.³ The agricultural economy of the Northern States can be divided into cropping subregions according to climate and ecology: (1) land where groundnuts and food crops like guinea corn, millet, beans, etc. are grown; (2) land where cotton and food crops are grown; (3) land where cotton, groundnuts and food are produced,

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TABLE 1.1. TRENDS IN AGRICULTURAL EXPORTS AND IMPORTS IN NIGERIA, 1950-1960			
Year	Total Nigerian Exports	Exports from Agriculture, Livestock, and Forestry as a Percentage of All Nigerian Exports	Index of Exports of Agriculture, Livestock, and Forestry 1950 = 100
		Per Cent	
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TABLE 1.3.--Share of Agriculture, Livestock, and Forestry in Total Exports, Nigeria, 1950-1968.

Year	Total Nigerian Exports	Exports from Agriculture, Livestock, and Forestry as a Percentage of All Nigerian Exports	Index of Share of Exports From Agriculture, Livestock, and Forestry
	£N Mill	Per Cent	1950 = 100
1950	90.223	99.1	100
1951	120.064	95.7	96
1952	129.530	96.7	97
1953	124.232	86.3	97
1954	149.532	87.0	98
1955	132.614	83.6	98
1956	134.573	85.5	94
1957	127.534	84.2	96
1958	135.550	87.6	95
1959	163.497	87.5	98
1960	169.714	83.4	94
1961	173.628	79.8	90
1962	168.536	75.0	84
1963	189.672	83.4	94
1964	214.650	70.8	79
1965	268.269	61.0	68
1966	284.065	51.5	58
1967	241.818	54.7	61
1968	211.085	62.5	70

Source: Total Nigerian export figures, Annual Abstract of Statistics, F.O.S., Lagos, 1963, 1964, 1969. For Value of Exports of agriculture, livestock, and forestry, see Table 1.2.

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and (4) land in the Middle Belt where mainly root food crops and some grains are grown. The agricultural economy of the Southern States can be divided into four production zones: (1) land where cocoa and food are grown; (2) land where oil palm and food crops are produced; (3) land where oil palm, rubber, and foods are produced; and (4) land where mainly oil palm, rubber, cocoa, or foods are produced.

Marketing Boards, the Export
Sector and State Government
Revenues

It might be argued that it is now irrelevant to go into the original intent for setting up the marketing boards. Not quite. In June, 1971, the report of the Study Group on Oil Palms⁴ felt a need to go "a little deeper" into the original laws establishing the marketing boards from which it concluded that "unless the law governing the marketing board is changed . . . there can be no improvement in the industry."

Arguments about the origins of the marketing board system have become very extensive.⁵ Both in the Cocoa White Papers⁶ and subsequent legislation, it is evident that some form of stabilization of producer prices, money or real income was intended as a primary goal within the general framework of securing "the most favourable arrangements for the purchase, grading, export

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Official Attitudes on the Revenue

Role of Marketing Boards

The view has now evolved, among policy makers and some academicians alike, that price stabilization was not, and in some cases should not, be the main objective behind the setting up of the marketing boards. In the First Annual Report of the Nigerian Groundnut Marketing Board, it was stated:

The first charge on the board's funds must be for working capital to finance its purchases of groundnut. . . . Price stabilization must always constitute the primary aim on the board's actual and prospective resources after the critical requirements of working capital have been met.⁸

By the time of the First Development Plan, attitudes had swung almost full circle. After spelling out the contribution of the (then) Northern Nigeria Marketing Board to its capital development program, the Northern Nigerian Government 1962-68 Development Plan planned to relieve "the board of its liability for subsidizing the producer price of crops in lean years, and fixing producer prices annually at such a level in relation to world prices as to anticipate a surplus on the year's operations to cover operating costs." The plan went on further to state that "the marketing board will inevitably look increasingly to Nigerian sources to provide the

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short-term credit required to finance crop purchases and movement."⁹ Two things have occurred: first, the marketing boards have come to treat the so-called surpluses as real surpluses freely to be used by the marketing boards and the State Governments at will.¹⁰ Second, with the regionalization of marketing boards, State Governments have come to see them as sources of revenue for their various capital development programs. In addition to this source of revenue from crops, export crops have also been subject to a produce sales tax and an export tax that is a mixture of specific and ad valorem rates. Under the New Revenue Allocation Decree retrospective April, 1969, 40 per cent of export duties on commodities other than oil will be credited to the distributable pool while the producing states will receive 60 per cent, instead of 100 per cent as previously. The pool will then be divided into two parts: one-half to be divided equally between the states and the other half to be divided on the basis of population.¹¹ Olakanpo and Teriba imply a strong positive correlation between the existence of marketing board institutions and the imposition of produce sales taxes and export taxes on export crops.¹²

Table 1.4 shows the relative dependence of State Governments on marketing board crops (we shall henceforth refer to crops subject to marketing board control as marketing board crops because for some of these crops

TABLE 1.4.--The Contribution of Taxes on Marketing Board Crops to State Revenues, Nigeria, 1956-1966.

Year	Western Region			Northern States			Eastern States		
	Total Revenue	Contribution of Taxes on Marketing Board Crops to Regional Revenue		Total Revenue	Contribution of Taxes on Marketing Board Crops to Northern States Revenue		Total Revenue	Contribution of Taxes on Marketing Board Crops to Eastern States Revenue	
		Per Cent	EN Mill		Per Cent	EN Mill		Per Cent	EN Mill
1956	14,381	30.7	13,748	21.8	9,008	24.8			
1957	44,957	54.3	21,941	24.7	12,184	20.6			
1958	17,080	25.5	18,733	24.7	13,380	18.6			
1959	17,546	30.0	18,575	28.7	14,216	17.2			
1960	21,074	48.5	21,089	28.9	16,556	22.9			
1961	33,734	60.5	26,529	16.2	18,533	18.1			
1962	26,940	7.2	21,568	29.0	22,107	32.8			
1963	28,872	62.1	26,722	24.4	20,698	21.9			
1964	25,816	33.2	30,273	22.2	20,338	26.7			
1965	27,567	21.3	39,371	n.a.	29,442	16.5			
1966	25,286	28.8	24,483	n.a.	32,642	n.a.			

Source: For total State Revenue (current and capital accounts), Annual Abstract of Statistics, F.O.S., Lagos, 1963, 1969; Digest of Statistics, July, 1970. Percentage Contributions of Marketing Boards crops derived from the absolute values of resources from marketing boards and allied statutory corporations from O. Teriba and O. Olakanpo, Fiscal, Monetary and Investment Implications of the Marketing Boards, *Ibid.*, p. 17. Percentage contributions do not correspond with those of Teriba and Olakanpo because our figures for total state revenues differ from theirs most of the time. Presumably this is because they used Budget figures for total state revenues, which are not available for the period 1956-1966. The figures for the Marketing Boards are from the Marketing Boards' annual reports. The old Western Region up until 1963 was the present Western State, Mid-West State, and Lagos State; after 1963, it comprised Lagos State and Western State.

Note: "n.a." means "not available."

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like cotton, only a very small proportion will be exported in the future). For the purposes of this study, marketing board so-called surpluses are seen as taxes on the producers of marketing board crops. By 1960-61, revenues from taxes on crops in the Western State and Lagos State accounted for 60.5 per cent of total financial resources of the State Government; this dependence reached a low of 7.2 per cent in 1961-62. In the Eastern States, this relative dependence reached a high of 27.8 per cent in 1961-62 and a low of 14.1 per cent in 1962-63. In the six Northern States, this relative dependence reached a high of 29.9 per cent in 1958-59 and 15.6 per cent in 1960-61 (we are here referring to the old regions in the terminology of the new states).

For the Second Development Plan period, the marketing boards are expected to play an even more important role (Table 1.5). In the 1970-74 Development Programme, marketing boards and statutory corporations (mainly financed by marketing boards) provide more than one-third of the total internal government revenue resources in Western, South-Eastern, and Kwara States; in South Eastern State these sources account for one-half of the State's planned investment expenditure. Rivers State is least dependent on marketing boards and statutory corporations as sources of revenue. (Kano and South-Eastern States would have deficits rather than surpluses

TABLE 1.5. -- Vital Statistics for Registered and Non-Registered Prostitutes, 1900-1910.

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TABLE 1.5.—Total Revenue and Investment Expenditure Related to Revenue From Marketing Boards and Statutory Corporations, by States, Nigeria, 1970-74.

State Government	Revenue From Marketing Boards, Statutory Corporations and Other Capital Receipts		Marketing Board and Statutory Corporations Percentage of Total Revenue of State Government		Total Investment Expenditure		Resource Gap: Investment Minus Total		Marketing Board Investment as a Percentage of Total Investment Expenditure		Resource Gap: Mining, Marketing Board and Statutory Corporation Revenue	
	£M Mill	Per Cent	£M Mill	Per Cent	£M Mill	Per Cent	£M Mill	Per Cent	£M Mill	Per Cent	£M Mill	Per Cent
Western	67.6	28.0	41.4	72.2	-4.6	38.8	-32.6	38.8	-32.6			
South-Eastern	29.5	11.0	37.3	21.2	8.3	51.9	-2.7	51.9	-2.7			
North	2.3	0.8	34.8	17.2	-14.9	4.7	-15.7	4.7	-15.7			
North Central	19.4	3.2	16.5	29.1	-9.7	11.0	-12.9	11.0	-12.9			
North Western	21.4	3.2	15.0	24.4	-3.0	13.1	-6.2	13.1	-6.2			
North Eastern	21.5	3.2	14.9	24.8	-3.3	12.9	-6.5	12.9	-6.5			
Kano	42.7	6.0	14.1	40.3	2.4	14.9	-3.6	14.9	-3.6			
East Central	7.3	0.8	10.9	43.1	-35.8	1.9	-36.6	1.9	-36.6			
Lagos	29.0	3.0	10.3	19.6	9.4	15.3	6.4	15.3	6.4			
Benin Plateau	18.1	1.6	8.8	15.9	2.2	10.1	.6	10.1	.6			
Mid-western	37.3	3.2	8.6	26.8	10.5	11.9	7.3	11.9	7.3			
Rivers	44.8	3.0	6.7	24.4	20.4	12.3	17.4	12.3	17.4			

Source: Second National Development Plan, 1970-74, Federal Ministry of Information, Lagos, 1970, p. 301.

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on total current and capital account if marketing board and statutory corporation sources of revenue were no more available to these state governments; East Central, Kwara, North Central, North Eastern, North Western, and Western States will have much larger deficits in the absence of marketing board and statutory corporation sources of revenue.) Table 1.5 shows the projected dependence of various state governments on marketing board crops.

The Western State Development Plan 1970-74, states¹³ that "as at present, the main source of internal receipts for capital development remains the Western Nigeria Marketing Board" and that in determining net producer prices, "emphasis would be given to the need to marshall adequate revenue from this vital area to aid the state's development effort."

On the academic side, Helleiner states that "growth should have carried greater weight in Nigerian policy formation than stability, and there exists no conclusive evidence that the two are correlated."¹⁴ Teriba and Olakanpo have stated that "one important fiscal implication of the regionalization of the marketing boards is their conversion from potential stabilizers of producer prices into potential stabilizers of Regional Government Revenue."¹⁵

Policy makers being so concerned about the revenue potential of marketing boards and their allied statutory

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corporations have not bothered themselves with the negative output and sales effects of the heavy taxes on marketing board crops. Their policies are based on the implicit assumptions of zero price elasticities of supply and/or sales of marketing board crops. Recently, state governors and other public officials have expressed grave concern over what they term the "falling output" of marketing board crops.¹⁶ This, it seems to me, is really a concern over the future of the revenue potential of marketing board crops.¹⁷ On the academic side, though Helleiner in his monumental study¹⁸ admits of the possibility of positive price supply elasticities, the core of his analysis implicitly assumes zero price elasticities of supply of marketing board crops.¹⁹ Nowhere in the literature is the possibility of drastically cutting down taxes on crops, raising producer prices and still leaving state government and marketing board revenue from agriculture substantially unaffected thoroughly discussed.

There is an absence in the academic literature of any analysis of the effects of taxation of marketing board crops (represented by the marketing board surplus, the produce sales tax and the export tax) on the scale of farming measured either in terms of acreages or size of labor employed. But this problem has become increasingly important in recent years as farmers have reallocated resources to different crops in response to differential

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tax rates on these crops. In the Northern States, state governors and other public officials are worried at the increasing diversion of land acreage away from groundnuts into food production resulting from substitutions in production in response to the effects of government and marketing board taxes on relative crop prices.²⁰

Objectives of This Study

The first objective of this study then is to provide a framework for examining the effects of government and marketing board taxation of crops and subsidies on inputs on the commitment of resources to production, with application to the use of land and labor resources on the groundnut and cotton farms of the Northern States.

More specifically, the framework will be addressed to the following questions. What have been the effects of these taxes on the supply, "retirement," or salvaging of used resources from and disinvestment in these resources on, Northern States farms? Have these taxes tended to induce groundnut and cotton farmers in the Northern States to use exactly the same, more, or less of land and labor in the absence of these taxes and subsidies? If policy makers are willing to live with the institutional reality of the marketing board system but are anxious to minimize the allocative distortions of these taxes with respect to

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resource use, what are the required compensating subsidies on resources? A related question is: what have been the effects of differential tax rates on cotton and groundnuts on the relative outputs of these crops?

The second aim of this study is to examine the quantitative impact on Northern States Government and marketing board tax revenue from cotton and groundnuts of paying farmers higher prices than the actual prices they received. This will enable us to examine to what extent, if any, the (crop tax) revenue loss that results from paying farmers higher prices can be offset by the positive effect, if any, of higher prices on sales of these crops to the board.

Given past and planned dependence of many State Governments on contributions (loans and grants) from marketing boards and allied statutory corporations for their various State Development Plans the third aim of this study then is to examine whether these contributions can be trusted to stabilize state government revenues over projected plan periods as has been recently suggested.

This problem is important for the stability of State Government operations and even political stability in the future.

Yet this knowledge is crucial for an understanding of the responsiveness of tax revenue from these crops to changes in the board's price.

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With The Significance of These Problems the study, the second. A useful conceptual framework provides a basis for empirical measurements. Empirical measurements of the effects of these taxes on resource use are necessary for sensible policy discussions. There is mounting concern in the Northern States over the diversion of acreages away from groundnuts and cotton to other crops and also over the fact that in some states such as the North-East State and the North-West State, suitable additional land has not been planted in these crops.

Unemployment is currently a serious problem. There is concern over the drift of farmers and youth from rural to urban areas. Rural people deciding (at the margin) where to invest their future labor time are known to have increasingly chosen the non-farm, urban labor market. There is also concern over the slow transformation of traditional agriculture in Nigeria. Why are few farmers adopting new recommendations, or buying new inputs, etc.? These are all issues a good conceptual framework should help throw light on.

We have no estimates of the price responsiveness of sales of cotton and groundnuts to the Northern States Marketing Board. Yet this knowledge is crucial for an understanding of the responsiveness of tax revenue from these crops to changes in the board's price.

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Chapter With regards to the third objective of the study, the recent experience of the Western State is a good example. For the 1971-72 budget year for the Western State, "capital receipts of some £N 7 mill fell £N 5 mill short of estimates because the state of world markets, particularly for cocoa, made it impossible for the marketing board to make a contribution. . . ."21

Plan of This Study

Chapter II will review previous studies. Shortcomings as they relate to the themes of this study will be briefly listed.

Chapter III will present the framework for analyzing the effects of government and marketing board taxes on crops and subsidies on inputs on resource use and scale of farming in the cotton and groundnut farms of the Northern States. A production function approach is used with the Cobb-Douglas serving as an example. Chapter IV develops the theme that in examining problems of State Government Revenue from marketing board crops, the relevant concept for most of the crops is the price elasticity of sales to the marketing board. Some illustrative calculations are carried out to show the dependence of government revenue from marketing board crops on this parameter and the level of taxes. Chapter V presents some empirical evidence on the sales elasticity parameter and other parameters and other effects of government pricing policy.

Chapter VI examines the
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Chapter VI examines the potential of marketing boards as stabilizers of state revenues. Chapter VII summarizes the main findings, draws some conclusions and offers recommendations for agricultural development in Nigeria in the 1970's and 1980's.

¹ Second National Development Plan, 1970-74 (Lagos: Federal Ministry of Information, 1970), p. 51.

² The country's revenue from oil was \$5.80 million in 1970, \$24.270 million in 1971; the share of foreign exchange earnings accounted for by oil was 45 per cent in 1969, 58 per cent in 1970, and 71 per cent in 1971. See New Nigerian (Lagos), February 24, 1972, p. 1. Whereas Nigerian spinning accounted for only 8.6 per cent of total crop of bales of cotton in 1960-61, by 1970-71, the estimated use was 115.2 per cent, with the shortage to be met from carry-over stocks from 1969-70. See Report of the Study Group on Cotton and Other Fibres (Lagos: Federal Department of Agriculture, 1971), p. 14.

³ Glenn L. Johnson, et al., A Generalized Classification Approach to Agricultural Sector Analysis With Special Application to Nigeria (East Lansing: Michigan State University, 1971), p. 12.

⁴ Report of the Study Group on Oil Palm (Lagos: Federal Department of Agriculture, June, 1971), p. 30.

⁵ See P. T. Bauer, West African Trade (Cambridge: Cambridge University Press), pp. 262-75; P. T. Bauer and S. S. Yamey, Markets, Market Control and Marketing Reform (Maidenhead and Nicolson, 1968), pp. 132-35.

⁶ P. T. Bauer, West African Trade, p. 262.

⁷ Ibid., p. 276.

⁸ First Annual Report of the Nigerian Groundnut Marketing Board, p. 16.

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⁴Report of
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⁵See P. T.
Cambridge University
S. S. Yamey, Markets
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⁶P. T. Ba

⁷Ibid., p

⁸First Annual
Marketing Board,

Development Plan 1962-68 (Kaduna: Government of Northern Nigeria, Ministry of Economic Planning, 1962), p. 45.

10 The Cocoa White Papers which preceded the establishment of the Cocoa Marketing Board state "In some seasons when world prices are low, the price paid to the producer will be less than the average realization on overseas sales. The boards will, on such occasions, show a 'surplus.' There will, however, be other seasons in which the boards will show a deficit."

FOOTNOTES

¹ Second National Development Plan, 1970-74 (Lagos: Federal Ministry of Information, 1970), p. 53.

² The country's revenue from oil was ₦ 80 million in 1970, ₦ 270 million in 1971; the share of foreign exchange earnings accounted for by oil was 41 per cent in 1969, 58 per cent in 1970, and 71 per cent in 1971. See New Nigerian (Kaduna, February 26, 1972), p. 1. Whereas Nigerian spinning accounted for only 8.6 per cent of total crop of bales of cotton in 1960-61, by 1970-71, the estimated use was 115.2 per cent, with the shortage to be met from carry-over stocks from 1969-70. See Report of the Study Group on Cotton and Other Fibres (Lagos: Federal Department of Agriculture, 1971), p. 14.

³ Glenn L. Johnson, et al., A Generalized Simulation Approach to Agricultural Sector Analysis With Special Application to Nigeria (East Lansing: Michigan State University, 1971), p. 12.

⁴ Report of the Study Group on Oil Palms (Lagos: Federal Department of Agriculture, June, 1971), p. 33.

⁵ See P. T. Bauer, West African Trade (Cambridge: Cambridge University Press), pp. 263-75; P. T. Bauer and B. S. Yamey, Markets, Market Control and Marketing Reform (Weidenfeld and Nicolson, 1968), pp. 138-55.

⁶ P. T. Bauer, West African Trade, p. 268.

⁷ Ibid., p. 276.

⁸ First Annual Report of the Nigerian Groundnut Marketing Board, p. 16.

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⁹ Development Plan 1962-68 (Kaduna: Government of Northern Nigeria, Ministry of Economic Planning, 1962), p. 45.

¹⁰ The Cocoa White Papers which preceded the establishment of the Cocoa Marketing Board state "In some seasons when world prices are high, the price paid to the producer will be less than the average realization on overseas sales. The boards will, on such occasions, show a 'surplus.' There will, however, be other seasons in which the average world price is below the price paid to producers. On these occasions the boards will make a 'loss,' which will be financed from the 'surpluses' accrued in years of high world prices. The intention is that 'profits' will be utilized primarily to maintain the maximum possible stability in the price paid to the producer. Thus, on the average of a period of years, it is expected that the average net price paid in West Africa will be substantially equal to the average net price realized on world markets and that the boards' buying and selling transactions will therefore approximately balance." It is significant that the authors used the words "profits," "surplus," and "loss" in inverted commas realizing the true nature of these balances. See P. T. Bauer, West African Trade (Cambridge: Cambridge University Press, 1954), p. 269.

¹¹ See Annual Economic Review (Nigeria: Standard Bank Ltd., London, June, 1970), p. 16.

¹² O. Teriba and O. Olakanpo, Fiscal Monetary and Investment Implications of the Marketing Boards (NISER: International Conference on the Marketing Board System, 1971), p. 14.

¹³ Western State Development Plan, 1970-74 (Ibadan: Ministry of Economic Planning and Reconstruction, 1971), p. 58.

¹⁴ Helleiner does not indicate which type of correlation he is referring to. He would presumably be most delighted if there was perfect negative correlation between growth and stability! We might add also that the evidence of zero correlation between growth and stability is not conclusive. More basic is the fact that the correlation coefficient itself proves nothing.

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16. The Federal
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p. 174.

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¹⁵O. Teriba and O. Olakanpo, op. cit., p. 10.
(See Chapter VI below for an examination of this potential.)

¹⁶The Federal Finance Commissioner, Alhaji Shehu Shagari, has suggested that "failure by farmers to increase their productivity could be traced to the poor prices paid by the marketing boards" and he has called for a new marketing system. See West Africa, #2858 (March 24, 1972). p. 374.

¹⁷Thus a correspondent writes in the Daily Times, "Northern State Governments, especially Kano, North Western and North Eastern States have had their revenue grossly undercut by having to lose sales tax which is £N 2:15: = a ton." See Daily Times, Lagos, February 3, 1972, p. 7. We might add that these State Governments also lose the marketing board's so-called trading surplus that could have accrued and also a refund of some of the export tax that could have been imposed.

¹⁸G. K. Helleiner, Peasant Agriculture, Government and Economic Growth in Nigeria (Richard Irwin, Inc., 1966).

¹⁹Helleiner realizes the revenue potential of marketing boards and he even advocates maximization of this potential. He not only plays down on the price elasticities of supply of marketing board crops, he does not consider that this may not be the relevant concept for purposes of government and marketing board revenue from these crops. The price elasticity of supply (output) of a marketing board crop may be zero and yet the price elasticity of sales to the marketing board may be positive and very large.

²⁰Thus a correspondent for West Africa 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." See West Africa, #2857 (London: March 17, 1972).

²¹See West Africa, #2865 (Apapa: Times Press, May 12, 1972), p. 587.

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CHAPTER II

REVIEW OF PREVIOUS STUDIES

This chapter contains a review of some previous studies as these relate to the objectives of this study.

of its export earnings via the marketing boards away from the producer to other marketing board officials." 2

Marketing Boards as Revenue Collectors for State Governments

We too give primary importance to economic growth. Our brief review of past studies will be limited only to those parts that are relevant to the objectives of this study.

and superior sources of future income streams must take a generalized view of capital accumulation, human and physical. A preoccupation with the revenue needs of State Governments should not lead us to neglect the effects of these taxing policies on the generation of surplus, and adverse effects of taxes on marketing board crops, he states that they are not in themselves "sufficient objection to the use of export taxes." He cites some evidence from a survey of cocoa farmers (1951-52) and oil palm producers in the South East state, and concludes that the largest proportion of any increase in income to farmers through higher taxes would be consumed and "that since a much

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larger proportion of the increase in peasant income would have been consumed than that which was actually consumed out of marketing board trading surpluses, the rates of return on peasant investments would have had to be much greater than those on marketing board ones if peasant uses of the funds in the aggregate were really to have been considered superior." He goes on further to state "it can therefore unambiguously be stated that Nigerian development has been aided through the device of channeling a portion of its export earnings via the marketing boards away from the producer to other (governmental) decision makers."²

We too give primary importance to economic growth. But we seriously question his implied prescriptions. Any theory of economic growth derived from investments in new and superior sources of future income streams must take a generalized view of capital accumulation,³ human and physical. A preoccupation with the revenue needs of State Governments should not lead us to neglect the effects of those taxing policies on the generation of savings, new and superior forms of farm-produced capital and investment in new capital forms on Nigerian farms. Glenn Johnson's warning in his Encyclopedia article is appropriate at this point:

A frequently neglected source of agricultural Public policy is an important determinant of the rate of capital formation in agriculture. Some policies and programs exploit farmers heavily, leaving little surplus to accumulate in agriculture. If such taxes are levied on commodities in whose production the

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country has a comparative advantage, the over-all rate of capital accumulation in the country's agriculture may be reduced substantially even though tax moneys are reinvested in agriculture.⁴

Without substantial capital formation in a sector that is still expected to contribute 44.2 per cent of the GDP in 1974, overall economic growth will be impeded.

Government and marketing board selective taxation of crops have distorted the pattern of relative rates of return on investments in both farm produced and non-farm produced capital when both human and physical forms of capital are considered. These taxes are most likely to have introduced allocative distortions in the patterns of investments in durable resources. Galletti, etc. have long ago shown, by implication, the investment responsiveness of Nigerian farmers to crop price changes. A more liberal view of capital may turn a substantial part of what Helleiner terms "consumption" into investments in human capital. The author feels that Helleiner does not give adequate emphasis to the consumption propensity of government agencies. The evidence is strong that there has been a lot of waste, that a lot of the farmers' money went into "political capital formation" for various political parties and individuals.⁵

A frequently neglected source of agricultural growth is increased specialization, the "reallocations of agricultural production from farm to farm within regions, from region to region and between the farm and non-farm

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economy."⁶ In the Nigerian case, government taxation policies are likely to distort specialization patterns. The Western State has for years sustained losses on its cotton operating account because of its declared policy to make the Western State self-sufficient in cotton. Thus, cotton prices in the Western State have been consistently higher than those in the Northern States as shown in Table 2.1.

TABLE 2.1.--Ratios of Cotton Prices in the Western State to Cotton Prices in the Northern States for Different Grades of Cotton, Nigeria, 1963/64-1971/72.

Year	Grades		
	NA1	NA2	NA3
1963/64	1.00	1.00	
1964/65	1.20	1.02	.90
1965/66	1.37	1.00	.88
1966/67	1.43	1.05	.92
1967/68	1.52	1.13	1.00
1968/69	1.17	.90	.78
1969/70	1.50	1.20	..
1971/71	1.50	1.20	..
1971/72	1.38	1.09	..

Source: Ratios computed from Western State and Northern States cotton prices in Report of the Study Group on Cotton and Other Fibres, Federal Department of Agriculture, Lagos, 1971, p. 64 and p. 7 respectively.

From this table it is clear that apart from 1963/64, NA1 cotton farmers in Western State were

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consistently paid higher prices than their counterparts in the Northern States; NA2 cotton prices were similarly higher in the West than in the North most of the time; only for NA3 cotton were Northern prices higher than those in the West. The extreme lack of comparative advantage of the West in the production of NA1 cotton even in the presence of consistently higher relative prices becomes particularly evident from the fact that the percentage contribution of NA1 cotton to all sales of cotton in the Western State was zero in all years except 1963/64 and 1967/68.⁷ These artificial incentives no doubt must have inhibited the formation, use and allocation of capital in those crops in which the Western State has a comparative advantage. The reallocation of capital has been a source of growth in the agriculture of other countries, e.g., the United States;⁸ we should expect unimpeded specialization in agricultural production within Nigeria to be a source of growth. To the extent that these government and marketing board taxes distorted patterns of specialization they have inhibited economic growth of Nigerian agriculture. And the issue is not whether marketing boards have contributed or have not contributed to economic development--the real question is the contribution of investment in new and superior sources of income streams that would have occurred in the absence of taxation of marketing board crops. To the extent that investments in new and superior biological

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strains, new cultivation practices, etc., by the millions of farmers were inhibited by the heavy taxes, then these taxes have inhibited economic growth that could not be offset by farm settlements, expensive corporation buildings, a few university scholarships and roads built with this money that were not, in many cases, even in the major crop producing areas (road construction in Ijebu Province vis-a-vis Ondo and Ibadan Provinces are classic examples).⁹

Potential Producer Income
and Potential State
Government Revenue

Helleiner¹⁰ calculates "potential producer income," what the farmer would have received if all taxes on the crop were given to the farmer. His estimates of potential producer income contain a downward bias insofar as there are positive supply price and/or sales price elasticities for the various crops, and therefore his calculation of total percentages of potential producer income that are taken away in taxes contain an upward bias, given the elastic nature of the demand curves facing aggregates of producers of most marketing board crops. For short-run determination of revenue to the marketing board it is the price elasticity of sales to the board of any crop that is more relevant. The supply (output) price elasticity could be zero and estimates of potential producer income would still be biased downward if the price elasticity of sales to the marketing board is positive. For a given increase

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in producer prices, potential producer income would still be biased downward if the price elasticity of sales to the marketing board is positive. For a given increase in producer prices, potential producer income would be larger if the price elasticity of sales to the board exceeds the supply (output) price elasticity. The price elasticity of supply (output) of a crop could be positive and yet the price elasticity of sales to the board is zero.

The question of revenue surplus accruing to the state government and the marketing board at moving average prices that are higher than actual producer prices was treated by Olayide and Olatunbosun¹¹--where they compute this surplus revenue at the moving average prices as the value of exports at world market prices minus the value on moving average pricing basis. Their estimates contain a downward bias for all those crops which have positive price elasticity of sales (or supply) to the marketing board. Their surplus government revenue figures implicitly assume a zero price elasticity of sales of the crop to the marketing board.

Let us formalize their argument. Suppose

$$S = (P_W - P_M)M \quad (1)$$

where S is their "'producers surplus' in the hands of the CMB," P_W is the world market price, P_M is their calculated moving average price and M is the quantity of the crop sold

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$$\epsilon_{SP_M} = \epsilon_{MP_M} - \frac{P_M}{P_W - P_M} \quad (2)$$

where we have assumed that small changes in the moving average price do not affect world price.¹²

From (2), if $\epsilon_{MP_M} = 0$, then the elasticity of "'producers surplus' in the hands of the CMB" with respect to the moving average price is always negative so long as taxes on these crops are positive. In this case, raising the moving average price tends to lower the "'producers' surplus' in the hands of the CMB," and conversely for the lowering of the moving average price (e.g., compare Tables 19 and 27 in their article). However, if ϵ_{MP_M} is sufficiently positive, it is possible for the elasticity of "'producers' surplus' in the hands of the CMB" with respect to the moving average price to become positive, implying that it is then possible for increases in the

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moving average price to lead to increases in the "'producers' surplus' in the hands of the CMB." On the other hand, if $\epsilon_{MP_M} < 0$, then, as moving average prices are raised, "'producers' surplus' in the hands of the CMB" will fall more than in the case where $\epsilon_{MP_M} = 0$. We doubt whether Nigerian farmers behave irrationally in the way indicated by a negative ϵ_{MP_M} --that they will sell less to the board as they are paid higher moving average prices! Also, in their calculation of potential producer incomes,¹³ Olayide and Olatunbosun implicitly assume a zero price elasticity of sales to the marketing board for the crops they treat. Their estimates--arrived at by evaluating actual sales at the higher moving average prices--contain a downward bias for those crops with positive price elasticity of sales to the marketing boards.

In the CSNRD studies perhaps not enough emphasis was given to the possibility of raising producer prices and still leaving government revenues from agriculture substantially unaffected, without any resort to petroleum revenues,¹⁴ or new production functions. The recent simulation study¹⁵ which takes a comprehensive view of the Nigerian agricultural sector is a powerful application of the simulation approach to agricultural sector analysis.

The basic shortcoming of the above (arbitrary) sample of previous studies is that the effects of government pricing policies on resource use in Nigerian farms were not adequately treated.

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J. K. Eicher and C
Nigerian Economy (C
Press, 1970).

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³H. G. Joh
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M. M. Blaug, ed.,
1962, p. 34.

⁴See Glen
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⁵See A Wh
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⁶See Gle

⁷See Rep
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⁸Glenn.

FOOTNOTES

¹G. K. Helleiner, "The Fiscal Role of the Marketing Boards in Nigerian Economic Development, 1947-61," in C. K. Eicher and C. Liedholm, Growth and Development of the Nigerian Economy (East Lansing: Michigan State University Press, 1970).

²Helleiner, op. cit., p. 141.

³H. G. Johnson, "Towards a Generalized Capital Accumulation Approach to Economic Development," reprinted in M. Blaug, ed., Economics of Education 1 (Penguin Books, 1968), p. 34.

⁴See Glenn L. Johnson, "Capital," International Encyclopedia of the Social Sciences (The Macmillan Company and the Free Press, 1968), p. 231.

⁵See A White Paper on the Military Government Policy for the Reorganization of the Northern Development Corporation (Kaduna: Government Printer, 1966); A White Paper on the Northern Nigerian Military Government's Policy for the Comprehensive Review of the Past Operations and Methods of the Northern Nigeria Marketing Board (Kaduna: Government Printer, 1967); Coker Commission of Inquiry Into Operations of Statutory Corporations in Western Nigeria (1963).

⁶See Glenn L. Johnson, op. cit., p. 231.

⁷See Report of the Study Group on Cotton and Other Fibres, op. cit., p. 64. A more subtle argument for differential pricing would be differential transports costs--but this is not the basis for the present policy in the Western State.

⁸Glenn L. Johnson, op. cit., p. 231.

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¹⁵ Glenn
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⁹Though the effects of these taxes are probably less significant for groundnuts and cotton relative to the tree crops of the South, they are still nonetheless very important relative to what would have obtained in the absence of these taxes.

¹⁰Helleiner, op. cit., Table 2, p. 123.

¹¹D. Olatunbosun and S. O. Olayide, "The Effect of the Marketing Boards on the Output and Income of Primary Producers" (NISER, Ibadan: International Conference on the Marketing Board System, 1971), p. 64.

¹²This assumption need not hold in reality. With Nigeria in competition with other groundnut exporting countries, the price elasticity of demand facing Nigerian exporters depends on their share in total world exports, total world market elasticity of demand for the export crop and the elasticity of supply of all others competing with Nigerian exporters. With Nigerian exports (E_N) and exports of other competitors (E_O) a function of world price (P), i.e.,

$$E_N + E_O = f(P)$$

it follows that

$$\eta_{E_N, P} = \frac{1}{S_N} \eta_M - \frac{1-S_N}{S_N} \epsilon_O$$

where $\eta_{E_N, P}$ is the elasticity of demand facing Nigerian exporters of the crop, η_M is the total world market elasticity of demand for this export crop, ϵ_O is the elasticity of supply of all other exporters and S_N is Nigeria's share of the market.

¹³Olatunbosun and Olayide, op. cit., Tables 22-25.

¹⁴Glenn L. Johnson, O. J. Scoville, G. K. Dike, and C. K. Eicher, Strategies and Recommendations for Nigerian Rural Development, 1969-1985, CSNRD 33 (East Lansing: Michigan State University, 1969).

¹⁵Glenn L. Johnson, etc., A Generalized Simulation Approach to Agricultural Sector Analysis With Special Application to Nigeria (East Lansing: Michigan State University, 1971).

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CHAPTER III

THE EFFECTS OF GOVERNMENT AND MARKETING BOARD TAXATION OF CROPS AND SUBSIDIES ON INPUTS ON THE COMMITMENT OF RESOURCES TO FARMING IN THE NORTHERN STATES

Introduction

Our first objective is to provide a framework for analyzing the effects of taxes on marketing board crops on resource use in Northern States farming. This framework will help us to determine the effects of these taxes on the supply of used resources from Northern States farms and the long run disinvestment in productive resources. It will help us to determine the effects of these taxes on the levels of resource use on Northern States farms: have these taxes tended to induce cotton and groundnut farmers to use exactly the same, more or less of the resources (particularly land and labor) that they would have used in the absence of these taxes? Looking at the problem from a "second best" point of view, given that we have these taxes on marketing board crops, what compensating subsidies on inputs used would minimize the allocative distortions

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(with respect to resource use) of these taxes? What are the induced effects of differential taxation on the relative outputs of cotton and groundnuts in the Northern States?

This chapter has three main sections: first we look at the induced effects of differential taxation of cotton and groundnuts on the relative outputs of these crops; second we look at the effects of taxes on crops and subsidies on inputs on the supply or retirement of used resources from farms and the disinvestment process, and the demand for resources and the investment process on Northern States farms; and third, the question of whether State Governments and their marketing boards should engage in "compensating" subsidies on inputs in the presence of government taxation is viewed as a "second best" problem.

The Effects of Taxes on the Relative
Outputs of Groundnuts, Cotton
and Food Crops

The government imposes a produce sales tax and an export tax that is sometimes partially on a specific tax basis and partially on ad valorem basis. The marketing board imposes a tax on producers approximated by the so-called "trading surplus" of the marketing boards.¹ These three elements comprise taxation by the government. At the same time the government subsidizes many new inputs like fertilizers, chemicals, sprays, new seed varieties, information supplied by the extension services of the government, etc. Let the farmer's production function

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We can write the representative farm's production function in implicit form as:

$$F(Y_1, Y_2, \dots, Y_m, X_1, \dots, X_n) = 0 \quad (1)$$

where Y_j ($j = 1, \dots, m$) is output of the j^{th} crop and X_i ($i = 1, \dots, n$) is quantity of the i^{th} resource where at this level of abstraction 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.

Let input X_i be subsidized at rate t_i per unit so that the price paid per unit of the input by the farmer = $(1-t_i) P_{x_{ia}} = \lambda_i P_{x_{ia}}$ where $P_{x_{ia}}$ is the market acquisition price of X_i exclusive of government subsidy. Though some components of government and marketing board taxation are

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$$\frac{\partial L}{\partial Y_j} = u_j P_j Y_j +$$

levied on a specific tax basis (e.g., the marketing board surplus and some of the export tax), these taxes are partly determined each year on the basis of market prices of crops in the absence of taxes. Let the three components of taxation of crops be converted to a tax rate as a proportion of the potential market price so that a £N 10 tax per ton of groundnuts with a potential market value (inclusive of the tax, i.e., the potential producer price) of £N 50 amounts to a tax rate of 20 per cent.² Let us call this tax rate τ_j so that the price received per unit of the crop $= (1-\tau_j) P_{Y_j} = \mu_j P_{Y_j}$ where P_{Y_j} is the expected market producer price of the j^{th} crop inclusive of government taxation, i.e., the potential producer price.

The profit equation for a multi-crop farm in the face of these government policies is:³

$$\Pi = \sum_{j=1}^m \mu_j P_{Y_j} Y_j - \sum_{i=1}^n \lambda_i P_{X_{ia}} X_i \quad (2)$$

Then the farmer maximizes his profit function subject to the production function in implicit form. Form the Lagrangian:

$$L = \sum_{j=1}^m \mu_j P_{Y_j} Y_j - \sum_{i=1}^n \lambda_i P_{X_{ia}} X_i + \phi F(Y_1, \dots, X_n) \quad (3)$$

The necessary conditions for equilibrium are:

$$\frac{\partial L}{\partial Y_j} = \mu_j P_{Y_j} + \phi \frac{\partial F}{\partial Y_j} = 0, \quad j=1, \dots, m \quad (4a)$$

$$\frac{\partial L}{\partial x_{ia}} = -\lambda_i P_{x_{ia}} + \phi$$

$$\frac{\partial L}{\partial x_i} = F(Y_1, \dots, X_n)$$

From (4a) above:

$$\frac{\partial L}{\partial x_i} = -\frac{\partial Y_r}{\partial Y_j} = \frac{w_j}{w_r} \frac{P_{Y_j}}{P_{Y_r}}$$

which says that in a transformation between government and market quantities of other quantities equal the ratio weighted by the price by the farmer and ... m.

From (4

$$\frac{P_{Y_j}}{P_{Y_r}} \geq \frac{P_{Y_j}}{P_{Y_r}} \text{ and } \frac{P_{Y_j}}{P_{Y_r}} < \frac{P_{Y_j}}{P_{Y_r}}$$

In the special case of no taxation or chosen on the and guinea counts of cr

$$\frac{\partial L}{\partial X_i} = -\lambda_i P_{X_{ia}} + \phi \frac{\partial F}{\partial X_{m+i}} = 0, \quad i=1, \dots, n \quad (4b)$$

$$\frac{\partial L}{\partial \phi} = F(Y_1, \dots, X_n) = 0 \quad (4c)$$

From (4a) above:

$$\frac{F_j}{F_r} = - \frac{\partial Y_r}{\partial Y_j} = \frac{\mu_j}{\mu_r} \frac{P_{Y_j}}{P_{Y_r}}, \quad j, r=1, \dots, m \quad (4d)$$

which 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, must equal the ratio of their potential (producer) prices, each weighted by the proportion of the unit crop price received by the farmer after deduction of all taxes, μ_j, μ_r ; $j, r=1, \dots, m$.

From (4d), it follows that:

$$\frac{\mu_j}{\mu_r} \frac{P_{Y_j}}{P_{Y_r}} \begin{matrix} \geq \\ < \end{matrix} \frac{P_{Y_j}}{P_{Y_r}} \text{ as } \frac{\mu_j}{\mu_r} \begin{matrix} \geq \\ < \end{matrix} 1. \quad (4e)$$

In the special case in which $\mu_j = \mu_r = 1$ (i.e., there is no taxation of any of the two crops), a point will be chosen on the transformation curve between, say, millets and guinea corn that reveals no distortion in the relative amounts of crops produced by the farmer:

$$p_j > p_r \Rightarrow \frac{w_j}{w_r} \frac{p_{y_j}}{p_{y_r}}$$

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$$\mu_j > \mu_r \Rightarrow \frac{\mu_j}{\mu_r} \frac{P_{Y_j}}{P_{Y_r}} > \frac{P_{Y_j}}{P_{Y_r}}$$

which leads to more of Y_j being produced than would have been the case in the absence of taxation, and vice versa for $\mu_j < \mu_r$.

In Southern Katsina and Northern Zaria and parts of North East and North West States where it is possible to grow either cotton or groundnuts with the same fixed resources at the beginning of each growing season, differential taxation which renders $\mu_j \neq \mu_r$ induces substitution in production which leads to the production of relative amounts of cotton and groundnuts different from what they would have been in the absence of these taxes. Table 3.1 shows empirical evidence of induced allocative distortions in the relative amounts of cotton and groundnuts produced in the Northern States, particularly in North Central, North West, and North East States, given the specifications of our model.

All other things equal, government and marketing board taxation of groundnuts had the effect of inducing production of groundnuts at a level lower than would have been the case in the absence of these taxes in 10 out of 16 years and of inducing production on a larger scale than would have been the case in 6 out of 16 years. Taxation of cotton had the effect of inducing production of cotton

TABLE 3.1.--Effects of Government and Marketing Board Taxes on Relative Prices of Cotton and Groundnuts Produced on Mucshen
Nigerian Farms, Nigeria, 1950-1953.

Year	Groundnuts			Cotton		
	Net Producer Price	Composite Tax	Potential Producer Price	Net Producer Price	Composite Tax	Potential Producer Price
	u_j		u_j	u_k		u_j u_k
					bn/Ton	

TABLE 3.1.--Effects of Government and Marketing Board Taxes on Relative Prices of Cotton and Groundnuts Produced on Northern States Farms, Nigeria, 1950-1965.

Year	Groundnuts				Cotton			
	Net Producer Price	Composite Tax	Potential Producer Price	μ_j^a	Net Producer Price	Composite Tax	Potential Producer Price	μ_r^b
	₦N/Ton				₦N/Ton			
1950	21.2	25.8	47.0	.451	36.37	38.04	72.77	.671
1951	36.0	17.3	53.3	.675	55.07	58.04	113.11	1.208
1952	36.0	14.3	50.3	.715	55.07	29.5	84.57	1.098
1953	36.8	20.1	56.9	.647	54.81	43.3	98.11	1.16
1954	36.7	16.3	53.0	.692	55.10	24.3	79.31	.997
1955	33.7	5.9	39.6	.851	54.68	27.0	81.68	1.27
1956	35.2	8.6	43.8	.804	55.13	17.1	72.23	1.05
1957	33.7	15.8	49.5	.681	54.88	14.1	68.98	.856
1958	37.0	-1.7	35.3	1.048	54.91	-0.4	54.86	1.000
1959	34.7	2.8	37.5	.925	55.07	-2.6	52.47	.881
1960	36.0	8.2	44.2	.814	55.97	-2.0	53.97	.783
1961	35.6	4.8	40.4	.881	55.76	.004	55.764	.999
1962	32.9	4.4	37.3	.882	49.76	4.7	54.46	.914
1963	28.5	6.2	34.7	.821	44.48	6.9	51.38	.965
1964	29.4	8.9	38.3	.768	44.92	11.2	56.02	.960
1965	28.6	9.3	37.9	.755	47.23	7.6	54.83	.877

Source: For groundnut prices 1950-52, G. K. Helleiner, Peasant Agriculture, Government and Economic Growth in Nigeria. Irwin, 1966, Table II-B-4; 1953-66, H. Kriesel, Marketing of Groundnuts in Nigeria, CSNRD 19 (1968), p. 68; Tax figures for groundnuts 1953-66, Ibid.; Cotton prices 1950-52, G. K. Helleiner, op. cit., 1953-66, H. Kriesel, Cotton Marketing in Nigeria, CSNRD 24 (1968), p. 73; Tax figures for cotton 1952-66, Ibid., Tax figures for groundnuts 1950-52 and cotton 1950-51, G. K. Helleiner, op. cit.

^a μ_j is the proportion of unit potential producer price for groundnuts that was actually received by farmers.

^b μ_r is the proportion of unit potential producer price for cotton that was actually received by farmers; with no taxes on both of these crops, $\mu_j = \mu_r = 1$ and there would be no allocative distortions in the relative quantities of cotton and groundnuts produced on Northern States farms.

Note: Potential producer price is net crop price plus composite tax per ton. Nonavailability of data 1967-70 is not a serious loss for our purpose as these were the crisis years.

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Food crops are not taxed. Thus the proportion of unit potential producer price received by food crop growers is unity. The above model therefore implies that in the cotton-groundnuts-food crops zone, taxation of cotton and groundnuts induced farmers to produce relatively more of food crops than would have been the case in the absence of these taxes for most of the period concerned. This must have affected specialization patterns in the country with respect to food production.

Some limitations of the special case represented by (4e) should be noted. The assumption that the quantities of other crops other than the two crops under consideration and the quantities of inputs used in a given crop season remain constant may be particularly restricting where in a given crop season farmers grow more than two crops whose quantities change during a given crop season. However, two crop mixtures are common throughout the Northern States,⁴ with quantities in the input vector more or less remaining the same in a given crop year. In such instances, the model does approximate reality.

The above analysis, therefore, provides strong reasons to expect allocative distortions induced by

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government and marketing board taxation with respect to the relative amounts of cotton, groundnuts, and food crops produced in the Northern States (1950-65).

Implicit in the model is the assumption that the planned relative outputs of crops are functions of the expected values of the probability distributions of crop prices. It is eminently plausible that farmers are influenced not only by mean prices, but also by higher moments of these distributions--particularly the variances of these prices.⁵ Insofar as farmers are risk averse,⁶ we would expect that the elasticity of the planned output of a given crop with respect to the standard deviation of the price of this crop is negative. In this sense, the above model represents the special case when this is zero for each crop or one in which, in the presence of risk aversion, the standard deviations are the same for the two crops. In the more general case, these conditions need not hold. In addition, other variables like weather, amount of information possessed by farmers, etc., that also influence farmers' decisions have not been treated.

Effects of Taxes and Subsidies on
Equilibrium Amounts of
Resources Used

From (4d), for the i^{th} input and the j^{th} crop:

$$\frac{\lambda_i^P x_{ia}}{\mu_j^P y_j} = \frac{-F_{m+i}}{F_j} = \frac{\partial Y_j}{\partial X_i}, \text{ from which}$$

$$\frac{w_j}{p_j} = \frac{\lambda_i}{w_j} P_{x_i} a_i'$$

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$$MP_{x_i, y_j} = \frac{\lambda_i}{w_j} P_{x_i}$$

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$$P_{Y_j} \frac{\partial Y_j}{\partial X_i} = \frac{\lambda_i}{\mu_j} P_{X_i a}, \quad \begin{matrix} i = 1, \dots, n \\ j = 1, \dots, m \end{matrix} \quad (5)$$

meaning that an input will, in profit maximizing equilibrium be demanded up to the point where the marginal value product of the input equals its acquisition price (exclusive of government subsidy) times the ratio of one minus the subsidy rate per unit of the i^{th} input divided by one minus the tax rate on the j^{th} crop. In equilibrium then,

$$MVP_{X_i, Y_j} = \frac{\lambda_i}{\mu_j} P_{X_i a}, \quad \begin{matrix} i = 1, \dots, n \\ j = 1, \dots, m \end{matrix} \quad (5a)$$

from which it follows that:

$$MVP_{X_i, Y_j} = \frac{\lambda_i}{\mu_j} P_{X_i a} \begin{matrix} \geq \\ \leq \end{matrix} P_{X_i a} \text{ as } \frac{\lambda_i}{\mu_j} \begin{matrix} \geq \\ \leq \end{matrix} 1 \quad \begin{matrix} i = 1, \dots, n \\ j = 1, \dots, m \end{matrix} \quad (5b)$$

where λ_i is the proportion of market unit acquisition price of the i^{th} input paid by the farmer and μ_j is the proportion of the unit potential producer price of the j^{th} crop received by the farmer. This means that for given subsidy rates on other inputs, quantities of other inputs and product price, if the proportion of unit price of, say, fertilizers in groundnuts production paid by farmers exceeds the proportion of market unit price of groundnuts received by the farmer, then as a result of government policy, the farmer is being induced to use less

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than the equilibrium amounts of fertilizers that would have obtained in the absence of government policies. If the tax rate per unit of groundnuts (expressed in the equivalent form of the proportion of the unit price of groundnuts taken away by the government) equals the subsidy rate per unit of fertilizers, then the groundnut farmer would be induced under our stated conditions to demand the same equilibrium amount of fertilizers that he would have demanded in the absence of government and marketing board policies. If the subsidy rate per unit of fertilizers exceeds the tax rate per unit of groundnuts, the farmer would be induced by government policy to employ more than the equilibrium amounts of fertilizers that would have been employed in the absence of government taxation.

Before presenting the empirical evidence, we need to extend the model to take account of salvaging and disinvestment in resources and the possibility that there may be neither investment nor disinvestment as farmers reorganize their farms in response to marketing board taxation and subsidy policies.

In response to changes in the rates of taxes on marketing board crops and subsidies on inputs, farmers are induced to reorganize their farms. This reorganization may lead to the salvaging of and disinvestment in certain inputs; it may lead to purchases and investments in new

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$$G = \sum_{j=1}^M u_j P_j (Y_j)$$

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inputs or it may lead to a reallocation of a fixed quantity among crops on the basis of an internal (within the farm-firm) opportunity cost principle. The gain (G) from reorganizing the farm-firm in response to changes in taxes on marketing board crops and subsidies on inputs is:⁷

$$G = \sum_{j=1}^m \mu_j P_{Y_j} (Y_j - Y_j^0) - \sum_i a_i (X_{ij} - X_i^0) \quad (6)$$

where μ_j is the proportion of the unit potential producer price of the marketing board crop received by the farmer, P_{Y_j} is the potential producer price of the marketing board crop, Y_j^0 and Y_j are the initial and reorganized output of the j^{th} crop, respectively, a_i is the unit value of X_i , X_{ij} is the amount of X_i used in producing the j^{th} crop after reorganization and X_i^0 is the initial quantity of X_i on hand. Let us define three price equations for X_i : one which says if the reorganized quantity exceeds the initial quantity on hand, then the relevant price for X_i is its market acquisition price times one minus the subsidy rate per unit of X_i ; if the reorganized quantity of X_i is less than the initial quantity on hand, then the relevant price for X_i is the market salvage price; and, if after profit maximizing reorganization it does not pay to vary the quantity of X_i , then X_i is fixed and the relevant price for X_i is its on-farm opportunity cost.

Thus,

$$\text{if } \sum_{j=1}^m X_{ij} >$$

$$\text{if } \sum_{j=1}^m X_{ij} < X_i^0$$

$$\text{and if } \sum_{j=1}^m X_{ij} = X_i^0$$

where P_{x_i} is the

X_i^0 = amount of X_i

The farm-firm will

these restrictions

$$\sum_{j=1}^m X_{ij} = X_i^0$$

$$X_i^0 - v_i$$

where (6a) says

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Lagrangian:

$$L = \sum_{j=1}^m \mu_j P_j Y_j + \lambda \left(X_i^0 - \sum_{j=1}^m X_{ij} \right)$$

$$+ W_i - \sum_{j=1}^m X_{ij}$$

Thus,

$$\text{if } \sum_{j=1}^m X_{ij} > X_i^0, \text{ then } a_i = \lambda_i P_{x_i a},$$

$$\text{if } \sum_j X_{ij} < X_i^0, \text{ then } a_i = P_{x_i s},$$

$$\text{and if } \sum_j X_{ij} = X_i^0, \text{ then } P_{x_i s} < a_i < \lambda_i P_{x_i a}, i=1, \dots, n.$$

where $P_{x_i s}$ is the salvage value of the i^{th} input. Let W_i = amount of X_i purchased and V_i = amount of X_i sold. The farm-firm wishes to maximize (G) above subject to these restrictions:

$$\sum_j X_{ij} = X_i^0 + W_i - V_i \quad (6a)$$

$$X_i^0 - V_i \geq 0 \quad (6b)$$

where (6a) says the reorganized quantity of inputs equals the initial quantity on hand plus new purchases less the quantity of inputs sold, while (6b) says sales of a given input cannot exceed initial quantity on hand. Form the Lagrangian:

$$\begin{aligned} L = & \sum_{j=1}^m \mu_j P_{y_j} (Y_j - Y_j^0) + \sum_{i=1}^n P_{x_i s} V_i - \sum_{i=1}^n \lambda_i P_{x_i a} W_i + \sum_{i=1}^n \delta_{1i} [X_i^0 - V_i \\ & + W_i - \sum_{j=1}^m X_{ij}] + \sum_{i=1}^n \delta_{2i} [X_i^0 - V_i] \end{aligned} \quad (7)$$

The Kuhn-Tucker conditions

λ_i, V_i and W_i are

are:

$$\frac{\partial L}{\partial x_{ij}} = P_{ij} - \lambda_i P_{ij} - \frac{\partial Y_i}{\partial x_{ij}}$$

$$\frac{\partial L}{\partial \lambda_i} = \delta_{li} - \lambda_i P_{ij}$$

$$\frac{\partial L}{\partial V_i} = P_{x_i s} - \delta_{li}$$

$$\frac{\partial L}{\partial W_i} = x_i^0 - v_i +$$

$$\frac{\partial L}{\partial W_i} = x_i^0 - v_i \geq$$

(7a) states that the firm in response to subsidies on inputs times the price of the resource is less than or equal to zero. (7b) states that the optimum purchase of the resource, i.e., acquisition of the on-farm resource, is in equilibrium, i.e., value equal to zero.

The Kuhn-Tucker conditions for maximizing with respect to x_{ij} , v_i and w_i and minimizing with respect to δ_{1i} and δ_{2i} are:

$$\frac{\partial L}{\partial x_{ij}} = \mu_j^p y_j \frac{\partial y_j}{\partial x_{ij}} - \delta_{1i} \leq 0, \quad \frac{\partial L}{\partial x_{ij}} x_{ij} = 0, \quad x_{ij} \geq 0; \quad (7a)$$

$$\frac{\partial L}{\partial w_i} = \delta_{1i} - \lambda_i^p x_{ia} \leq 0, \quad \frac{\partial L}{\partial w_i} w_i = 0, \quad w_i \geq 0; \quad (7b)$$

$$\frac{\partial L}{\partial v_i} = p_{x_i s} - \delta_{1i} - \delta_{2i} \leq 0, \quad \frac{\partial L}{\partial v_i} v_i = 0, \quad v_i \geq 0; \quad (7c)$$

$$\frac{\partial L}{\partial \delta_{1i}} = x_i^0 - v_i + w_i - \sum_j x_{ij} = 0 \quad (7d)$$

$$\frac{\partial L}{\partial \delta_{2i}} = x_i^0 - v_i \geq 0, \quad \frac{\partial L}{\partial \delta_{2i}} \delta_{2i} = 0, \quad \delta_{2i} \geq 0. \quad (7e)$$

(7a) states that in optimal reorganization of the farm-firm in response to taxes on marketing board crops and subsidies on inputs, the marginal value product of the input times the proportion of the unit potential producer price of the marketing board crop received by the farmer is less than or equal to its on-farm opportunity cost, δ_{1i} . (7b) states that in equilibrium reorganization, the optimum purchases of x_i involve a net acquisition price (i.e., acquisition price inclusive of subsidies) equal to the on-farm opportunity cost of x_i . (7c) states that in equilibrium, the optimum sale of x_i involves a salvage value equal to the opportunity cost for x_i when less than

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x_i^0 is sold. In (7e), δ_{2i} turns out to be the gain from selling x_i rather than using it, while (7d) says that in equilibrium, the constraint in (6a) is satisfied. From (7b), acquisition of x_i involves an acquisition price ($\lambda_i P_{x_i a}$) equal to its on-farm opportunity cost in equilibrium. Substituting this optimum equivalent of the opportunity cost in (7a), we get:

$$\frac{\partial L}{\partial x_{ij}} = \mu_j P_{y_j} \frac{\partial y_j}{\partial x_{ij}} - \lambda_i P_{x_i a} \leq 0, \quad \frac{\partial L}{\partial x_{ij}} x_{ij} = 0, \quad x_{ij} \geq 0, \quad (7a)$$

or

$$\frac{\partial L}{\partial x_{ij}} = P_{y_j} \frac{\partial y_j}{\partial x_{ij}} \leq \frac{\lambda_i}{\mu_j} P_{x_i a}, \quad \frac{\partial L}{\partial x_{ij}} x_{ij} = 0, \quad x_{ij} \geq 0 \quad (8)$$

from which $P_{y_j} \frac{\partial y_j}{\partial x_{ij}} > P_{x_i a}$ as $\frac{\lambda_i}{\mu_j} > 1$, where $P_{x_i a}$ is, in equilibrium, the on-farm opportunity cost of x_i . The on-farm opportunity cost is the relevant price for allocating a fixed amount of resources among competing crops.

If there are neither sales nor acquisition of a given input after reorganization, from (7b) and (7c), the on-farm opportunity cost of the input will be between its acquisition price inclusive of subsidies and its salvage price. This on-farm opportunity cost of the input is its MVP evaluated at the crop's potential producer price times the proportion of the unit potential producer price of the crop paid by the board to the farmers.

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Also important for investment-disinvestment decisions is the most recent history of relative prices. If real prices of resources have been persistently high in the past, a reduction in real prices through a reduction in taxes on marketing board crops may not result in increased investment in resources if farmers do not expect this change in marketing board policy to last, and conversely for a sudden increase in taxes if real prices of resources had been persistently low in the past. This is particularly so for small changes in taxes on crops and subsidies on inputs. Farmers on the basis of past experience with marketing board pricing policies form concepts of "normal" real prices for resources. Any sudden departures from these "normal" prices may not affect farmers' investment-disinvestment decisions if farmers expect a return to these "normal" prices. The importance of regressive expectations is thus emphasized in our response studies.

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.,

$$P_{x_2s} < \mu_Y P_Y \frac{\partial Y}{\partial X_2} < \lambda_2 P_{x_2a}$$

for all possible changes in taxes on marketing board crops and all subsidies on the inputs (where μ_Y is the proportion of the unit potential producer price of Y received by the

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farmers and λ_2 is the proportion of the unit acquisition price of X_2 paid by the farmer).

In Figure 3.1, let EE be 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 ,⁸ X_1 is fixed in an economic sense. With the imposition of taxes on Y (marketing board so-called trading surpluses, produce sales tax and export tax, where all these taxes are converted into their ad valorem equivalents), the adjusted MVP is given by EE' (i.e., $EE' = \mu_Y EE$). With EE' , it still does not pay the farmer to change the level of X_1 employed because at the given level of X_1 , its MVP is still higher than its salvage value, P_{x_1s} , but lower than its acquisition price, P_{x_1a} .

Suppose taxes are raised so that the adjusted MVP of X_1 is EE'' . It pays to salvage some of the given quantity of X_1 since its salvage value now exceeds its MVP. There is disinvestment by the amount K_2K_1 . Such salvaging of inputs seems to have occurred with respect to the land and labor resources employed on Northern States farms in recent years. If the initial quantity of X_1 happens to be K_1' , K_3 is optimum quantity in the absence of taxes. With taxes leading to EE' , optimum amount of X_1 is K_3' implying that taxes have reduced acquisition in the optimum by $K_3'K_3$. Taxes have thus reduced acquisitions of X_1 below what they would have been in the absence of taxes. With the heavier taxes leading to EE'' , not only

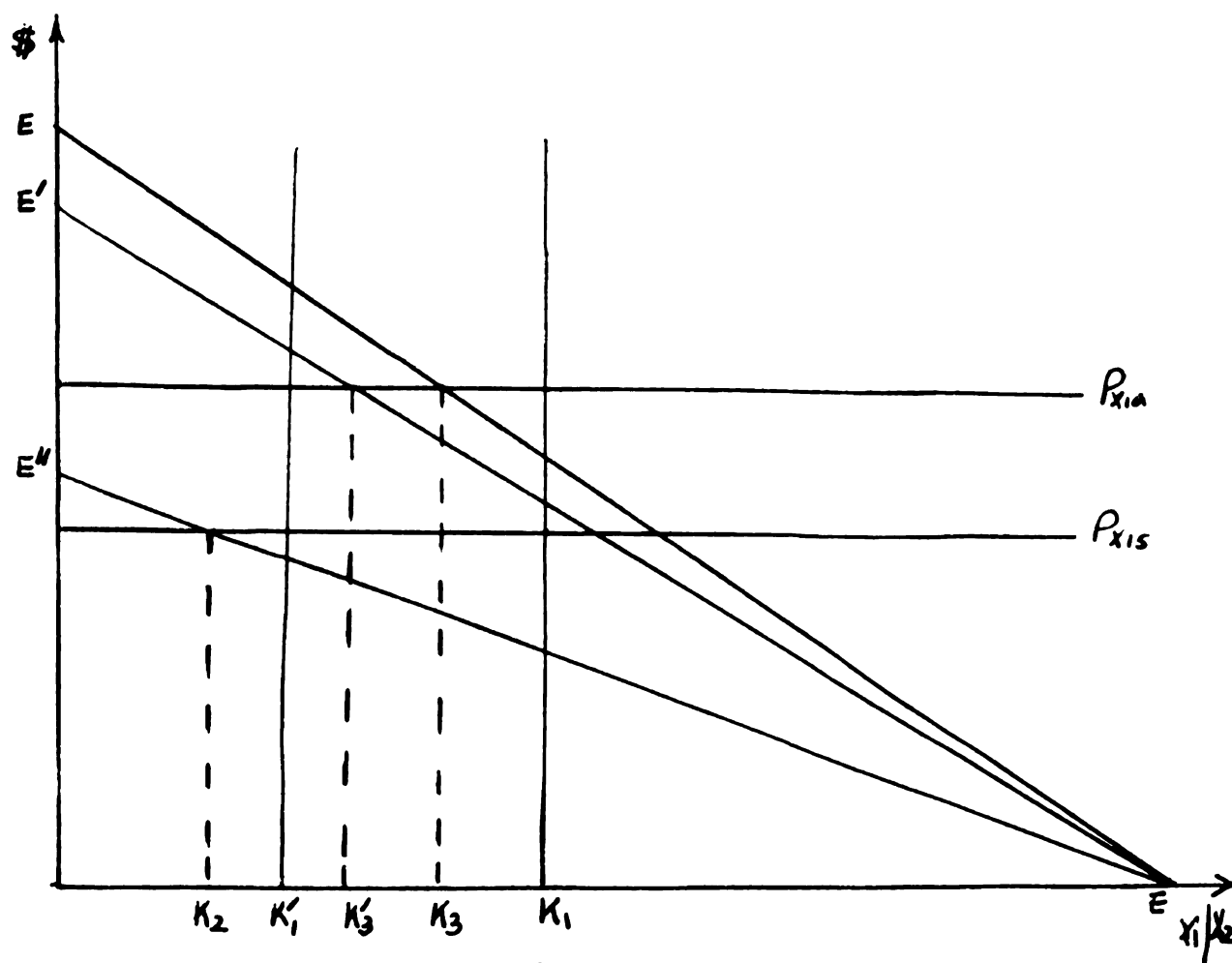
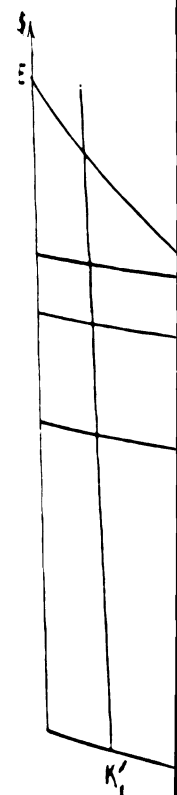


Figure 3.1

is the additional acquisition in the absence of taxes represented by K'_1K_3 not forthcoming but also some of the initial quantity on hand ($K_2K'_1$) is salvaged. The closer to the origin is the initial quantity on hand of X_1 , the more a given tax leads to less acquisitions of X_1 than would have been the case in the absence of taxes. The movement of farm youth and school leavers from rural areas and non-use of available suitable land for cotton and groundnuts in the North-East, North-West and North-Central States are evidence of acquisitions that are less than would have been optimal in the absence of taxes.

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In Figure 3.2, let EE , P_{x_1a} and P_{x_1s} have the meanings given them above. Let the subsidy rate be t_1 so that the farmer pays $(1 - t_1)P_{x_1a} = \lambda_1 P_{x_1a}$ 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 $\lambda_1 P_{x_1a}$.

Whether the initial quantity on hand is K_1 ,⁹ K_1' or K_3 , with subsidies leading to $\lambda_1 P_{x_1a}$ as the new supply line, there will be additional acquisition of X_1 up to K_4 . With K_1' as the initial quantity on hand, the same amount of subsidies do not lead to new acquisitions of X_1 .

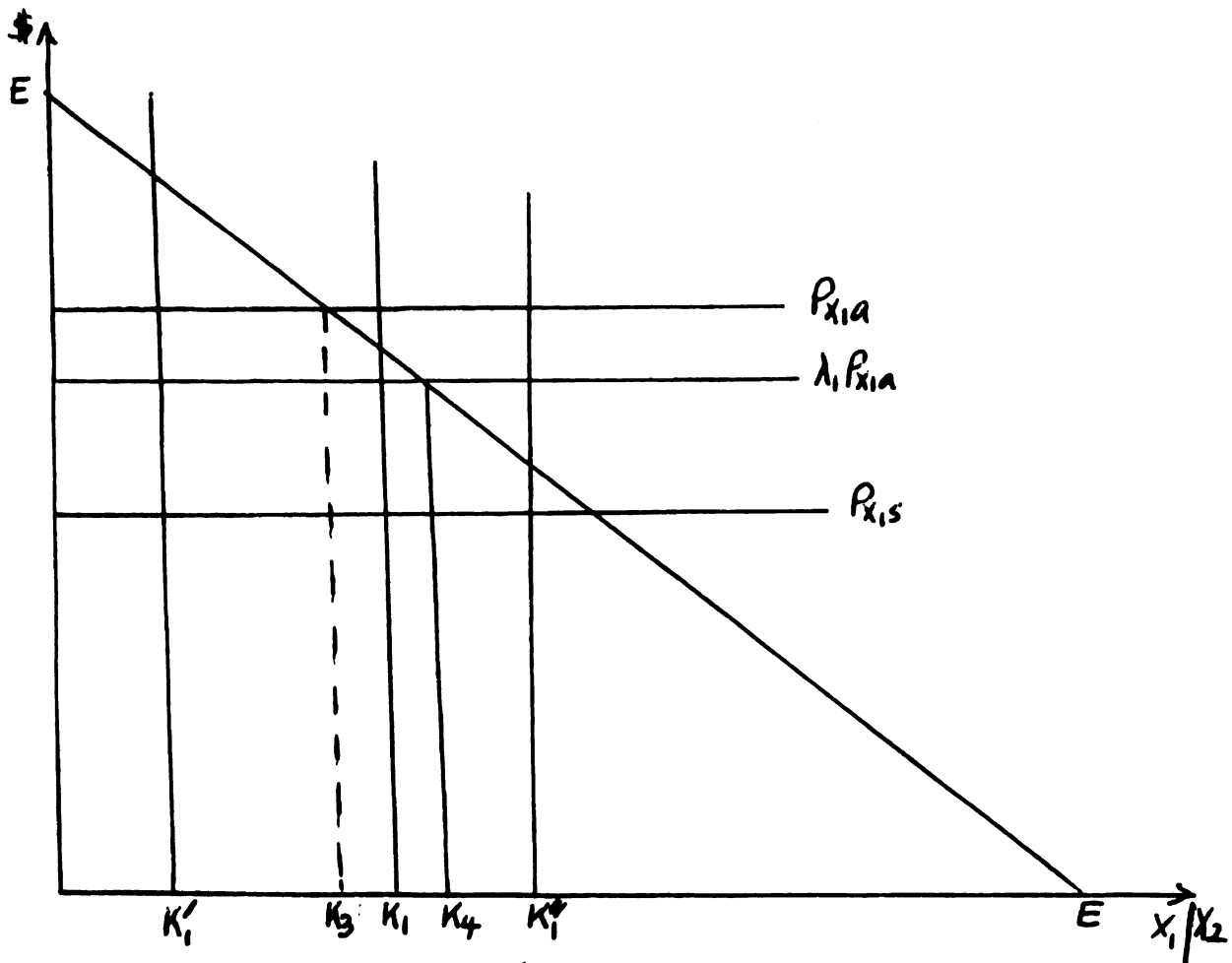


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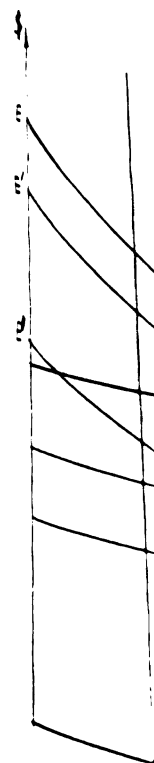
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The case of simultaneously taxing Y and subsidizing X_1 will be briefly presented. In Figure 3.3, EE , EE' , EE'' , P_{X_1a} , $\lambda_1 P_{X_1a}$ and P_{X_1s} all have their previous meanings. If the initial quantity on hand is K_3 , imposition of taxes on Y leading to EE'' and the granting of subsidies on X_1 lead to neither acquisition nor sale of X_1 . On the other hand, with initial quantity of X_1 of K_1 and with the same amount of subsidies and taxes leading to EE' there is new acquisition up to the new equilibrium point K'_1 ; in this case, a resource that was initially fixed now becomes variable as a result of taxes on Y and subsidies on X_1 . If the initial quantity on hand is K'_1 , then taxes

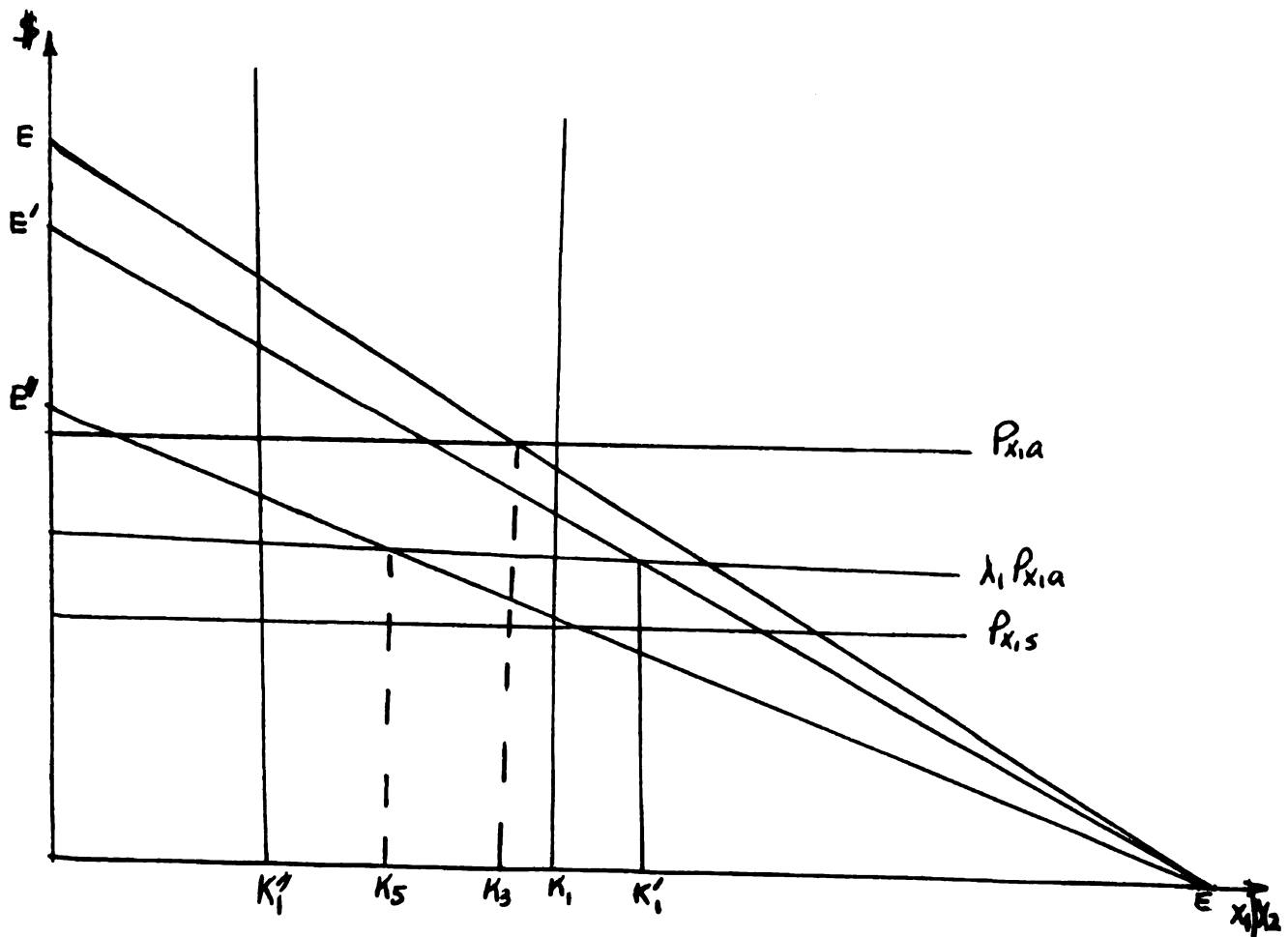


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represented by EE' and subsidies represented by $\lambda_1 P_{x_1} a$ lead to acquisitions by the amount of $K_1' - K_1$; with taxes represented by EE'' and with the same subsidies, acquisitions of X_1 increase by the amount $K_1' - K_5$.

From Figure 3.1 and the accompanying analysis, the following propositions can be derived. In the absence of subsidies, if the resource was initially fixed in an economic sense, taxes on the marketing board crop would need to be substantial for salvaging (and disinvestment) to occur. For this initially fixed resource, the larger the differential between salvage and acquisition values, the larger the required taxes on the crop for disinvestment to occur and conversely for a small differential. If the initial quantity on hand were the equilibrium amount K_3 (Figure 3.1), small taxes leave the resource fixed while large taxes lead to some salvaging and disinvestment, for a given differential between salvage and acquisition values. If the initial quantity on hand in the absence of taxes is less than the equilibrium amount K_3 , small taxes lead to acquisitions that are less than would have been the case in the absence of taxes while large taxes lead to both reduced acquisitions as well as some salvaging of the initial quantity on hand. Apart from the basic result of resource fixity, other results are obtained that are different from those of the neoclassical theory of the firm when the assumption of equality between salvage and

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acquisition values is dropped. With an initial quantity on hand of K_3 (Figure 3.1), whereas the neoclassical theory predicts a reduced use of the resource as a result of taxes, the extended theory predicts that small taxes leave resource employment unaffected while large taxes lead to salvaging up to the equilibrium point where salvage value equals MVP (e.g., K_2K_3 is salvaged with taxes leading to EE'' in Figure 3.1). The corresponding salvaging for the same large taxes (' EE'' ') using the usual neoclassical model is the distance between K_3 and the intersection between P_{x_1a} and EE'' , which is many times K_2K_3 .¹⁰ With an initial quantity on hand of K_1' (Figure 3.1), for taxes that adjust EE down up to the intersection of P_{x_1a} and the vertical line at K_1' , both the neoclassical theory and its extended form produce the same result--taxes reduce acquisitions of X_1 below optimal levels in the absence of taxes. For larger taxes (as represented by EE'' in Figure 3.1), the neoclassical theory predicts disposals or reductions in quantity on hand that are much larger than those predicted with the extended theory.

Similar propositions can be drawn from Figures 3.2 and 3.3 but we leave these out because labor and land which produce the bulk of value added in Nigerian agriculture have not been subsidized significantly in the past.

Some clarifications are necessary for drawing inferences from available empirical evidence. From (5b),

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the marginal value product of a resource from a given crop exceeds the acquisition price¹¹ of the resource if the ratio of the proportion of unit acquisition price paid by the farmer to the proportion of the unit potential producer price of the crop received by the farmer exceeds unity. In this case, government and marketing board policies will induce farmers to use less of the resource than would have been the case in the absence of taxes and subsidies. The converse result holds when this ratio is less than unity. Equilibrium use of a resource here is defined as when its MVP equals its acquisition price which in the case of a fixed resource allocated to two crops is the foregone opportunity cost (i.e., its foregone MVP in alternative use).

When the model is extended to take account of the differential between salvage and acquisition values, a ratio of the proportion of unit acquisition price of the input paid by the farmer to the proportion of unit potential producer price of the crop paid by the board to the farmer greater than unity also implies that less of the resource is being used than would have been the case in the absence of these policies.¹² In this case, however, "less use" includes both the acquisitions that are less than would have otherwise been the case in the absence of these policies as well as the induced salvaging and disinvestment in the quantity on hand as the salvage

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value of the resource relative to its MVP rises as a result of these taxes. For resources that are fixed, the relevant acquisition price for allocating between crops is the on-farm opportunity cost of the resource. For resources that were initially fixed (economically) in the extended model, large taxes would lead to salvaging and disinvestment. Even small taxes lead to disinvestment in this resource the nearer the initial quantity is to the intersection point between the EE and P_{x_1s} curves.

Tables 3.2 and 3.3 show the effects of taxes on marketing board crops on the real (relative) prices of land and labor employed on cotton and groundnuts farms in the Northern States, 1950-66. So long 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., $\lambda_1 = 1$, 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 as salvage values exceed MVPS. Under our stated conditions, this means that for cotton, groundnuts, soybeans, palm oil and beniseed in the Northern States less labor (family and hired) is being used than would have

TABLE 1.1. - *Extension of Taxation on the Production of Potatoes, 1960-1965.*
Northern Potato Farming, Nigeria, 1960-1965.

Total	Export Duties	Surplus to the	Produce Tax	Total Tax as Proportional of Potential Price Inclusive of	Proportion of Potential Price That Was Paid	
					$\frac{\lambda_j}{p_j}$	$\frac{\lambda_j}{p_j}$

TABLE 3.2.--Effects of Taxes on Groundnuts on Real (Relative) Prices of Land and Labor Employed on Northern States Farms, 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 : Pro- portion of Potential Producer Price That Was Paid to Farmers	λ_{ia} μ_j
£N '000							
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	n.a.	.365	.635	1.57
1954	3,430	n.a.	8.2	1.0	.315	.685	1.45
1955	2,965	n.a.	-3.2	1.0	.143	.857	1.17
1956	3,192	6.2	1.4	1.0	.210	.790	1.27
1957	2,689	7.2	7.6	1.0	.297	.703	1.42
1958	2,987	3.3	-7.8	1.0	-.052	1.052	.95
1959	3,412	5.5	-3.5	1.0	.072	.928	1.08
1960	2,686	5.9	1.2	1.0	.180	.820	1.22
1961	3,658	6.1	-2.2	1.0	.125	.875	1.14
1962	3,722	5.4	-2.4	1.5	.127	.873	1.15
1963	3,770	4.7	.06	1.5	.170	.830	1.20
1964	4,363	5.6	1.2	1.5	.214	.786	1.27
1965	4,831	6.4	1.1	1.5	.215	.785	1.27

Source: For prices and tax figures 1953-66, see H. Kriesel, The Marketing of Groundnuts in Nigeria, CSNRD 19, p. 68. For prices and tax figures 1950-52, see G. K. Helleiner, op. cit. For 1950-52, only total tax figures available.

^aIt is assumed that land and labor were not subsidized so that λ_i , the proportion of the unit acquisition price of the resource paid by farmers, equals unity for both land and labor.

TABLE 3.3.--Effects of Taxes on Cotton on Real (Relative) Prices of Land and Labor Employed in Northern States 1940-1960.

Total	Surplus to the Marketing	Composite Tax per Ton	Total Tax as Proportion of Potential Producer Price Inclusive of Taxes	$\frac{A_1}{A_2}$ $\frac{P_1}{P_2}$	$\frac{A_1}{A_2}$ $\frac{P_1}{P_2}$
					Proportion of Potential Producer Price that was paid to Farmers

TABLE 3.3.--Effects of Taxes on Cotton on Real (Relative) Prices of Land and Labor Employed on Northern States Farms, 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_1 : Proportion Of Potential Producer Price that was Paid to Farmers	$\frac{\lambda_1}{\mu_1 a}$
			£M '000					
1950	n.a.	n.a.	1192.4	30.04	.328	.672	1.49	
1951	386	n.a.	2067.3	58.04	.441	.559	1.79	
1952	713.7	n.a.	1166.3	29.5	.349	.651	1.54	
1953	812.2	n.a.	1397.0	43.3	.441	.559	1.79	
1954	775.1	n.a.	1098.8	24.3	.306	.694	1.44	
1955	970.7	92.1	1595.5	27.0	.331	.669	1.49	
1956	812.1	75.4	490.6	17.1	.237	.763	11.31	
1957	750.6	68.1	199.4	14.1	.204	.796	1.26	
1958	851.2	115.6	-1020.9	-0.04	-.001	1.000	1.00	
1959	728.0	81.3	-1034.2	-2.6	-.050	1.050	.95	
1960	733.1	84.3	-989.4	-2.0	-.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	4.7	.095	.905	1.10	
1963	910.4	205.1	-98.4	6.9	.133	.867	1.15	
1964	812.8	182.1	465.6	11.2	.194	.806	1.24	
1965	684.5	182.1	122.5	7.6	.141	.859	1.16	
1966	676.0	180.4	-1023.7	-1.3	.163	.837	1.19	

Source: Price series for 1950-59: Extended and amended Kriesel series: H. Kriesel, *Cotton Marketing in Nigeria*, CSWRD 24, p. 73. The price series 1960-71 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. 474-75) 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 1960-67, see H. Kriesel, *op. cit.*, p. 55; for net taxes after deduction of produce sales tax for different grades of cotton 1960-67, 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 1968-71, see National Agricultural Development Conference, Federal Department of Agriculture, Lagos, 1971, p. 7; Weights for prices different grades 1968-70 from mean weights for the above Report of the Study . . . p. 60, while weights for 1971-72 were assumed to be those of 1970-71.

^aIt is assumed that land and labor were not subsidized so that λ_1 , the proportion of unit acquisition price of the resource paid by the farmer, equals unity of both land and labor.

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been the case in the absence of taxation. Insofar as rates of utilization of family labor and hired labor are explicitly introduced as factors of production in the production function, labor is being used less intensively now than would have been most profitable in the absence of taxation. Farmers are being induced by taxes on crops to work less intensively than they would otherwise have done in the absence of these taxes. Insofar 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 produce price, these taxes would induce the use of less land than would have been the case without them.¹³

The following conclusions may be drawn using the assumptions of the model. From Table 3.2, both land and labor (family and hired) used in groundnut 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 taxes on groundnuts. Government and marketing board taxation policies therefore have tended to limit the size of groundnut farms in the Northern States measured in terms of acreage or size of labor or intensity of use of these two resources.

Only in one year (1958) was this taxation such as to induce farmers to use more labor and land than they would have done in the absence of taxes.

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Table 3.3 shows the effects of government and marketing board taxation on the resources in cotton. The results are similar to the groundnuts case: on the whole, these taxes induced the under-utilization of land and labor resources used in cotton production for most of the period, relative to the amounts that could have been employed in the absence of these taxation policies. Only in two years in Table 3.3 was taxation such as to induce cotton farmers to use more land and labor resources in cotton production than would have been consistent with profit maximization in the absence of these taxes. There was no year in groundnut production when labor and land resources were induced to be employed in the same amount as would have been done in the absence of government and marketing board taxation, i.e., there was no year in which taxation policy was neutral with respect to the equilibrium amounts of land and labor that could have obtained in the absence of taxation. Only in two years (1958, 1961) was taxation neutral with respect to the equilibrium amounts of resource use in cotton.

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 tiny proportion of these farmers use fertilizers and other inputs that are

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subsidized; hence, any existing subsidies on fertilizers and chemicals become insignificant when the aggregate of farmers are considered and can thus be disregarded for all practical purposes. 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 (see last section of this chapter).

Elasticities and Their Limitations

Some serious limitations of elasticity concepts need to be noted before we illustrate the nature of the bias of our estimates of effects of government policies using a Cobb-Douglas function. Samuelson¹⁴ has listed the noninvariance of elasticities to changes in origin and our failure to treat the variable of interest directly as some of the problems. Thus, the price elasticity of demand for a product may be of some use in examining the qualitative behavior of revenue, but then this is due to our failure to examine the behavior of total revenue directly.

Glenn Johnson¹⁵ has provided theoretical reasons why elasticity concepts may not be very useful. He has shown by implication that the percentage change in a dependent variable for a one per cent change in an explanatory variable is not invariant with respect to the

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direction and size of the change; to this we add the previous history of changes or movements in the explanatory variable. When MVP's of a durable input are between its salvage and acquisition values and expectations are held with certainty that these bounds would hold in the future, then it does not pay to invest or disinvest in this asset.

Let some durable inputs have their MVP's between their salvage values and their acquisition prices. Let product price history be such that in the opinions of farmers crop price has been unusually low and they expect a return to more "normal" prices in near future. If farmers have regressive expectations, then they would invest in additional resources even though calculations using (current) actual product price will indicate that it does not pay to invest or disinvest in additional resources. The same considerations will apply in our analysis of disinvestment in productive assets. All this calls for caution in our response studies; it is a cry for modesty in our claims for the usefulness of elasticity concepts.

Comparative Statics and Biases in Our
Estimate of Effects of Government and
Marketing Board Taxation and
Subsidies on Resource Use

One important use of comparative statics is to predict the response of the dependent variable (direction

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and magnitude) for given parametric changes. A framework of analysis is potentially more useful if it can predict the response of equilibrium amounts of land and labor resources to given changes in subsidy rates on inputs and tax rates on crops that are imposed by State Governments and their respective marketing boards.

The nature of the bias in estimates of effects of government pricing policies using the MVP curve as the demand curve for the resource needs to be ascertained. In the agricultural economics literature, what is being held constant has sometimes not been clearly and consistently stated.¹⁶

The Bias in Estimates of Effects of
Government and Marketing Board
Taxation of Crops and Subsidies
on Inputs on Resource Use
Using a Cobb-Douglas
Production Function¹⁷

With the imposition of government and marketing board taxes on a crop and a subsidy on an input used to produce a crop, then for given prices of other crops and other inputs, whether use of the subsidized input will increase, remain the same or decrease depends on whether the percentage fall in the net acquisition price of the input times its own price elasticity of demand exceeds, equals or is less than the absolute value of the percentage fall in net producer crop price times the elasticity of demand for the input with respect to net producer crop

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price.¹⁸ Estimates of induced percentage changes in resource use depend on these elasticities and the magnitudes of the tax and the subsidy. Any bias in any of the elasticities would bias estimates of percentage changes in resource use as a result of government and marketing board pricing policies.

What is the nature of the elasticity bias in using an MVP curve as the resource demand curve instead of the "true"¹⁹ demand curve? Let the Cobb-Douglas form be:

$$Y = AX_1^{\beta_1} X_2^{\beta_2}, \quad \beta_1 + \beta_2 < 1, \quad \beta_i > 0 \quad (i = 1, 2), \quad (7)$$

from which the profits (π) are defined as:

$$\pi = \mu_Y P_Y A X_1^{\beta_1} X_2^{\beta_2} - \lambda_1 P_{X_1} a X_1 - \lambda_2 P_{X_2} a X_2 \quad (7')$$

Solving the necessary conditions for profit maximization simultaneously for X_1 and X_2 , we get, in the case of X_1 , its true demand function to be

$$X_1 = \lambda_1 P_{X_1} a^{\frac{1-\beta_2}{\beta_1+\beta_2-1}} [(\beta_1+\beta_2) \mu_Y P_Y A \beta_2^{\beta_2} \beta_1^{-\frac{1}{\beta_2}} (\lambda_2 P_{X_2} a)^{-\beta_2}]^{\frac{1}{1-\beta_1-\beta_2}} \quad (7a)$$

a demand function that is linear in the logs of the price variables. P_Y , $P_{X_1} a$ and $P_{X_2} a$ are the market prices for crop Y and inputs X_1 and X_2 respectively in the absence of taxes and subsidies. From the above, the elasticity

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of demand for X_1 with respect to its net acquisition price $(\lambda_1 P_{X_1 a})$ is:

$$\eta_{X_1, (\lambda_1 P_{X_1 a})} = \frac{1 - \beta_2}{\beta_1 + \beta_2 - 1} < 0 ;$$

the elasticity of demand for X_1 with respect to the net crop producer price $(\mu_Y P_Y)$ is

$$\eta_{X_1, (\mu_Y P_Y)} = \frac{1}{1 - \beta_1 - \beta_2} > 0 ,$$

Now suppose we solve for X_1 and X_2 not simultaneously but from each marginality (equilibrium) condition separately (which is what Heady and Ulveling have done in their analysis of leasing rights), then the demand function for X_1 which is defined for given quantities of X_2 is

$$X_1 = (\lambda_1 P_{X_1 a})^{\frac{1}{\beta_1 - 1}} [\mu_Y P_Y \beta_1 A X_2^{\beta_2}]^{-\frac{1}{\beta_1 - 1}} \quad (7'a)$$

from which these elasticities (whose meanings are clear from the subscripts) are derived:

$$\eta'_{X_1, (\lambda_1 P_{X_1 a})} = \frac{1}{\beta_1 - 1} < 0$$

$$\eta'_{X_1, (\mu_Y P_Y)} = \frac{1}{1 - \beta_1} > 0 ,$$

from which

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$$(\eta'_{x_1, (\lambda_1 P_{x_1 a})} - \eta_{x_1, (\lambda_1 P_{x_1 a})}) = \frac{\beta_1 \beta_2}{(\beta_2 - 1)(\beta_1 + \beta_2 - 1)} > 0$$

which implies that there is a downward bias in the elasticity of demand for labor with respect to its net off-farm acquisition price (after deduction of such government and marketing board subsidies like free extension services, free adult education classes, etc.) when we use an MVP curve as a demand curve rather than the true demand curve.²⁰

Very often we write and draw conclusions as if the MVP curve was the true demand curve for a resource. It is not only essential that the exact form of the elasticity bias be determined for different production functions; it is also important to determine on what its size depends. Intuitively it would appear that this bias will vary according to the importance of the input in production and also the importance of the other input. This indeed is the case for the Cobb-Douglas function. Larger values of β_1 produce larger values of the bias; the smaller the output elasticity of the input, for given output elasticities of other inputs, the smaller the difference whether we make statements on the effects of government and marketing board prices using MVP curves as demand curves or the true demand functions. Similarly, the bias in the elasticity of demand with respect to produce price can be determined.²¹

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Another important source of bias arises when the MVP of the input is between its off-farm acquisition price and its market salvage value. In this case the elasticity of demand for the input with respect to its off-farm market acquisition price is zero. This bias arises from failure to distinguish between salvage and acquisition prices. This has implications for our predicted investment-disinvestment response to changes in the level of taxes on marketing board crops. Suppose we want to predict the investment response to a lowering of taxes, i.e., the raising of marketing board producer prices. In Figure 3.4, let the MVP of X_1 with taxes at a given level be EE' . Let taxes be reduced so that the MVP curve is EE . With initial quantities on hand of K_1 , or K_3 , both the neoclassical theory and its extension predict increased demand for X_1 up to K'_3 . However, through errors of organization, initial quantities may be K_2 . With the same amount of tax reduction, it does not pay the farm-firm to vary the quantity of X_1 as its MVP is still between its off-farm market acquisition price and its salvage price. Thus, the neoclassical theory which assumes equality between the acquisition and salvage values will tend to underestimate the investment response to a lowering of taxes on marketing board crops.

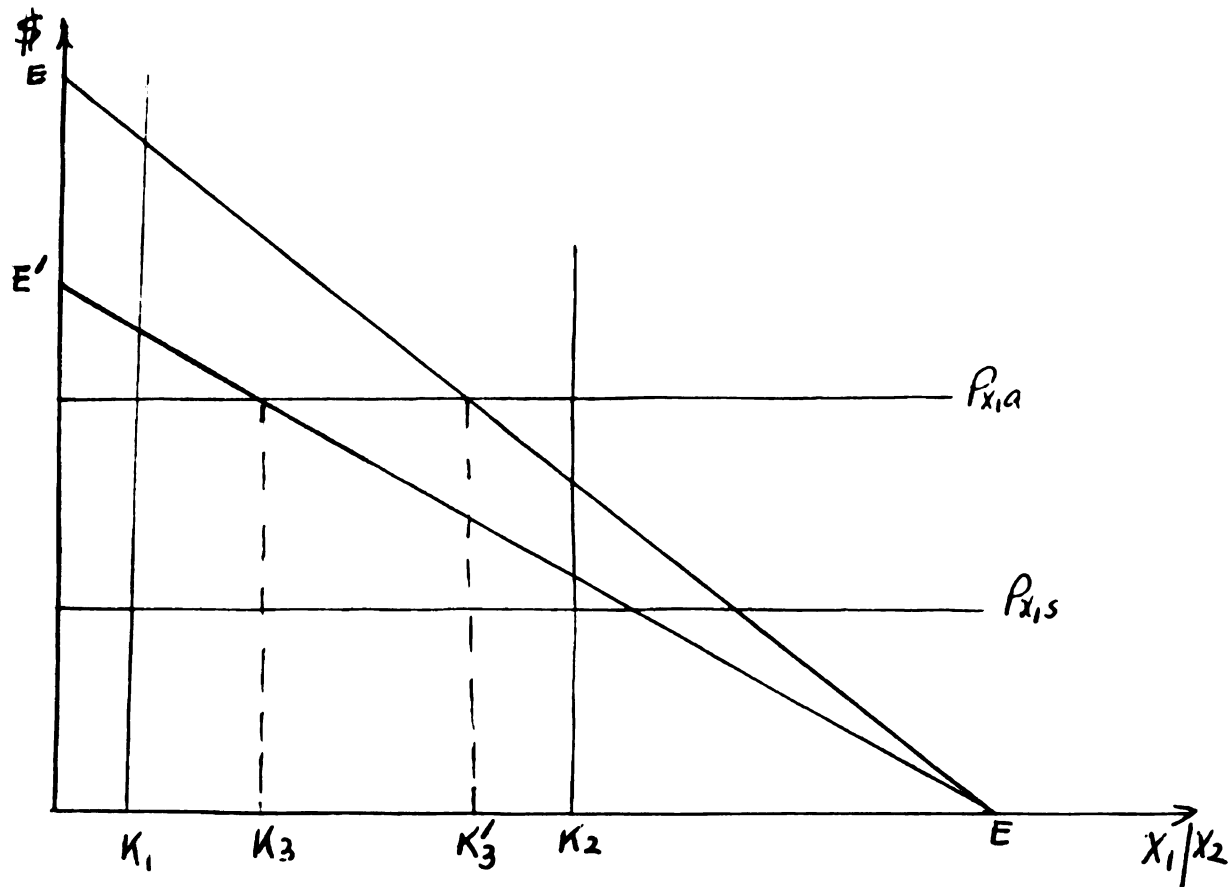


Figure 3.4

Aggregation Problems

Under normal circumstances when we try to aggregate these individual farm-firm effects of government and marketing board pricing policies based on the true demand curves for resources, there would be another bias from the downward sloping nature of the aggregate demand curve facing all farmers. We shall not go into the nature of this bias because of our assumption that all farmers in any production period face an aggregate demand curve that is infinitely elastic at the prices set by the marketing boards. If we summed individual farm effects based on individual MVP curves, we get another bias. The nature of this bias will not be examined here.

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The Implicit Assumption of Allocative
Equilibrium: Schultz's Hypothesis
as Our Point of Departure

An implicit assumption of the foregoing analysis is that farmers in the Northern States achieve allocative equilibrium with respect to such traditional resources as labor and land which still constitute the bulk of value added in agriculture in Nigeria. Time was when the need was to empirically test Professor T. W. Schultz's hypothesis of allocative equilibrium²² with respect to the use of traditional factors. Most of the evidence that is in is consistent with his hypothesis. Norman's data show evidence of allocative equilibrium in the use of traditional inputs like land and labor in Southern Zaria.²³ If we had data to estimate the input demand elasticities then we could use these to predict changes in resource use for given changes in taxes on crop and subsidies on inputs brought about by government and marketing boards.

Government and Marketing Board Taxation of
Crops and Subsidies on Inputs:
A "Second-Best" Problem

If labor produces the bulk of value added in farming activities in the Northern States and it is not being subsidized, in the presence of taxes on a crop produced by labor, if you want to minimize distortions in the amounts of labor employed, what is the compensating amount of subsidy on the other factor(s) to keep the quantity of labor employed constant? The theory of

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second-best says that given that you have a violation of some of your marginality conditions for an optimum, we cannot say apriori 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 in the net crop price received by farmers to keep the profit maximizing (equilibrium) quantity of labor employed on farms constant? In many important policy making circles in Nigeria, policy makers are wondering whether, given existing taxes on crops imposed by State Governments and their marketing boards, it might very well not be better to just compensate farmers by increasing the subsidies on inputs like fertilizers, chemicals, sprays, etc. 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.,

$$Y = A X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4}, \quad \sum_{i=1}^4 \beta_i < 1; \beta_i > 0, (i = 1, \dots, 4). \quad (8)$$

From the necessary conditions for equilibrium with respect to only the off-farm acquisition price and the MVP, the true demand functions for labor, fertilizer, chemicals,

and land holdi

$X_2, X_3,$ and X_4

$$\log X_1 = \frac{1}{4} \frac{1}{1 - \sum_{i=1}^4 \epsilon_i}$$

$$\log(\lambda_1 P_{X_1})$$

$$i, r = 1$$

From (2a) abo

$$d \log X_1 = \frac{1}{1 - \epsilon_1}$$

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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:

$$\log X_i = \frac{1}{1 - \sum_{i=1}^4 \beta_i} [\log A + \log (\mu_Y^P) + \sum_{r \neq i} \beta_r \log \beta_r + (\sum_{r \neq i} \beta_r - 1) \log (\lambda_i^P x_{ia}) - (\sum_{r \neq i} \beta_r - 1) \log \beta_i - \sum_{r \neq i} \beta_r \log (\lambda_r^P x_{ra})];$$

$$i, r = 1, \dots, 4. \quad (8a)$$

From (8a) above,

$$d \log X_1 = \frac{1}{1 - \beta_1 - \beta_2 - \beta_3 - \beta_4} [(\beta_2 + \beta_3 + \beta_4 - 1) d \log (\lambda_1^P x_{1a}) + d \log (\mu_Y^P) - \beta_2 d \log (\lambda_2^P x_{2a}) - \beta_3 d \log (\lambda_3^P x_{3a}) - \beta_4 d \log (\lambda_4^P x_{4a})]$$

$$(8b)$$

where we have set $dK = 0$, where

$$K = \frac{1}{1 - \beta_1 - \beta_2 - \beta_3 - \beta_4} [\beta_2 \log \beta_2 + \beta_3 \log \beta_3 + \beta_4 \log \beta_4 - (\beta_2 + \beta_3 + \beta_4 - 1) \log \beta_1], \text{ all constants, involving the given output elasticities of the four inputs.}$$

Now, set $d \log X_1 = 0$ and solve for $d \log (\lambda_2^P x_{2a})$

$$\frac{d \log (\lambda_2^P x_{2a})}{d \log (\mu_Y^P)},$$

$$\frac{d \log (\lambda_1^P x_{1a})}{d \log (\mu_Y^P)}$$

Setting $d \log X$

$$\frac{1}{\alpha_1 - \alpha_2 - \alpha_3 - \alpha_4} \quad (B)$$

$$d \log (\lambda_4^P x_4^a) =$$

$$d \log (\mu_Y^P Y) ;$$

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Setting $d \log X_1 = 0$,

$$\frac{1}{1-\beta_1-\beta_2-\beta_3-\beta_4} [\beta_2 d \log (\lambda_2^P x_{2a}) + \beta_3 d \log (\lambda_3^P x_{3a}) + \beta_4$$

$$d \log (\lambda_4^P x_{4a}) - (\beta_2 + \beta_3 + \beta_4 - 1) d \log (\lambda_1^P x_a)] = \frac{1}{1-\beta_1-\beta_2-\beta_3-\beta_4}$$

$$d \log (\mu_y^P y) ; \quad (8c)$$

then for given net acquisition prices of chemicals and land,
 $d \log X_1 = 0$ implies that²⁴

$$\frac{d \log (\lambda_2^P x_{2a})}{d \log (\mu_y^P y)} = \frac{1}{\beta_2} > 0$$

which says that as the net crop price received by farmers goes up by 1 per cent, the net acquisition price that they would have to pay for fertilizers to keep the quantity of labor constant goes up 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"

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percentage reduction in net acquisition price of fertilizers to compensate for a 1 per cent 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 1 per cent fall in the net producer price of, say, groundnuts would require a "compensating" fall in the net acquisition price of fertilizers of 20 per cent.

We do not have the output elasticity of fertilizers either at the farm level or at the States level. But we do have the output elasticity of land in Southern Zaria from Norman's study.²⁵ 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 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 1 per cent fall in the net producer price of cotton would "require" a "compensating" fall in the net acquisition price of land of 1.857 per cent; on cotton (gona land), it would require a compensating fall in net acquisition prices of land of 2.422 per cent; in groundnut production (gona land), a 1 per cent fall in the net

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producer price of groundnuts would "require" a "compensating" fall in net acquisition prices of land of 2.746 per cent. These required compensating investments in land by the government in the presence of taxation of cotton and groundnuts are particularly relevant for gona land which requires irrigation for all season cultivation (quoted estimates are for gona land).²⁶ 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

$$\frac{d \log (\lambda_2^P x_{2a})}{d \log (\mu_y^P)} = \frac{d \log \lambda_2}{d \log \mu_y} = \frac{1}{\beta_2}$$

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. Starting from equilibrium employment of labor, then for given changes in taxes on a crop and subsidies on land,

$$\Delta X_1 \begin{matrix} > \\ < \end{matrix} 0 \text{ according as } \frac{d \log \lambda_2}{d \log \mu_y} \begin{matrix} > \\ < \end{matrix} \frac{1}{\beta_2} ,$$

where ΔX_1 represents a "change" in X_1 .

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Considering a variant of the above, if labor gets the largest factor share in agriculture in the Northern States, then given taxes on, say, groundnuts, if "we" 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, from (8a), and assuming only X_1 and X_4 in the production function,

$$\log X_1 = \frac{1}{\beta_1 - 1} \log (\lambda_1^P x_1 a) + \frac{1}{1 - \beta_1} \log (\mu_Y^P Y) + \frac{\beta_4}{1 - \beta_1} \log X_4 + K$$

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

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

$$\frac{d \log (\lambda_1^P x_1 a)}{d \log (\mu_Y^P Y)} = \frac{\beta_1 - 1}{\beta_1 - 1} = 1,$$

which says that a 1 per cent fall in the net producer price of groundnuts or cotton requires a "compensating" 1 per cent fall in the net acquisition price of all labor employed if the quantity of labor employed is to

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$$\frac{d \log (\lambda_1 P_{x_1})}{d \log (w_Y P_Y)}$$

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remain constant. The corresponding "special elasticity"²⁷ in the case of the true demand curve for labor, assuming the price of land fixed is, with only X_1 and X_4 in the production function

$$\frac{d \log (\lambda_1 P_{x_1 a})}{d \log (\mu_y P_y)} = \frac{1}{1-\beta_4} > 0$$

which says that as the board reduces the net groundnut or cotton producer price by 1 per cent, the compensating fall in the net acquisition price of labor would be the inverse of one minus the output elasticity of land.

Table 3.4 shows some empirical results.

A parallel policy question is the amount of compensating subsidy on fertilizers used on Northern State farms for a given decrease in the net price of a marketing board crop if the amount of land employed in these crops is to remain the same. Policy makers are currently concerned about the diversion of land from groundnut production in the Northern States to other crops in the face of the relatively heavy taxes on groundnuts in recent years. There is an increasing competition between groundnuts and the other food crops in Kano State (the main producing state) with respect to the allocation of land. A major problem in cotton production in North Central State, North West State, and North East State is the competition between cotton and food crops for land.

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TABLE 3.4.--Compensating (Percentage) Subsidies on Labor for a One Per Cent Decrease in Net Price of a Marketing Board Crop so as to Keep the Quantity of Labor Employed on Northern State Farms Constant.

Enterprise	Compensating Percentage Subsidy on Labor ^a
	Per Cent
1. Cotton Production on <u>gona</u> land; $\beta_4 = 0.4128^b$	1.702
2. Groundnuts Production on <u>gona</u> land; $\beta_4 = .3641$	1.57
3. Guinea corn/Groundnuts Production on <u>gona</u> land; $\beta_4 = .6695$	3.025
4. Millet/Guinea Corn/Groundnuts Production on <u>gona</u> land; $\beta_4 = .6429$	2.800
5. Cotton/Cowpeas/Sweet Potatoes $\beta_4 = .5385$	2.166

Source: For output elasticities of land, D. W. Norman, An Economic Study of Three Villages in Zaria Province: Part II Input-Output Relationships (Zaria: Institute for Agricultural Research, Ahmadu Bello University, 1970), p. 126.

^aCompensating percentage subsidy on labor is defined as

$$\frac{d \log (\lambda_1 P_{x_1 a})}{d \log (\mu_y P_y)} = \frac{1}{1-\beta_4}$$

^b β_4 is the output elasticity of land.

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Given that there are taxes on cotton and groundnuts, what degrees of subsidies are required on these resources to keep their quantities employed in the production of marketing board crops constant? The question is important because of the allocative distortions introduced by taxation--these compensating subsidies are a way of coping with the adverse effects of these taxes with respect to resource use in Northern States farming.

The application of chemicals in groundnuts and cotton has great potential for high payoffs.²⁸ If the government wants to subsidize these chemicals (for seed dressing and spraying) to compensate for taxes on cotton and groundnuts so that the (equilibrium) quantity of land employed does not change, then, from (8a) the required percentage fall in the net acquisition price of chemicals for a 1 per cent fall in the net price of the marketing board crop is:

$$\frac{d \log (\lambda_3 P_{x_3 a})}{d \log (\mu_y P_y)} = \frac{1}{\beta_3} > 0,$$

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

Similarly if the government wants to subsidize these chemicals to compensate for taxes on cotton and groundnuts so that the (equilibrium) quantity of chemicals used in these crops does not change, then, from (8) and after setting $d \log X_3 = 0$, the required percentage fall

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in the net acquisition price of chemicals for a 1 per cent fall in the net price of the marketing board crop is:

$$\frac{d \log (\lambda_3^P x_3^a)}{d \log (\mu_Y^P)} = \frac{1}{1-\beta_1-\beta_2-\beta_4} > 0$$

which says that as the board reduces the net groundnut or cotton producer price by 1 per cent, the compensating fall in the net acquisition price of chemicals required to keep the (equilibrium) quantity of chemicals employed in these crops unchanged is the inverse of one minus the sum of the output elasticities of the other inputs in the production function. In the case of fertilizers, the corresponding required percentage fall in the net acquisition price of fertilizers for a 1 per cent fall in the net price of the marketing board crop is:

$$\frac{d \log (\lambda_2^P x_2^a)}{d \log (\mu_Y^P)} = \frac{1}{1-\beta_1-\beta_3-\beta_4} > 0 .$$

With the perfect competition assumption, the output elasticities of inputs become their factor shares and arguments about required compensating subsidies on inputs can be restated in terms of factor income shares.

From the last two results, it is evident that the less important a given resource is in production (as measured by its output elasticity) the more it has to be subsidized for a given percentage fall in the net producer

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price of the marketing board crop if the quantity of this resource employed is to remain constant.

Let us extend our results to include the case in which the initial quantity on hand is fixed where its MVP is between its off-farm acquisition cost and its salvage price. From our earlier analysis, small taxes in this case have no effect on total resource employment while large taxes lead to salvaging and disinvestment of the input. This implies that for small taxes, no compensating subsidies are required to keep quantities of inputs on hand at their initial levels. Large taxes lead to disinvestment in resources. What is required in this case is compensating policy action to prevent this disinvestment.

In Figure 3.5, EE , EE' , EE'' , P_{x_1a} , and P_{x_1s} all have their previous meanings. With initial quantity of X_1 on hand at K_1 (as arises, for example, from errors of organization) and taxes on the marketing board crop leading to the adjusted MVP curve EE' , there is no need for compensating subsidy on X_1 for its quantity to remain constant at K_1 because there is no incentive for its quantity to change even in the absence of subsidies. With larger taxes leading to EE'' , there is an incentive to salvage X_1 by the amount K_2K_1 . To prevent this, policy makers may "tax" the salvage value of X_1 : if it is off-farm salvage value, they may lower this to P'_{x_1s} ; if it is on-farm salvage value, they may "tax" this to bring it



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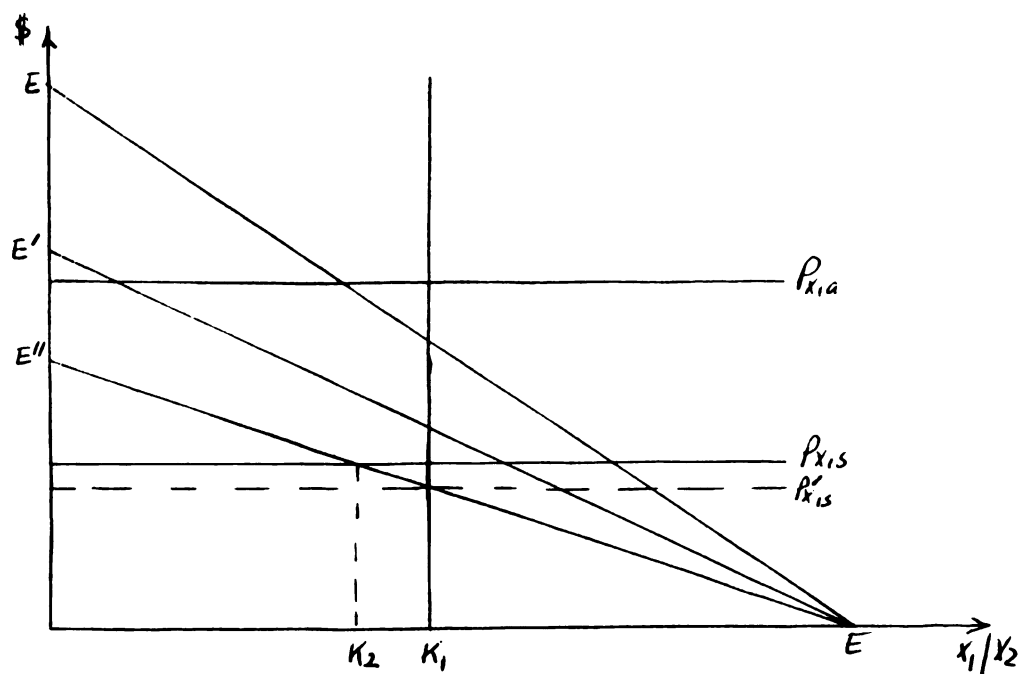


Figure 3.5

down to P'_{x_1s} . However, we do not know why policy makers would be interested in maintaining resources at production levels where market acquisition costs are not being covered!

Government and Marketing Board Taxation
of Crops Expressed as Taxes on
Resources Used in Farming

One possible alternative method of investigating the effect of government and marketing board taxation of crops and subsidy on inputs is to express all taxes as equivalent taxes on factors of production--labor (family and hired), land fertilizer, hoes, matchets as implied by

Johnson many years ago.²⁹ The owners of productive resources can regard them as items of wealth, the returns on which are the present value of net income streams earned by these resources. The present value of the gross income streams to a productive resource can be approximated by the present value of the (gross) expected marginal value product of the resource where the expected prices used are the potential producer (crop) price in the absence of all taxation of crops. From this must be netted out the present value of the per production period costs of using this productive resource (the user costs which refer to the costs incurred from the physical depreciation of the assets which is a function of the intensity of use of these resources, obsolescence costs, etc.). Then the capital value of a productive resource over the relevant horizon (which may be the economic length of life of the asset or the length of time the farmer plans to remain in business) can be represented as the discounted sum of the gross marginal value product minus the present value of per period costs of using the productive asset, i.e.,

$$K_0 = \mu_0 MVP_0 - T_0 + \sum_{t=1}^n \frac{\mu_t MVP_t^* - T_t^*}{\pi (1+r_j)} + \frac{S_n^*}{\pi (1+r_j)}$$

where K_0 is the capital value of the productive resource now, T_t^* is the cost of using the resource in period t ,

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μ_t is the proportion of expected MVP of the resource received by the farmer in period t (MVP*), r_j is the per period opportunity cost of funds tied up in this durable asset, S_n^* is the expected salvage value of the resource in time n and the price used in calculating the MVP is the potential producer price in the absence of all taxation. The impact of taxation of crops that is not offset by subsidies is to lower the capital value of resources. Farmers engaged in the production of marketing board crops suffer a loss in capital value of their initial resources.

This causes a redistribution of income: farmers of marketing board crops lose on the capital value of their resources; others who benefit from the use of this taxation in social investments (health, education, roads, etc.) gain. We have a non-Pareto better adjustment.

The Data

If we had adequate time series data on the use of any resource (fertilizers, chemicals, insecticides, land, labor, chemicals, etc.) we could estimate the elasticity parameters. Such time series data just do not exist for any reasonable stretch of time. Where some data exist for short periods as in the case of fertilizers it is not clear whether the figures reflect demand for these resources or they reflect the efficiency levels of the Extensions Department of the Ministry of Agriculture and Natural Resources.³⁰ The "frustrated demand" resulting

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the inefficiency of government officials does not appear in these figures. Even where the data on resource consumption are available, they are not likely to be broken down according to crop use. Table 3.5 shows fertilizer consumption in the Northern States, 1950-1967.

From the above model one would expect the demand for fertilizers on Northern States farms to be a function of the acquisition price of fertilizers and the net return (crop) prices received after all subsidies and taxes of the government and the marketing board have been worked out. From theory we expect demand for fertilizers to be a function of the real price of fertilizers. Even if we had data on the subsidized prices of fertilizers, a rational theory does not expect real fertilizer price to explain most of the demand for fertilizers.

The amount of information about the mean of the probability distribution of the incremental yield from the application of fertilizers plays a crucial role in the estimation of fertilizers. One can expect that in those regions of the Northern States with demonstration plots, extension, and other exposure to fertilizer use, the probability distribution of the incremental yield of fertilizers is "tighter." Differential access to different types of information³¹ will account for differences in fertilizer use across the Northern States. In other words, a rational analysis would incorporate elements of the

Year	Total Tons	Consumption		Producer Price		Price 1950=100	Fertilizers £N/Ton
		1953=100	1950=100	1950=100			
1950	750	107	100	100		100	n.a.
1951	2,300	330	307	170		150	n.a.
1952	1,375	197	183	170		150	n.a.
1953	698	100	93	165		148	n.a.
1954	614	88	82	167		150	n.a.
1955	703	101	94	167		150	n.a.
1956	1,310	188	175	153		139	n.a.
1957	732	105	88	176		150	n.a.
1958	1,258	180	168	160		150	n.a.
1959	1,013	145	135	172		153	n.a.
1960	920	132	123	176		150	n.a.
1961	1,920	275	256	159		135	14
1962	2,268	325	302	143		121	n.a.
1963	8,860	1,269	1,181	143		121	n.a.
1964	11,910	1,706	1,588	154		128	n.a.
1965	15,910	2,279	2,121	161		126	n.a.
1966	32,970	4,723	4,396	161		123	12
1967	47,500	6,805	6,333	137		115	16

Source: Fertilizer Consumption figures 1950-59 from Northern Nigeria Statistical Yearbook, 1966; 1960-67 C. K. Laurent, Problems Facing the Fertilizer Distribution Program in the Six Northern States, CSNRD 27. For cotton prices: 1950-63, Helleiner, op. cit., Table 11-B-6; 1964-67 from M. O. Titiloye and A. A. Ismail, A Survey of the Problems in the Domestic Arrangements for the Marketing of Groundnuts and Cotton (International Conference on the Marketing Board System, 1971), pp. 78-80. For groundnut prices: 1950-63, Helleiner, op. cit., Table 11-B-4; 1964-67, Report of the Study Group on Groundnuts (Lagos: Federal Department of Agriculture, 1971), p. 6. For scattered evidence on subsidized fertilizer prices: C. K. Laurent, op. cit.

Note: n.a. means "not available."

decision-making processes of farm managers and factors like the type of communal rights over land, the human elements of their interaction with extensions men, the amount of peak season labor available for application of fertilizer and weeding of incremental weed-growth and any analysis of the effects of government and marketing taxation and subsidies has to reckon with these factors. Table 3.6 shows the consumption of fertilizers in Kano State 1960/61-1969/70.

TABLE 3.6.--Fertilizer Consumption in Kano State, Nigeria, 1960/61-1969/70 (Tons).

Year	Superphosphate	Sulphate of Ammonia	Total
1960/61	200	n.a.	200
1961/62	430	14	444
1962/63	750	196	856
1963/64	1,200	55	1,255
1964/65	1,200	200	1,400
1965/66	2,240	362	2,602
1966/67	3,500	350	3,850
1967/68	n.a.	n.a.	n.a.
1968/69	8,500	3,015	11,515
1969/70	1,815	508	2,323

Source: Kano State Survey of Agriculture, 1971.

Note: n.a. means "not available."

We do not have any reliable data on the main resources used in farming in the Northern States either on a time-series basis or on a cross-sectional basis covering all the states.

Summary and Conclusions

The first part of the chapter provided a model for analyzing the allocative distortions induced by government and marketing board taxation, with respect to the relative quantities of crops produced and resources used. With differential taxation of cotton and groundnuts detrimental to groundnuts, the relative quantity of cotton was higher than would have been the case in the absence of all taxation wherever cotton and groundnuts were substitutes in production. Implicit in the model is the fact that food crops, relative to cotton and groundnuts, were produced in quantities larger than would have been the case in the absence of all taxation since food crops bore zero rates of taxation and cotton and groundnuts had positive rates of taxation most of the period examined, wherever food crops and these marketing boards crops were substitutes in production. This is all the more surprising given the current trend of rising food prices.³³ The fundamental indictment of government and marketing board taxation on this score is that it has affected the patterns of specialization in the country: farmers of marketing board crops have been induced to produce more food than would have been optimal in the absence of all taxation while other areas with a comparative advantage in food crop production alone have been neglected in government policies, e.g., the Middle Belt.

The basic model was then extended to take account of the possibility that it may not pay the farm-firm to vary the initial quantity of the resource on hand, i.e., there is neither investment nor disinvestment in this resource. The major analytical result was that investment-disinvestment responses to changes in taxes and subsidies were, in some cases, different from those predicted by the neoclassical model. This was specially the case with resources that were initially (economically) fixed in the absence of taxes and subsidies. The model was able to predict, in response to taxes on marketing board crops, not only acquisitions of resources below what they would have been in the absence of taxes but also to predict the salvaging of some of the initial quantity on hand until, in equilibrium, salvage value equals the MVP of the resource.

The empirical evidence shows that land (acreage) in cotton and groundnut farms in the Northern States are, through the induced response to real input price changes, smaller than would have been the case in the absence of taxes on these crops. This expected reduced acreage arises on two counts. First, taxes on cotton and groundnuts reduce land clearings or acquisitions below what they would have been in the absence of taxes. This is significant at a time when policy makers in the North-Eastern State, North-West State, and North Central State are

concerned about the fact that farmers are not planting suitable available land to these crops. Many production expansion programs over the next decade for most of the Northern States rely on expanded new acreage as well as improvement of existing acres. The finding that these taxes can be expected to adversely affect expanded acreage in these crops has implications for these production expansion programs. Second, these taxes lead to salvaging and disinvestment of the initial quantities on hand. The initial acreage is allocated to competing crops on the basis of opportunity-cost on the farm. It is not surprising that many farmers in the Northern States are known to have diverted acreages away from groundnuts to food production. Where cotton and groundnuts compete for land, this allocation must have been influenced largely by the differential taxation of cotton and groundnuts.

These taxes have had the same effect on labor. First, taxes on cotton and groundnuts have induced farmers to acquire less labor than they would have acquired in the absence of taxes. This reduces the rate of entry of new farmers into the production of these crops and it decreases the purchases of hired labor below what they would have been in the absence of these taxes. Peak season labor is a major constraint in the production of these crops. Taxes reduce purchases of hired labor during these peak seasons below what they would have been in the absence of taxes

on these crops. Second, taxes have increased the rate of exit of labor from the farm sector: as taxes become large, not only are labor purchases below what they would have been without taxes but some of the labor on hand in the farm-firm as well as in the farm sector as a whole is salvaged. Labor will continue to be salvaged until, in equilibrium, the salvage value of the labor of a given age and skill equals its marginal value product in cotton or groundnuts. For the older farmers, their relevant salvage values might be the present values of their expected marginal value product in food production. Alternatively, their salvage values might be the present values of their expected marginal value products in off-farm rural activities. For the younger farmers and school leavers, the relevant salvage value may be the present value of the expected marginal value product in the urban areas. When wages in urban areas rise from minimum wage legislation in the presence of taxes on marketing board crops, there is accelerated salvaging of young farmers and school leavers from the rural areas until in equilibrium, their salvage values equal their MVP's in cotton and groundnuts.

Our framework is potentially powerful for modeling the (tremendous) off-farm migration experienced in recent years. Unlike most existing models, this model's explicit focus is on the economic activities of people in rural areas as these are affected by national policies. Too

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often, the focus has been on the urban centers. A framework that is capable of explaining the impact of national policies on labor absorption in rural areas is potentially useful.

For those resources that were economically fixed initially, the model predicts that there would be salvaging of some of the initial quantity on hand as taxes increase. Not only are the stocks of these resources employed on these farms less than they would have been, but they are also being worked less intensively than would have been the case in the absence of all taxation.

Some resources may be fixed when off-farm acquisition and salvage values are considered. But from our apriori knowledge of the ease with which resources are shifted between crops in the cotton-groundnuts-foods economy of the Northern States, we infer that farmers must be allocating these fixed resources on an on-farm opportunity cost basis. These allocative responses are known to be sensitive to changes in taxes on marketing board crops. This further strengthens our empirical results on the allocative effects of these taxes on relative outputs of cotton, groundnuts, and foods and on resource use.

Given the fact that these resources still produce the bulk of value added in Northern States farming, these taxation policies by implication have inhibited the generation of private saving, investment and the formation and use of farm-produced capital.

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The third section of the chapter is more of the nature of a planning tool: even though fertilizers, chemicals and new inputs are insignificant in Northern States farming today, if policy makers are conscious of the institutional reality of marketing boards but are concerned about the allocative distortions of these taxes with respect to resource use, then what are the compensating subsidies on these resources so that their quantities and their intensity of use remain unchanged? These compensating subsidies are shown, within the Cobb-Douglas production function framework, to be related to the output elasticities of these resources. Calculations are then made using available estimated output elasticities of land and labor. This "second-best" approach has potential for planning purposes--budget allocations to input subsidies can rationally be related to expected tax rates on marketing board crops.

Dr. J. C. W. de Vries

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FOOTNOTES

¹Insofar as marketing costs of government and quasi-government agencies are unlikely to be lower than competitive marketing costs that would have obtained in the absence of these government agencies, then the marketing board surplus is the lower bound of the marketing board component of the taxes on farmers. This point has been almost entirely neglected in discussions of marketing board policies.

²One way of looking at this is to express specific taxes as their ad valorem tax equivalents yielding the same revenue. Their effects on outputs and prices are the same under competition (see R. Musgrave, The Theory of Public Finance (New York: McGraw Hill, 1959; C. Bishop, "The Effects of Specific and Ad Valorem Taxes," Quarterly Journal of Economics (1968)).

³This formulation does not preclude positive initial quantities of resources on hand, resources which can then be presumed to have salvage values different from acquisition values. It admits of positive initial quantities on hand up to the point where the acquisition price of the resource equals its MVP. For cases in which the MVP of the resource is between acquisition price and salvage value and when it is below salvage value for the initial quantities on hand, see p. 48.

⁴Some common combinations in Zaria Province have been documented by Norman: millet/guineacorn; guineacorn/groundnuts, guineacorn/cowpeas; groundnuts/cowpeas: okra/pepper; cotton/cowpeas; cotton/cowpeas. See D. W. Norman, op. cit.

⁵Behrman did the pioneering work in this area for Thailand. See J. Behrman, Supply Response in Underdeveloped Agriculture (Amsterdam: North-Holland Publishing Company, 1968).

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⁶Alternatively, farmers may employ "certainty equivalence" prices.

⁷We want to emphasize the assumption of initial equilibrium, i.e., that for constant relative prices, it does not pay to reorganize the farm. This point was not given adequate emphasis in Clark Edwards' original good treatment. See Clark Edwards, "Resource Fixity and Farm Organization," Journal of Farm Economics (November, 1959).

⁸This may arise from errors of organization, imperfect knowledge and foresight, etc.

⁹In this case, a resource that was initially fixed at K_1 becomes variable as a result of subsidies.

¹⁰In this sense, the neoclassical theory overestimates the induced reduction in resource use in response to taxes on crops.

¹¹In the case of allocating a given quantity of the resource among competing crops, this acquisition price equals, in equilibrium, the MVP of the resource in all uses (i.e., the on-farm opportunity cost of the resource). The two crops (e.g., cotton and groundnuts), one fixed input (e.g., land) case is only a special case of the model given on p. 36. The acquisition cost of an acre of land to be used in cotton is the foregone marginal value product of land in groundnuts and conversely for the acquisition of land from cotton production for use in groundnut production.

¹²Both land and labor are nonhomogeneous. References to resources are to resources of a given quality.

¹³Norman has both a lower and an upper bound for the annual cost of services 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 gaudana land (lowland field) the lower bound is 47 shillings and the upper bound is 370 shillings. In all likelihood (in the absence of government irrigation and reclamation projects, etc.), the farmer bears the full cost of this land. See D. W. Norman, An Economic Study of Three Villages in Zaria Province, Part II, Input-Output Relationships, p. 125. Bearing the full real costs of land is the common practice in the Northern States. He found the cost of non-family labor to be 0.51 shillings/man hour which he also uses to approximate the opportunity cost of family labor. This is a simplification but it is convenient.

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¹⁴P. Samuelson, Foundations of Economic Analysis (New York: Atheneum, 1965).

¹⁵Glenn L. Johnson, "The State of Agricultural Supply Analysis," Journal of Farm Economics (1960).

¹⁶Heady, in an analysis of the effect of leasing arrangements on farm size, derives demand curves for inputs that are based on MVP curves. This introduces bias in the estimation of effects. Such an analysis should be able to predict the effects of changes in leasing arrangements on farm size--but such estimates would be biased if we use MVP curves as input demand curves. Ulveling, in a comment on the Heady article, fails to bring out the basic problem--the question of what is being held constant in the derivation of input demand curves. He does not, for example, make clear whether his equations at the bottom of p. 142 are to be solved simultaneously to get the true demand function or whether each marginality condition (equilibrium) is to be solved to get the (special) input demand function. Much of our own analysis of the nature of the bias should be seen as a critique of Heady and Ulveling. See E. Heady, "Optimal Farm Size," American Journal of Agricultural Economics (February, 1971); E. Ulveling, "Comment," American Journal of Agricultural Economics (February, 1972).

¹⁷For other sources of bias, see p. 68.

¹⁸This implicitly assumes input use is a function of its acquisition price and crop price.

¹⁹What is "true" in some sense depends on your assumptions. We use "true" here in the sense that it is more general--the demand curve that allows other input quantities to vary is more general than one which does not. "More general" could be used in place of "true"; use of the latter here is the author's preference.

²⁰There is consequently a tendency to underestimate the reduction in resource use that results from an increase in taxes on marketing board crops using the MVP curve as the demand curve for the resource.

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$$\eta'_{x_1, (\mu_Y^P Y)} - \eta_{x_1, (\mu_Y^P Y)} = \frac{1}{1-\beta_1} - \frac{1}{1-\beta_1-\beta_2} = \frac{-\beta_2}{(1-\beta_1)(1-\beta_1-\beta_2)}$$

²²See T. W. Schultz, Transforming Traditional Agriculture (Yale University Press, 1964). Schultz's hypothesis is general enough to include the case in which, with fixed resources to be allocated among competing crops, the relevant acquisition price is the on-farm opportunity cost.

²³Letting X_1 and X_2 denote labor and land respectively in a Cobb-Douglas framework, Norman finds these results:

Millet/guinea corn (gona land): $\beta_1 = 0.5925$, $\beta_2 = 0.3189$, $\beta_1 + \beta_2 = 0.9104$, $MVP_{x_1} = 0.58$, $P_{x_1 a} = 0.51 \Rightarrow \frac{MVP_{x_1}}{P_{x_1 a}} = 1.14$; $MVP_{x_2} = 66.11$,

$P_{x_2 a} = 100 \Rightarrow \frac{MVP_{x_2}}{P_{x_2 a}} = .66$ Fadama land (all crops): $\beta_1 = 0.2746$,

$\beta_2 = 0.8543$, $\beta_1 + \beta_2 = 1.1289$, $MVP_{x_1} = 0.46$, $P_{x_1 a} = 0.51 \Rightarrow \frac{MVP_{x_1}}{P_{x_1 a}} =$

0.90 ; $MVP_{x_2} = 641.85$, $P_{x_2 a} = 370 = \frac{MVP_{x_2}}{P_{x_2 a}} = 1.73$; Cotton/cowpeas/

sweet potatoes (gona land): $\beta_1 = 1.0556$; $\beta_2 = 0.5385$; $\beta_1 + \beta_2 =$

1.5941 ; $MVP_{x_1} = 0.62$; $P_{x_1 a} = 0.51$; $\frac{MVP_{x_1}}{P_{x_1 a}} = 1.22$

Source: For output elasticities, see D. W. Norman, op. cit.

²⁴The same result holds if it is the quantity of land that policy makers want to keep constant.

²⁵D. W. Norman, op. cit.

²⁶Note: 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.

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²⁷This "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.

²⁸Johnson states, " . . . Nigeria is unlike many countries of the world in that it is not private land owners who exploit the Nigerian farmer; instead, if the Nigerian farmer is exploited by those who control income from land, it must be the government which would be doing so via marketing board levies on the economic rent of land." See Glenn L. Johnson, "Factor Markets and the Problem of Economic Development," in W. W. McPherson, ed., Economic Development of Tropical Agriculture (University of Florida Press, 1968). It should be pointed out that Johnson's point is valid for all resources engaged in the production of marketing board crops receiving no net subsidies.

²⁹"Fertilizers and insecticides are now purchased in bulk by State Ministries of Natural Resources and distributed to farmers through the extension services and local agents, but in some cases adequate supplies are not available when the farmers need them." Report of the Study Group on Cotton and Other Fibres (Lagos: Federal Department of Agriculture, 1971), p. 28.

" . . . Nigeria's agricultural output is being severely limited by the non-availability of inputs. No where is the effect of this greater or more forcefully indicated than in the groundnut area . . . demand . . . is so strong that it finally changes hands at full cost, or higher, even though it is intended to sell for half the actual cost." Report of the Study Group on Groundnuts (Lagos: Federal Department of Agriculture, 1971), p. 38.

³⁰Glenn L. Johnson, Managerial Processes of Mid-
n Farmers (Iowa State University Press, 1961).

³¹Some of this is due to the poor transport
tructure coupled with poor storage facilities.

CHAPTER IV

SALES OF CROPS TO THE MARKETING BOARD

AND GOVERNMENT AND MARKETING BOARD

REVENUE FROM TAXES ON CROPS

Introduction

The second objective of this study is to examine the quantitative impact on tax revenue from cotton and groundnuts of paying farmers (generally) higher prices. This will enable us to see to what extent, if any, the resulting (crop tax) revenue loss can be offset by the positive effect (if any) of higher prices on sales of these crops on the marketing board.

The chapter is divided into two main sections. The first section examines the determinants of revenue from taxation of crops, or the relationship between taxes on marketing board crops and the resulting revenue; the second part argues that fundamental to the revenue potential of any crop is the underlying investment-disinvestment process.

It will be assumed in this chapter that competitive conditions exist in the cotton and groundnut



sectors, that farmers in the aggregate, in any marketing period selling a crop to the board, face an infinitely elastic demand curve at the producer price fixed by the board.

The Determinants of Government
Revenue From Taxation
of Crops

The immediate determinants of government and marketing board revenue from taxation of a given crop are the quantities offered for sale to the board and the tax rates imposed per unit of the crop or on an ad valorem basis.

The quantity of any crop offered for sale to the board depends in some way on the total output of the crop produced, the amount of the crop consumed by the farmers themselves, the amount sold to the non-farm consuming public or more generally the amount sold on the Nigerian domestic market through private market channels and the amounts sold to neighboring countries (e.g., Niger, Cameroon, Dahomey) through smugglers.

The quantity of a marketing board crop that is produced would depend on the net producer price of this crop relative to the prices of closely competitive crops; the relative availability of new and superior inputs in the various crops and the amounts of both normative and non-normative information concerning the expected values and variances of the probability distributions of yields,

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prices, costs, technological parameters, human behavior, etc. In the presence of risk aversion, one would expect the elasticity of output of a given marketing board crop with respect to the relative standard deviation of its price to be negative.

The consumption of a marketing board crop by its producers (total or per capita basis) themselves would depend on the relative price of the crop and the real income of the producers.

The amount of groundnuts sold on the Nigerian domestic market depend on net producer prices for groundnuts and/or groundnut products like locally made groundnut oil relative to the net producer prices being paid by the board and the ease with which the crop can be transported to local markets in the country from surplus areas. The domestic market has exercised a strong pull on marketing board crops in recent years,¹ an influence particularly strengthened by some shortages created during the recent civil disturbances. It has paid producers and middlemen engaged in groundnuts and palm oil production and marketing to divert large quantities of these crops away from the marketing boards into the Nigerian domestic (internal) market. If, for example, the consumption demand for groundnuts is a function of income and population (for simplicity, assume own-price constant), then the percentage increase in its consumption over a year would depend on

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the income and population demand elasticities for groundnuts and the annual percentage changes in income of consumers and population. Assuming that the income elasticity of demand for groundnuts is zero and that the population demand elasticity for groundnuts is unity, the percentage increase in demand for groundnuts in the given year will equal the annual percentage increase in population.²

The strong influence of net producer prices in neighboring countries relative to the net producer price offered by the Nigerian Marketing Boards has become evident in recent years.³ In spite of institutional obstacles and poor transportation facilities, market forces can be expected to bring about movements in the relative quantities of a crop offered for sale in the respective markets (the Nigerian domestic market, the market for smugglers and the marketing boards) in response to net producer price differentials. The smuggling of marketing board crops is subject to some risk (the legal status of this economic activity is still ambiguous in places). A marketing board crop will tend to be smuggled across the border so long as the expected net producer price exceeds the marketing board net producer price received by farmers, producers and middlemen, where the factors used to weight the net producer prices ruling in neighboring countries are the probability of not getting caught in the process of

smuggling and the probability of not getting a conviction once caught.⁴ It is not clear whether policy makers should drive these probabilities to zero or one.

In the short run, therefore, we expect sales to the boards of any crop to be influenced by the net producer price paid by the board, the net producer price of the crop or its allied product in the Nigerian internal market, the incomes of consumers of the crop, the stock of the crop available in any given marketing period and the relative net producer price for the crop in neighboring countries--or more strictly the expected net producer prices in neighboring countries.

In the long run, sales to the boards are also affected by substitutions in production in movements along given transformation curves as a result of differential rates of taxation on crops or more generally on economic activities and shifts to new transformation curves due to research etc. Farm managers will in this case not only be affected by relative expected crop prices but also relative standard deviations of prices and yields.

Determinants of the level of taxes to impose will include projected revenue needs of the marketing board for its activities (of which stabilization is only one), State Government revenue for development plans, and even political considerations (the level of taxes on cocoa was a political issue in the Western State in the 1950's and the early 1960's).

Intuitively, it would appear that the response of tax revenue from a given crop to changes in the board's producer price for this crop is somehow related to the response of sales (to the board) of this crop to changes in the board's producer price. In the case of two crops, given the same percentage change in their producer prices, it would appear that tax revenue response to this price change will be "larger" with the crop that has the "larger" response in sales (to the board) to price changes. What then is the link between the response of tax revenue from a crop to changes in the board's price (or inversely to changes in the level of taxes per ton on this crop) and the response of sales of this crop (to the board) to changes in the board's producer price?

Sales to the Marketing Board and
Government and Marketing Board
Revenue From the Taxation
of Crops

Define revenue proceeds by the State Government and its marketing board from taxes on a given crop as:

$$R_j = t_j M_j \quad (1)$$

where R_j is total revenue from all taxation on a marketing board crop, t_j is the composite unit tax and M_j is the quantity of the j^{th} crop sold to the board. Total taxation is composed of marketing board so-called trading surplus, produce sales tax and export tax. In such a regime of

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unit taxes the elasticity of government and marketing board revenue from taxes on a crop with respect to the net producer price paid to the farmer is the sum of the unit tax elasticity with respect to the net producer price⁵ and the elasticity of the quantity of the crop sold to the marketing board with respect to the net producer price.

If policy makers implicitly assume that prices paid to farmers exert no influence on sales of crops to the marketing board, then the revenue elasticity with respect to the net producer price equals the unit tax elasticity with respect to net producer price. Since the latter can be presumed negative as long as taxes are positive, policy makers and some academicians implicitly assume that the elasticity of government and marketing board revenue from taxes on a given crop with respect to the net producer price paid to farmers by the board is always negative (i.e., that raising net producer prices paid to farmers will always reduce government and marketing board revenues from taxes on the crop). If the elasticity of sales of a given crop to the marketing board with respect to its net producer price is negative (i.e., sales fall as farmers are offered higher prices), then the revenue elasticity with respect to net producer price is always negative which implies that government and marketing board revenues will always fall if taxes on crops are lowered or net producer prices are raised; if the elasticity

of sales to the marketing board with respect to net producer price is positive and is greater than the absolute value of the unit tax elasticity with respect to net producer price, then the revenue elasticity with respect to net producer price is positive, meaning that government and marketing board revenues from taxes on a crop will rise when farmers are paid higher net producer prices.

This possibility is potentially very significant: revenue for State Governments has become a constraining force⁶ in State development plans; this ability to raise State revenues from internal sources affects the overall economic and social development of the country. Higher producer prices paid to farmers benefit them on many counts: higher cash money incomes enhance the farmers' ability to invest in new and superior forms of capital (human and non-human), an investment ability that is essential to the transformation of traditional agriculture; or to create a potential market for the goods of the young but rapidly expanding industrial sector, though the importance of this depends on the percentage change in farmers' income and the income elasticity of demand for these products. Higher producer prices would slow down the artificially induced exit of resources from the farm sector as in the case of labor whose expected marginal value products on the farms are drastically lowered by heavy taxation of marketing board crops.

Tables 4.1 and 4.3 show the unit tax elasticities⁷ for cotton and groundnuts. The higher the taxes on crops the larger is the (absolute value of) elasticity. These tables form the basis for the revenue elasticity tables.

It is to be expected that if taxes on a crop are very heavy and sales of this crop to the board are price responsive, sales will fall and government revenues will also fall. If sales are indeed very price responsive, it is possible that increases in producer prices paid to farmers will induce large increments in sales and possibly lead to a rise in (crop) tax revenue. This indeed seems to be the case for the levels of taxes imposed on cotton and groundnuts for the period 1950-66, as shown in Tables 4.2 and 4.4. It has been shown (footnote 4) that the elasticity of government and marketing board revenue (from taxes on a crop) with respect to the crop net producer price paid by the board to farmers is the sum of the unit tax price elasticity ($E_{t_j p_n}$) and the elasticity of sales of the crop with respect to the net producer price of the crop paid by the board ($E_{M_j p_n}$). Under the assumptions (stated on page 100) above, the unit tax price elasticities are presented in Tables 4.1 and 4.3 for cotton and groundnuts. To get the elasticity of government and marketing board revenue (from taxes on a crop), i.e., $E_{R_j p_n}$, we assume different values for the elasticity of sales of the crop with respect to the net producer price

TABLE 4.1.--Unit Tax Elasticities for Cotton Using Producer Prices, Taxes and Potential Producer Price, Nigeria, 1950-1966.

Year	Cotton Prices	Taxes	Potential Producer Price	Unit Tax Elasticities
	P_n	t_j	P_p	
₦N/Ton				
1950	36.37	36.04	72.77	-1.01
1951	55.07	58.04	113.11	-0.95
1952	55.07	29.50	84.57	-1.87
1953	54.81	43.30	98.11	-1.27
1954	55.10	24.30	79.40	-2.27
1955	54.68	27.00	81.68	-2.03
1956	55.13	17.10	72.23	-3.22
1957	54.88	14.10	68.98	-3.89
1958	54.91	-0.04	54.87	1372.75
1959	55.07	-2.60	54.47	21.18
1960	55.07	-2.00	53.07	27.53
1961	46.67	.004	46.674	-1166.75
1962	45.27	4.70	49.97	-9.63
1963	45.27	6.90	52.17	-6.56
1964	46.67	11.20	57.87	-4.17
1965	46.67	7.60	54.27	-6.14
1966	44.80	-1.30	53.50	-34.46

Source: Producer Prices, 1950-1959, Extended and amended Kriesel Series: H. Kriesel, Cotton Marketing in Nigeria, CSNRD-24, p. 73. The price series 1960-1966 are our own constructed series resulting from our dissatisfaction with existing series. Helleiner's Table 11-B-6 (pp. 474-475) used only Grade 1 prices for all the years when a weighted price index of prices is clearly better. However, constructing a weighted price index faces many problems. For weights for the price series 1960-1967, see H. Kriesel, Cotton Marketing in Nigeria, CSNRD-24, p. 55; for net prices after deduction of produce sales tax for different grades of cotton for 1960-67, 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, International Conference on the Marketing Board System, NISER, Ibadan, 1971, pp. 78-80. Prices for different grades of cotton 1968-71 from Report of the Study Group on Cotton and Other Fabrics, National Agricultural Development Committee, Federal Department of Agriculture, Lagos, 1971, p. 7; weights for prices of different grades 1968-70 from mean weights in above Report of . . . , p. 60 while weights for 1971-72 were assumed to be those of 1970-71.

Note: The unit tax elasticity is defined as the percentage change in taxes per unit of a marketing board crop per unit percentage change in the net producer price of the crop paid by the marketing board (exact formula derived in footnote 4--the negative of the net producer price divided by the composite tax per unit of the crop). Thus, the unit tax elasticity is negative as long as taxes are positive (no subsidies). The higher the net producer prices (P_n) relative to these taxes (t) the larger the (absolute) value of this elasticity.

TABLE 4.2.--Cotton: Tax Revenue Elasticities With Respect to the Board's Producer Price of Cotton for Different Assumed Price Elasticities of Sales to the Board, Northern States, Nigeria, 1950-1966.

Year	Cotton Prices	Taxes	Tax Revenue Elasticities for Different						
	P_n	t_j	$E_{t_j P_n}$	$E_{M_j P_n}$	$E_{M_j P_n}$	$E_{M_j P_n}$	$E_{M_j P_n}$	$E_{M_j P_n}$	$E_{M_j P_n}$
				$= -1$	$= 0$	$= 1$	$= 2$	$= 3$	$= 5$
				bn/Ton					
1950	36.37	36.64	-1.01	-2.01	-1.01	-0.01	.99	1.99	3.99
1951	55.07	58.04	-0.95	-1.95	-0.95	.05	1.05	2.05	4.05
1952	55.07	29.50	-1.87	-2.87	-1.87	-0.87	.13	1.13	3.13
1953	54.81	43.30	-1.27	-2.27	-1.27	-0.27	.73	1.73	3.73
1954	55.10	24.30	-2.27	-3.27	-2.27	-1.27	-0.27	.73	2.73
1955	54.68	27.00	-2.03	-3.03	-2.03	-1.03	-0.03	.97	2.97
1956	55.13	17.10	-3.22	-4.22	-3.22	-2.22	-1.22	-0.22	1.78
1957	54.88	14.10	-3.89	-4.89	-3.89	-2.89	-1.89	-0.89	1.11
1958	54.91	-0.04	1372.75	1371.75	1372.75	1373.75	1374.75	1375.75	1377.75
1959	55.07	-2.60	21.18	20.18	21.18	22.18	23.18	24.18	26.18
1960	55.07	-2.00	27.53	26.53	27.53	28.53	29.53	30.53	32.53
1961	46.67	0.004	-1166.75	-1167.75	-1166.75	-1165.75	-1164.75	-1163.75	-1161.75
1962	45.27	4.70	-9.63	-10.63	-9.63	-8.63	-7.63	-6.63	-4.63
1963	45.27	6.90	-6.56	-7.56	-6.56	-5.56	-4.56	-3.56	-1.56
1964	46.67	11.20	-4.17	-5.17	-4.17	-3.17	-2.17	-1.17	0.83
1965	46.67	7.60	-6.14	-7.17	-6.14	-5.14	-4.14	-3.14	-1.14
1966	44.80	-1.30	-34.46	-35.46	-34.46	-33.46	-32.46	-31.46	-29.46

Source: Cotton Prices, taxes same as in Table 4.1.

Note: E_{t,P_n} from Table 4.1. The Elasticity of Northern States Government and Marketing Board Revenues from taxes on cotton with respect to the board's net producer price for cotton, $E_{M_j P_n}$, is defined as the percentage change in this tax revenue for a one percentage change in the board's net producer price for cotton. For a given tax level, the possibility of raising producer prices increases with the elasticity of sales of cotton to the board with respect to the board's net producer price.

TABLE 4.3.--Unit Tax Elasticities for Groundnuts Using Producer Prices, Taxes and Potential Producer Price, Nigeria, 1952-1964.

Year	Producer Prices	Composite Taxes	Potential Producer Price	Unit Tax Elasticities
	P_n	t_j	P_p	
	₦N/Ton			
1952	35.0	20.1	55.1	-1.741
1953	35.5	16.3	51.8	-2.177
1954	35.4	5.9	41.3	-6.000
1955	32.4	8.6	41.0	-3.767
1956	37.4	15.8	53.2	-2.367
1957	33.9	-1.7	32.2	19.941
1958	36.4	2.8	39.2	-13.000
1959	37.4	8.2	45.6	-4.560
1960	33.7	4.8	38.5	-7.020
1961	30.3	4.4	34.7	-6.886
1962	30.3	6.2	36.5	-4.887
1963	32.7	8.9	41.6	-3.674
1964	34.1	9.3	43.4	-3.666

Source: Producer Prices 1950-63, Helleiner, op. cit., Table 11-B-4; 1964-65, Report of the Study Group on Groundnuts, Federal Department of Agriculture, Lagos, 1971, p. 6. Tax figures from H. C. Kriesel, Marketing of Groundnuts in Nigeria, CSNRD-19, Michigan State University, East Lansing, 1968, Table 14, p. 68.

Note: The unit tax elasticity is defined as the percentage change in taxes per unit of a marketing board crop per unit percentage change in the net producer price of the crop paid by the marketing board (exact formula derived in footnote 4--the negative of the net producer price divided by the composite tax per unit of the crop). Thus, the unit tax elasticity is negative as long as taxes are positive (no subsidies). The higher the net producer prices (P_n) relative to these taxes (t) the larger the (absolute) value of this elasticity.

TABLE 4.4.--Groundnuts: Tax Revenue Elasticities With Respect to the Marketing Board's Producer Price for Different Assumed Price Elasticities of Sales to the Board, Northern States, Nigeria, 1952-1964.

Year	Groundnut Prices P_n	Taxes t_j	E_{t,P_n}	Tax Revenue Elasticities for Different				
				E_{M,P_n}	E_{M,P_n}	E_{M,P_n}	E_{M,P_n}	E_{M,P_n}
				= -1	= 0	= 1	= 2	= 4
				£N/Ton				
1952	35.0	20.1	-1.741	-2.741	-1.741	-0.741	0.259	4.259
1953	35.5	16.3	-2.177	-3.177	-2.177	-1.177	-0.177	1.823
1954	35.4	5.9	-6.000	-7.000	-6.000	-5.000	-4.000	-2.000
1955	32.4	8.6	-3.767	-4.767	-3.767	-2.767	-1.767	0.233
1956	37.4	15.8	-2.367	-3.367	-2.367	-1.367	-0.367	3.633
1957	33.9	-1.7	19.941	18.941	19.941	20.941	21.941	25.941
1958	36.4	2.8	-13.000	-14.000	-13.000	-12.000	-11.000	-9.000
1959	37.4	8.2	-4.560	-5.560	-4.560	-3.560	-2.560	-1.440
1960	33.7	4.8	-7.020	-8.020	-7.020	-6.020	-5.020	-3.020
1961	30.3	4.4	-6.886	-7.886	-6.886	-5.886	-4.886	-2.886
1962	30.3	6.2	-4.887	-5.887	-4.887	-3.887	-2.887	-1.113
1963	32.7	8.9	-3.674	-4.674	-3.674	-2.674	-1.674	0.326
1964	34.1	9.3	-3.666	-4.666	-3.666	-2.666	-1.666	0.334

Source: Produce Prices Data 1950-1963: Helleiner, op. cit., Table 11-B-4, 1964-1965; Report of the Study Group on Groundnuts, National Agricultural Development Committee, Federal Department of Agriculture, Lagos, 1971, p. 6.

Note: For E_{t,P_n} , see Table 4.3. The elasticity of Northern States Government and Marketing Board Revenues from taxes on groundnuts with respect to the board's net producer price for groundnuts is defined as the percentage change in this revenue for a one percentage change in the board's net producer price for groundnuts. For a given tax level, the possibility of raising this revenue by raising producer price increases with the elasticity of sales of groundnuts to the board with respect to the board's net producer price.

Notice how for given level of taxes on groundnuts, the possibility of increasing government and marketing board revenue by paying farmers higher prices increases with the sales price elasticity of groundnuts, e.g., with composite taxes on groundnuts of £N 20.1/ton in 1952, $E_{M,P_n} = -0.741$ for $E_{M,P_n} = 1$ and $E_{M,P_n} = 0.259$ for $E_{M,P_n} = 2$.

of the crop paid by the board ($E_{M_j P_n}$). The assumed values for $E_{M_j P_n}$ are -1,0,1,2,3,4,5,6. From the calculated $E_{t_j P_n}$ and the assumed values for $E_{M_j P_n}$, $E_{R_j P_n}$ is calculated for 1950-66. From Tables 4.2 and 4.4, the possibility of increasing tax revenue from a crop for given levels of taxes increases with the elasticity of sales of the crop to the board with respect to the net producer price paid by the board. This possibility increases with the level of taxes, i.e., for given sales elasticity of the crop with respect to its net producer price, the elasticity of tax revenue from a crop with respect to the net producer price it pays to farmers increases in numerical value with the level of taxes.⁸ From Table 4.2, in 1952, composite tax on cotton was £N 29.50 per ton and with a sales price elasticity of cotton = 2, $E_{R_j P_n} = 0.13$; in 1953, the composite tax was £N 43.30/ton and with the same sales price elasticity, $E_{R_j P_n} = 0.73$. Allowing only the unit tax elasticity to vary and setting $E_{M_j P_n} = 1$, the corresponding figures are: for 1952, $E_{R_j P_n} = -0.87$; for 1953 $E_{R_j P_n} = -0.27$. Thus as taxes on marketing board crops rise, the responsiveness of (crop) tax revenue to changes in net producer price also rises and conversely for a fall.

Resource Fixity, Supply Response
and Government Revenue

If relative crop price changes in a given crop enterprise are such that the expected MVP's of resources

are bounded by the salvage values and acquisition values of these resources so that there is no motivation for investment or disinvestment in these resources, the crop supply (output) response to crop price changes will be small. Building on the recognition that a durable resource has two prices, the Johnsonian theory leads us to expect, in principle, a difference between expansion and contraction supply price elasticities corresponding, respectively, to the rising and falling phases of crop prices.⁹

Even though sales to the marketing board are of primary interest for (crop) tax revenue purposes, insofar as we can presume positive correlation between total output and sales to the board, we would still be interested in the underlying production relations as such.

Starting from a production function, we can write the output (supply) price elasticity of a crop as the weighted sum of elasticities of demand for the productive resources with respect to the crop price where the weights are the output elasticities of these resources. From this, the more resources whose demands (and supplies of used quantities on hand) are not affected by crop price changes, then the less likely it is that the supply of the crop will be affected by crop price changes. In addition, for this to be strictly true, it must also not pay to change resource service flows per unit of stock or

per unit of stock per unit of time through variations in the rates of utilization of the durable resources.

Implied in the above is the following. The link between the investment and disinvestment response of durable resources to crop price changes and the supply price response of crops would seem to be influenced in some way by the "importance" of the resources in production. If it does not pay to invest or disinvest in some durable resources that are relatively unimportant in the production of this crop but it pays to invest or disinvest in a resource whose "importance" in the production of this crop far outweighs these other resources, then we may observe significant output response to crop price changes on account of changes in this resource even though it does not pay to invest or disinvest or vary the rates of utilization of the other resources.¹⁰ The higher the output elasticity of a resource, the stronger the link between its investment and disinvestment response to crop price changes and the supply price response of the crop and vice versa. Under competition, the larger the factor income shares of resources, the stronger the influence of the factor's investment and investment response to crop price changes on the output supply (price) relations of the crop.¹¹ Irreversibilities in the crop supply relation derivable from irreversibilities in the investment-disinvestment relations in productive facilities may enable

governments and marketing boards to maintain higher tax rates on a given crop than would otherwise be the case in the absence of these irreversibilities. The extent of these irreversibilities will to some extent be influenced by the ease of substitution of resources among enterprises.

For example, let the acquisition price of a farmer of a given farming skill and age be what it would cost a farm-firm to "acquire" a new farmer of the same vintage now. This is the supply price of a farmer of this vintage. Let his salvage value be approximated by the present value of the net income streams that he would earn in the next best alternative use. If government and marketing board taxes are such that the MVP's of resources (labor and land) are bounded by their off-farm market acquisition prices and salvage values, where the relevant salvage value is still within the farm sector, then government and marketing board taxes induce farm reorganization that still leaves most of these resources within the farm sector--a farmer may reorganize and quit groundnut production in favor of food production as a result of government pricing policy.¹² If resources are not enterprise specific, then the degree of resource fixity within a given crop enterprise may be much less than that for the farm sector as a whole.

These propositions may then be derived: from our aprior knowledge of the limited degree of resource fixity within crop enterprises, and the transformation possibilities between crops in the cotton-groundnut-foods economy of the Northern States, the long-run revenue potential from taxing any of these crops is not very great. Second, given the much larger degree of resource fixity within the agricultural sector vis-a-vis the non-agricultural sector, there is some potential for revenue from the agricultural sector as a whole given existing demand functions for resources now in agriculture for use in the non-agricultural sector. Public policies such as minimum wage laws for unskilled workers in the urban areas effectively raise the off-farm salvage value of people currently engaged in the farm sector. Such policies have the effect of making resources variable that might have otherwise been fixed in the farm sector. Thus, if there are substantial irreversibilities¹³ in the investment-disinvestment relations and in the output supply relation in the agricultural sector as a whole, then there is some potential for a tax on the agricultural sector. This is the theoretical link between irreversibilities in the investment-disinvestment relations as defined by Johnson and problems of government and marketing board revenue and supply response in developing agriculture. To the extent that irreversibilities in the investment-disinvestment

relations and in the output supply relation are small when the agricultural sector as a whole is considered, then the revenue potential is small. If demand schedules for resources (now in agriculture) for use in the non-agricultural sector should shift rightwards for given (upward sloping) supply curves of these resources, then the salvage values of these resources in the non-agricultural sector will rise and any government and marketing board taxation which depresses the MVP's of these resources below their non-agricultural sector salvage values will lead to disinvestment in these resources, the mobility of these resources from the agricultural sector to the non-agricultural sector, and a likely fall in agricultural output.

From our apriori knowledge of the extent of the mobility of resources between crop enterprises in the cotton-groundnuts-food crops economy of the Northern States, we suspect that irreversibilities in the investment-disinvestment relations underlying the production of any one of these crops (though not necessarily within the farm sector as a whole) may not be extensive.

Summary and Conclusions

It has been shown in this chapter that for purposes of government and marketing board revenues from taxes on crops, the relevant variable is the sales and not the total output of the crop (arguments are provided to show

why we cannot apriori presume that the correlation coefficient between total output and sales to the board is unity for any marketing board crop in Nigeria).¹⁴ Various influences on sales of marketing board crops are discussed. This discussion underlies the estimation effort in the next chapter. Policy makers and some academicians are concerned about the effects of changes in the net producer prices the boards pay farmers on State Government revenues, with the usual presumption that paying farmers higher prices will always lead to a fall in State Government revenues from taxes on these crops. A simple model is presented to show the dependence of the responsiveness of (crop) tax revenues on the price responsiveness of sales of crops to the board, particularly when these crops have large domestic and neighboring-country markets. Some illustrative calculations are used with empirical data on level of taxes and net producer prices for cotton and groundnuts for the period 1950-66 to show how tax revenues from these two crops would fall if net producer prices paid to farmers were further reduced (and thus implied taxes raised) for reasonably low elasticities of sales of these crops to the board with respect to the net producer prices paid by the board. These calculations illustrate the eventual futility of heavy taxes on these crops with respect to raising large crop tax revenues.

The last part of this chapter showed that questions of the revenue potential of individual crops and the farm sector as a whole depend on the underlying investment-disinvestment process and its responsiveness to various relative price changes.

The calculations of the government and marketing board revenue elasticities with respect to both net producer price and taxes in this chapter clearly point to the relation of (crop) tax revenue to the price responsiveness of sales of crops to the marketing board. In the next chapter, this price responsiveness of sales of crops to the marketing boards is estimated.

FOOTNOTES

¹" . . . Palm oil is available for export only in insignificant quantities . . . this could be due to increased demand for food." See Twelfth Annual Report of the Western Nigeria Marketing Board, 1966, p. 7. In its report a year later, the WNMB stated "The abnormal fall in the quantity of palm produce purchased in the period was due to the immediate effect of the Nigerian crisis. Moreover, domestic sales yielded higher prices per ton than overseas sales for the farmer or the producer/licensed buying agent like the Western Nigeria Development Corporation" (emphasis my own). See Thirteenth Annual Report of the Western Nigeria Marketing Board, 1967, pp. 6-7.

A correspondent for the Daily Times writes of groundnut oil, "What used to cost 1/9d a bottle now costs 5/= . . ." See Daily Times, Lagos, February 3, 1972, p. 7.

²Assuming groundnut consumer prices are constant between two years and making groundnut consumption (C) a function of population (P) and measured income (Y), then even if the income elasticity of demand for groundnuts were zero and the population elasticity of demand for groundnuts were unity, the percentage increase in domestic groundnut consumption over the period will equal the percentage increase in population:

$$C = C(Y, P)$$

from which

$$\frac{\Delta C}{C} = \eta_{cy} \frac{\Delta Y}{Y} + \eta_{cp} \frac{\Delta P}{P}$$

where $\frac{\Delta C}{C}$ is the percentage increase in groundnut consumption over the period, η_{cy} is the income elasticity of consumption of groundnuts, η_{cp} is the population elasticity of demand for groundnuts. Setting $\eta_{cy} = 0$ and $\eta_{cp} = 1$ makes $\frac{\Delta C}{C} = \frac{\Delta P}{P}$.

³A writer in West Africa writes "Available supplies to the marketing board have in any case been reduced because of the continuance of smuggling over the border into Niger, which has been encouraged by the high prices obtainable for groundnuts in that country. At the same time in Nigeria, in the bush itself, it is believed that larger quantities are being pressed for oil for domestic consumption" (emphasis my own). See West Africa, London, #2857, March 17, 1972.

⁴For the last groundnut season, "Farmers were getting about £N 86 a ton on the border with Niger Republic compared with £N 36 which they get in Nigeria." See Daily Times, Lagos, February 3, 1972, p. 7.

⁵The sum of the three components of the tax per unit of the crop when added to the net producer price paid to farmers by the marketing boards (P_n) gives the potential producer price (P_p) that the farmer would have received per unit of the crop in the absence of all State government and marketing board taxation. Thus the derived value of the unit tax on a crop depends on the net producer price per unit of the crop that the marketing board decides to pay the farmers. We can then write:

$$t_j = f(P_n, P_p), \text{ or more specifically,}$$

$t_j = P_p - P_n$. Differentiating (3) with respect to P_n and converting to elasticities, then:

$$E_{R_j P_n} = E_{t_j P_n} + E_{M_j P_n}$$

$$\text{where } E_{t_j P_n} = \frac{-P_n}{t_j} = \frac{-[P_p - t_j]}{t_j} = \frac{t_j - P_p}{t_j} < 0, \text{ if } t_j < P_p$$

and $E_{R_j P_n}$ is the State Government and marketing board revenue elasticity with respect to the net producer price paid out by the board, $E_{t_j P_n}$ is the unit tax elasticity with respect to net producer price and $E_{M_j P_n} (= \frac{dM_j}{dP_n} \frac{P_n}{M_j})$

is the elasticity of sales to the marketing board with respect to the net producer price.

Alternatively, suppose we write:

$$t_j = P_p - P_n$$

$$R_j = t_j M_j = (P_p - P_n) M_j = P_p M_j - P_n M_j$$

$$\frac{dR_j}{dP_n} = P_p \frac{dM_j}{dP_n} + \frac{dP_p}{dP_n} M_j - [M_j + P_n \frac{dM_j}{dP_n}]$$

$$\begin{aligned} \frac{dR_j}{dP_n} \frac{P_n}{R_j} &= P_p \frac{dM_j}{dP_n} \frac{P_n}{M_j} \frac{M_j}{(P_p - P_n) M_j} - \left[\frac{M_j P_n}{(P_p - P_n) M_j} + P_n \frac{dM_j}{dP_n} \frac{P_n}{(P_p - P_n) M_j} \right] \\ &= E_{M_j P_n} - \frac{P_n}{t_j} \end{aligned}$$

But from $t_j = P_p - P_n$, and assuming that P_p does not change,

$$E_{t_j P_n} = -\frac{P_n}{t_j}$$

$\Rightarrow E_{R_j P_n} = E_{M_j P_n} + E_{t_j P_n}$ which is the same as in the text.

⁶In the 1972-73 Federal Budget, of the expected gross revenue of £N 650 m., about £N 180 m. will be allocated to State Governments and £N 160 m. will be set aside for the development fund. The Federal Government is repaying immediately the £N 5.5 m. loan given by the (then) Regional Marketing Boards to the former Central government in 1964. It is hoped that early repayment will help the marketing boards and state governments to stabilize their finances and pay higher producer prices. See West Africa, #2861 (April 14, 1972), pp. 439, 465. In the 1968-69 Federal Budget, projected Total Revenue was £N 152 mill, of which £N 54 mill was to be appropriated to the States. The corresponding figures for 1969-70 were, respectively, £N 188 mill, £N 73 mill, and for 1970-71, £N 279 mill, £N 115 mill respectively. Source for these figures: Annual Economic Review, Nigeria (London: Standard Bank Ltd., 1968, 1970).

⁷The unit tax elasticity is not derived from any choice--theoretic framework of an optimizing economic agent. It is based more on definition of the tax per unit of the crop being expressed as the difference between the potential producer price and the net producer price per unit of the crop after all taxes have been deducted. Roughly speaking, this elasticity indicates the "required"

change in taxes if net producer prices paid to farmers are changed--if prices are lowered, by definition, implied taxes are raised, hence the negative elasticity.

⁸This is consistent with the expectations of the Model: From footnote 4,

$$E_{R_j P_n} = E_{M_j P_n} - \frac{P_n}{t_j}$$

from which

$$\frac{\partial E_{R_j P_n}}{\partial t_j} = \frac{t_j + P_n}{t_j^2} > 0.$$

⁹Glenn L. Johnson, "The State of Agricultural Supply Analysis," Journal of Farm Economics (May, 1960).

¹⁰Second order effects such as the effect of the increase in the "important" resource on the marginal products of resources with which it is complementary need to be incorporated in a full analysis.

¹¹Fortunately, empirical investigations of the link between the investment-disinvestment relations in durable resources and the output supply relation have focused on resources whose factor shares loom large in the production process. See Glenn L. Johnson, Overproduction Trap (The Johns Hopkins University Press, 1972).

¹²Given a transformation curve between, say, guinea corn and groundnuts, government and marketing board taxation of groundnuts may so change relative crop prices as to produce a corner solution in which the farmer after reorganization produces only guinea corn. Allocation of the fixed resources is then based on their on-farm opportunity costs.

¹³Bauer recognizes this point. He states, "the presence of certain irreversible functional relationships on the side of both production and consumption may also be turned to good use in the framing of taxation. Though very high prices may at times be required to stimulate the establishment of productive capacity for certain crops, once the capacity has been established, it may continue to be operated at appreciably low prices; the establishment

of plantations (both estates and small holdings) of cultivated crops in remote areas and their subsequent operation are a convenient example." See P. T. Bauer, Economic Analysis and Policy in Underdeveloped Countries, Cambridge University Press, London, 1957, p. 95. Bauer however, does not provide any theory to explain these irreversibilities.

¹⁴Using seed issues and assuming different seed-rate applications per acre and different yields per acre, we have estimated total output of seed cotton for all the Northern States for the period 1960/61-1970/71. For some reason, the correlation coefficient between sales of seed cotton to the marketing board and various estimates of total output of seed cotton in the Northern States over this period was found to be negative in all cases. For all estimates of total output the correlation coefficient was approximately -0.26. Probably this has something to do with our estimates of output.

1

CHAPTER V

ESTIMATION OF IMPACT ON GOVERNMENT AND MARKETING BOARD TAX REVENUE FROM GROUNDNUTS AND COTTON OF CHANGES IN THE BOARD'S NET PRODUCER PRICES FOR THESE CROPS

Introduction

The last chapter dealt with the relationship between (crop) tax revenue responsiveness to changes in the board's producer price and the responsiveness of sales (to the board) to producer price changes. Estimation of the sales price responsiveness of marketing board crops is essential for a quantitative assessment of the effect on (crop) tax revenue of paying farmers higher producer prices for these crops. This chapter attempts to estimate this sales price responsiveness and to assess the quantitative impact on (crop) tax revenue of changes in the board's producer prices.

This chapter is divided into four main sections. The first part sketches a simultaneous equation system in which we incorporate our apriori knowledge of the factors influencing the sale of a crop to the marketing board. The

essence of this is the need to identify and specify a structure of which the sales supply equation is only a component. The second part of the chapter contains a modified model in which all the regressors of the sales supply equation are predetermined. Single sales supply equations are then estimated for both cotton and groundnuts by ordinary least squares. The third section contains equations to predict sales when farmers are paid higher prices. These predictions, together with the new higher producer prices and the implied lower taxes on farmers, are then used to assess the quantitative impact of higher producer prices on tax revenue from these two crops.

The last section of the chapter contains a summary of our findings in this chapter.

The simultaneous equation nature of the problem was recognized in Chapter IV. It is assumed that the farmers, producers, and middlemen of any marketing board crop allocate total output of the crop between domestic non-industrial consumption requirements (farm and non-farm) and sales to the board. It is also assumed that producers for any marketing board in Nigeria face an infinitely elastic demand curve at the price set by the board.

The Model

The structural equations of the model are postulated to be:

$$D_j = D_j(P_{D_j}, I): \text{ domestic consumption demand;}$$

$$M_j = M_j(Y_j, P_{N_j}, P_{D_j}): \text{ sales to the marketing board}$$

$$Y_j = Y_j(P_{N_j}, P_{N_r}, K): \text{ supply relation;}$$

$$M_j = Y_j - D_j: \text{ marketing board crop supply identity}$$

where:

D_j is domestic consumption demand for the marketing board crop by both the farming and non-farming population, assumed endogenous;

P_{D_j} is the domestic producer price of the marketing board crop, assumed endogenous;

I is real income of all domestic consumers of this crop, assumed exogenous;

M_j is the quantity of the crop sold to the marketing board in any given year, assumed endogenous;

Y_j is the total output of the crop in a given year, assumed endogenous;

P_{N_j} is the net producer price of the crop exogenously fixed by the board which determines the infinitely elastic demand curve facing the farmers, producers, and middlemen of this marketing board crop;

P_{Nr} is the net producer price of a closely competitive crop (i.e., competitive in production). We assume that the price of this crop is exogenously determined outside this system;

K is the set of exogenous factors affecting production (weather, new production functions from application of fertilizer, spraying, and seed dressing, etc.); in this study, this set is specifically represented by time.

The crop supply identity says that total output is allocated between non-industrial domestic consumption (farm and non-farm) and sales to the marketing board.¹

The endogenous variables of the system then are D_j , P_{D_j} , Y_j , M_j while the exogenous variables are P_{Nj} , I , K , and P_{Nr} . If we give the above structural equations their linear approximations, we have

$$D_{j,t} - \alpha_0 - \alpha_1 P_{Dj,t} - \alpha_2 I_t = \epsilon_{1,t} \quad (1a)$$

$$M_{j,t} - \beta_0 - \beta_1 P_{Nj,t} - \beta_2 P_{Dj,t} - \beta_3 Y_{j,t} = \epsilon_{2,t} \quad (1b)$$

$$Y_{j,t} - \omega_0 - \omega_1 P_{Nj,t} - \omega_2 P_{Nr,t} - \omega_3 K_t = \epsilon_{3,t} \quad (1c)$$

$$M_{j,t} - Y_{j,t} + D_{j,t} = 0, \quad t = 1, \dots, n \quad (1d)$$

which can be written in matrix form as

$$BY_t + \Gamma X_t = \epsilon_t \quad (1)$$

1

where:

$$B = \begin{bmatrix} 1 & -\alpha_1 & 0 & 0 \\ 0 & -\beta_2 & 1 & -\beta_3 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & -1 \end{bmatrix} ; Y_t = \begin{bmatrix} D_{jt} \\ P_{Djt} \\ M_{jt} \\ Y_{jt} \end{bmatrix}$$

$$\Gamma = \begin{bmatrix} -\alpha_0 & -\alpha_2 & 0 & 0 & 0 \\ -\beta_0 & 0 & -\beta_1 & 0 & 0 \\ -\omega_0 & 0 & -\omega_1 & -\omega_2 & -\omega_3 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} , X_t = \begin{bmatrix} 1 \\ I_t \\ P_{Njt} \\ P_r \\ K_t \end{bmatrix} , \epsilon_t = \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \\ \epsilon_{3t} \\ 0 \end{bmatrix}$$

where we assume that the disturbances of the structural equations satisfy the assumptions of the classical normal linear regression model which in matrix notation are:

$$\epsilon_t \sim N(0, \phi) \quad E(\epsilon_t \epsilon_s') = 0$$

where ϕ is the variance-covariance matrix of the structural disturbances.²

By the order conditions for identifiability³ we have the following results: the equation for the domestic consumption demand of the marketing board crop (1a) with two endogenous variables and two excluded predetermined variables is over-identified; the equation for the sale of a crop to the marketing board (1b) with three endogenous

variables and two excluded predetermined variables is exactly identified, while the equation depicting the supply relation (1c) with one endogenous variable and one excluded predetermined variable is under-identified.

The equation of most interest to us is that depicting sales of the crop to the marketing board (1b), the sales supply equation. For the rank and order conditions for identifiability of this equation, form the system matrix:

$$(B, \Gamma) = \begin{bmatrix} 1 & -\alpha_1 & 0 & 0 & -\alpha_0 & -\alpha_2 & 0 & 0 & 0 \\ 0 & -\beta_2 & 1 & -\beta_3 & -\beta_0 & 0 & -\beta_1 & 0 & 0 \\ 0 & 0 & 0 & 1 & -\omega_0 & 0 & -\omega_1 & -\omega_2 & -\omega_3 \\ 1 & 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

The submatrix obtained by striking out the second row and all columns of (B, Γ) corresponding to variables that are included in the sales supply equation is:

$$\Delta = \begin{bmatrix} 1 & -\alpha_2 & 0 & 0 \\ 0 & 0 & -\omega_2 & -\omega_3 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

By the rank criterion, the sales supply equation is exactly identified or over-identified if and only if $\text{rank } (\Delta) = G-1$ where G is the number of structural equations. Δ has at least one 3×3 nonsingular square submatrix (Δ^*) .

$$\Delta^* = \begin{bmatrix} 1 & -\alpha_0 & -\alpha_2 \\ 0 & -\omega & 0 \\ 1 & 0 & 0 \end{bmatrix} ; |\Delta^*| = -\alpha_2 \omega_0 ;$$

so that rank $(\Delta) = 3 = G-1$ which,⁴ together with the order condition above, provides the necessary and sufficient condition for identification of the sales supply equation.⁵

The reduced form equations can then be written in unrestricted form as: $Y_t = \Pi X_t + V_t$ (2)

$$Y_t = \begin{bmatrix} D_{jt} \\ P_{Djt} \\ M_{jt} \\ Y_{jt} \end{bmatrix}, \quad \Pi_t = \begin{bmatrix} \Pi_{11} & \Pi_{12} & \Pi_{13} & \Pi_{14} \\ \Pi_{21} & \Pi_{22} & \Pi_{23} & \Pi_{24} \\ \Pi_{31} & \Pi_{32} & \Pi_{33} & \Pi_{34} \\ \Pi_{41} & \Pi_{42} & \Pi_{43} & \Pi_{44} \end{bmatrix}, \quad X_t = \begin{bmatrix} 1 \\ I_t \\ P_{Njt} \\ K_t \end{bmatrix}, \quad V_t = \begin{bmatrix} v_{1t} \\ v_{2t} \\ v_{3t} \\ v_{4t} \end{bmatrix}$$

From (1), Y_t can be solved: $Y_t = -B^{-1}\Gamma X_t + B^{-1}\epsilon_t$ (3)

and from (2) above, (3) would imply

$$\Pi_t = -B^{-1}\Gamma$$

$$V_t = B^{-1}\epsilon_t$$

from which the variance-covariance matrix of the reduced form disturbances is

$$\psi = E(V_t V_t') = E[(B^{-1}\epsilon_t) (B^{-1}\epsilon_t)']$$

$$E[B^{-1}\epsilon_t \epsilon_t' (B^{-1})'] = B^{-1} \phi (B^{-1})'$$

where ψ , being a linear combination of the structural disturbances, is assumed to obey normal classical linear regression assumptions.⁶

$$B^{-1} = \begin{bmatrix} 1 & -\alpha_1 & 0 & 0 \\ 0 & -\beta_2 & 1 & -\beta_3 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & -1 \end{bmatrix}^{-1}$$

$$= \frac{1}{\alpha_1 + \beta_2} \begin{bmatrix} \beta_2 & -\alpha_1 & \alpha_1 - \alpha_1 \beta_3 & \alpha_1 \\ -1 & -1 & 1 - \beta_3 & 1 \\ -\beta_2 & \alpha_1 & \beta_2 + \alpha_1 \beta_3 & \beta_2 \\ 0 & 0 & \beta_2 + \alpha_1 & 0 \end{bmatrix}$$

From

$$Y_t = -B^{-1} \Gamma X_t + B^{-1} \epsilon_t,$$

$$\begin{bmatrix} D_j \\ P_{Dj} \\ M_j \\ Y_j \end{bmatrix} = - \frac{1}{\alpha_1 + \beta_2} \begin{bmatrix} -\alpha_0 \beta_2 + \alpha_1 \beta_0 - \omega_0 \alpha_1 (1 - \beta_3) & -\alpha_2 \beta_2 & \alpha_1 \beta_1 - \alpha_1 \omega_1 (1 - \beta_3) \\ \alpha_0 + \beta_0 - \omega_0 (1 - \beta_3) & \alpha_2 & \beta_1 - \omega_1 (1 - \beta_3) \\ \alpha_0 \beta_2 - \alpha_1 \beta_0 - \omega_0 (\beta_2 + \alpha_1 \beta_3) & \alpha_2 \beta_2 & -\alpha_1 \beta_1 - \omega_1 (\beta_2 + \alpha_1 \beta_3) \\ -\omega_0 (\beta_2 + \alpha_1) & 0 & -\omega_1 (\beta_2 + \alpha_1) \end{bmatrix}$$

$$\begin{bmatrix} -\omega_2 \alpha_1 (1 - \beta_3) & -\omega_3 \alpha_1 (1 - \beta_3) \\ -\omega_2 (1 - \beta_3) & -\omega_3 (1 - \beta_3) \\ -\omega_2 (\beta_2 + \alpha_1 \beta_3) & -\omega_3 (\beta_2 + \alpha_1 \beta_3) \\ -\omega_2 (\beta_2 + \alpha_1) & -\omega_3 (\beta_2 + \alpha_1) \end{bmatrix} \begin{bmatrix} 1 \\ I_t \\ P_{Njt} \\ K_t \end{bmatrix}$$

$$+ \frac{1}{\alpha_1 + \beta_2} \begin{bmatrix} \beta_2 & -\alpha_1 & \alpha_1 & -\alpha_1 \beta_3 & \alpha_1 \\ -1 & -1 & & 1 - \beta_3 & 1 \\ -\beta_2 & \alpha_1 & \beta_2 & +\alpha_1 \beta_3 & \beta_2 \\ 0 & 0 & \beta_2 & +\alpha_1 & 0 \end{bmatrix} \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \\ \epsilon_{3t} \\ 0 \end{bmatrix}$$

Thus the endogenous variables are expressed in terms of all the predetermined variables and the structural disturbances.

We would then estimate the sales supply equation by two stage least squares.

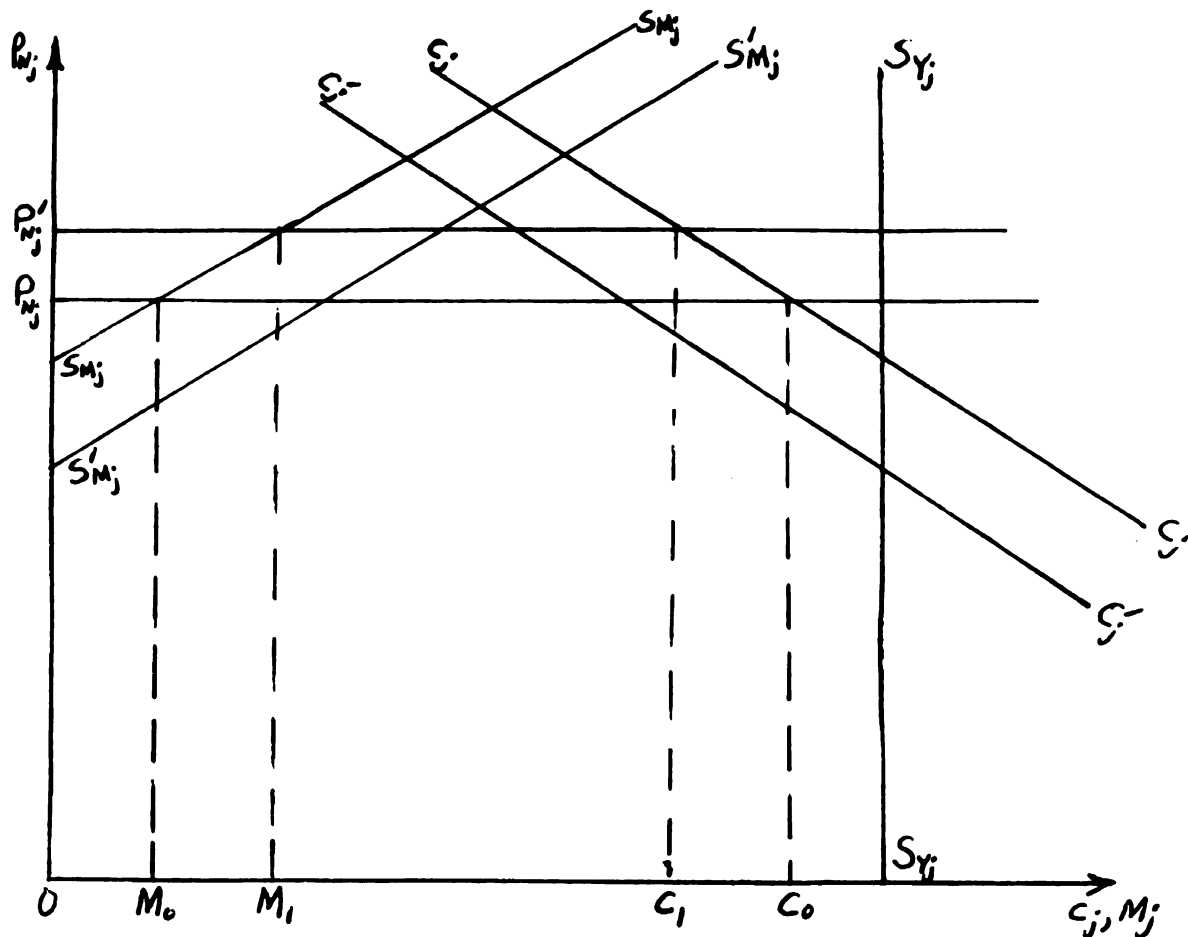
Two stage least squares estimation of the sales supply equation would require prior (first stage) estimation of domestic price and total output of the marketing board crop, the other endogenous variables in the sales supply equation. As we have no figures on total output of groundnuts and cotton over the last two decades,⁷ we cannot estimate the sales supply relation in this model; as data becomes available in the future, this equation could be estimated within the context of this model. For ordinary least squares estimation, we would need to operationalize the model so that the OLS estimates will be unbiased and consistent.

A Modified Model

We shall assume that the only price affecting the quantities of any crop sold to the board are the board's net producer prices.⁸ We would expect that the higher this price, the less will be consumed on the domestic market and the more that would be sold to the board. It is also assumed that Nigerian farmers are unaware of the true world prices for their products and that the price affecting their production and sales decisions is the board's net producer price.

Short Run Modified Model

The short run here is a given production-marketing period, strictly speaking, a given marketing period, when the total quantity of output from production of cotton or groundnuts is fixed. The aggregate sales supply curve of a crop to the board in this case of a partial monopsony on the buying side is the difference between this available total stock of the crop and the lateral sum of all individual (domestic: farmers and non-farmers) demand curves for the crop as shown on the following page, using groundnuts for illustration: S_{yj} is the given stock of groundnuts within this period (zero price elasticity of supply or production); C_j is the lateral sum of all domestic demand curves for groundnuts; S_{mj} is the lateral difference between total supply and total consumption; P_{Nj} is the net producer price for groundnuts offered by the board, which



in equilibrium is assumed equal to the appropriately adjusted home market price. With the demand curve C_jC_j and a marketing board price of P_{Nj} , OC_0 is consumed and OM_0 is sold to the marketing board. With a higher marketing board price P'_{Nj} , OC_1 is consumed and OM_1 is sold to the marketing board.⁹ From the diagram,¹⁰ the elasticity of sales of groundnuts to the marketing board with respect to the net producer price paid by the board is positive so long as the elasticity of total output (supply) of the crop with respect to this net producer price is non-negative and the (money income constant) price elasticity of demand for groundnuts is negative. Under normal

circumstances we expect these conditions to hold for most marketing board crops. We assume that the real income (I) of the bulk of domestic consumers of groundnuts is not influenced by the sales of groundnuts to the marketing board.¹¹ The producers themselves form a small proportion of domestic consumers of groundnuts. An increase in real income leads to a rightward and upward shift in the aggregate demand curve and a corresponding upward and leftward shift in the sales supply curve if groundnuts are a normal good while the converse result holds if groundnuts are inferior goods. In the latter case, an increase in real income of consumers leads to a downward and leftward shift in the aggregate demand curve to $C'_jC'_j$ and a corresponding rightward and downward shift in the sales supply curve to $S'_{Mj}S'_{Mj}$. Thus if the sales supply function is

$$M_j = M_j(P_{Nj}, I, Y_j), \quad (4)$$

the plausible signs of the partials of the function are:

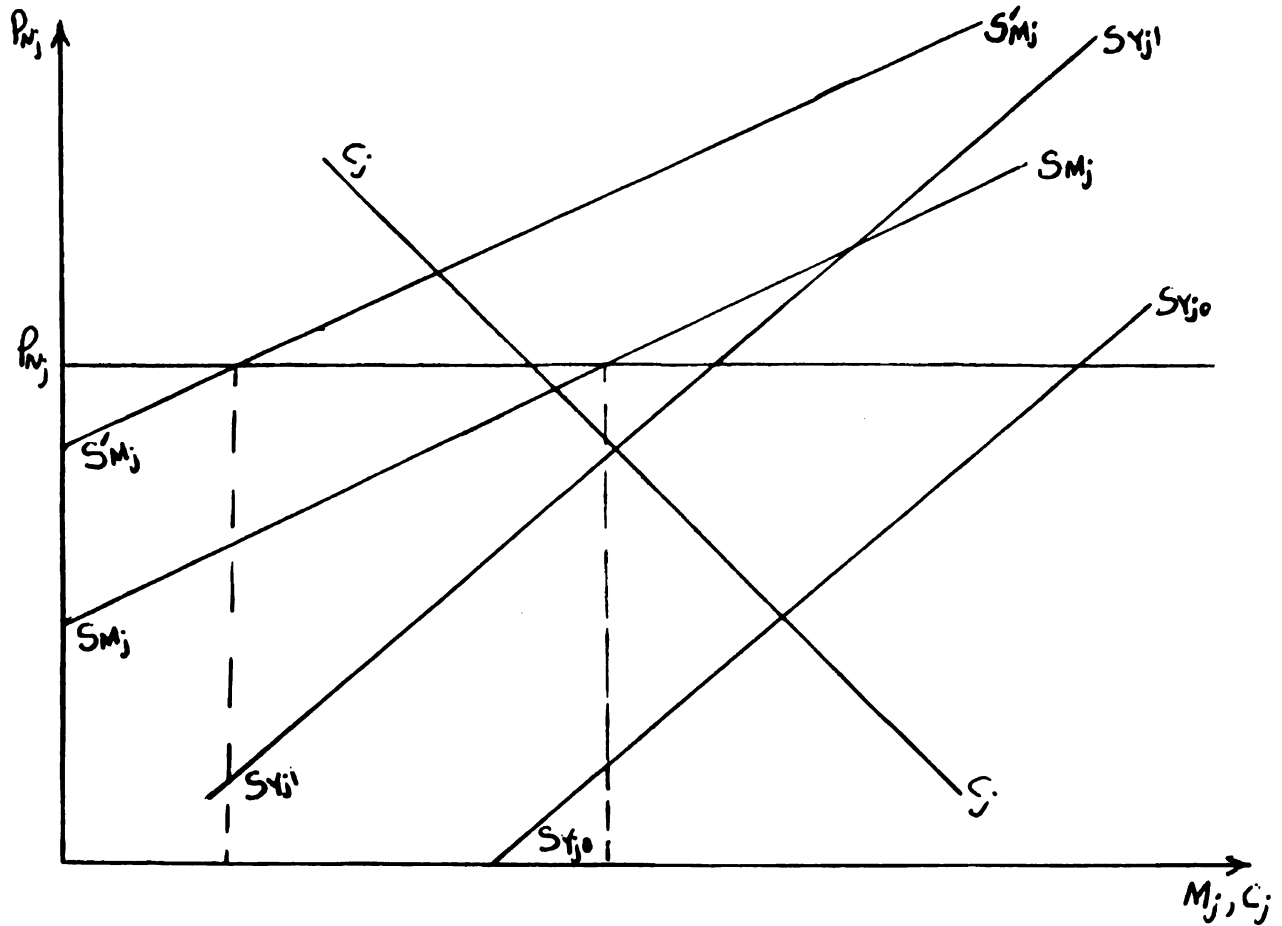
$$\frac{\partial M_j}{\partial P_{Nj}} > 0, \quad \frac{\partial M_j}{\partial Y_j} > 0, \quad \frac{\partial M_j}{\partial I} > 0 \text{ as } \eta_{cjI} < 0$$

where Y_j is the given stock of the marketing board crop and η_{cjI} is the income elasticity of demand for this crop. All the explanatory variables in the above relation are assumed predetermined so that when given a specific regression expression, the disturbances and the explanatory

variables are presumed to be independently distributed; hence we can expect the OLS estimates to be unbiased and consistent.

The Long Run Modified Model

If the period is long enough for production to respond to price and other variables, then changes in sales of groundnuts to the marketing board would then partly reflect substitutions in production as producers move along given or changing transformation surfaces in response to relative price changes. For these long run relations, theory leads us to expect some irreversibilities in the underlying investment-disinvestment relationships. Then the output response of Nigerian farmers depend not only on the magnitude of the crop price change but also on the sign of the price change.¹² The theory of the investment-disinvestment response to crop price changes (see Chapters III and IV) leads us to expect a difference between expansion supply price elasticities and contraction supply price elasticities corresponding to the expansion and contraction phases of crop prices respectively. These elasticities are also influenced by the most recent history of relative prices and farmers' expectations about their movement in the immediate future. In the diagram on the following page, if expected food prices rise relative to the price of a marketing board crop, then with food crops competing with the marketing board crop in production the



supply curve of the latter shifts from S_{Yj0} to S_{Yj1} and the sales supply curve, for given demand curves, correspondingly shifts upwards and to the left, to S'_{Mj} . In this case, an increase in food prices leads to a fall in total sales to the marketing board from M_{j0} to M_{j1} . From the above discussion, we would have a supply relation

$$S_{Yj} = S_{Yj}(P_{Nj}, P_{Nr}, K) \quad (5)$$

and

$$\frac{\partial S_{Yj}}{\partial P_{Nj}} > 0, \quad \frac{\partial S_{Yj}}{\partial P_{Nr}} < 0 \quad \text{and} \quad \frac{\partial S_{Yj}}{\partial K} > 0$$

1

where P_{Nr} is the price of a competing crop and K stands for those exogenous factors like technical change which influence total supply of the marketing board crop.

Empirical Results

The sales supply equations for groundnuts and cotton were all estimated by ordinary least squares. It became obvious at an early stage that there was autocorrelation in our series. Whether this is a serious drawback depends on the purposes to which we intend to put our estimates. For prediction purposes Malinvaud maintains that though the estimates of the coefficients may be imprecise, predictions based on them "are nevertheless fairly good."¹³ I decided to incorporate some knowledge of the autoregressive structure in my analysis for the purposes of prediction.¹⁴ I therefore ran first stage ordinary least squares for all equations. For the groundnut equations, I assumed a first order autoregressive scheme and estimated the autocorrelation coefficient from the residuals yielded by my first stage estimates. These autocorrelation coefficient estimates were then used to transform the original variables; in the second stage, ordinary least squares was applied to the transformed variables. This transformation exercise produced inconclusive results; it was therefore not done for the cotton equations.

Most of the equations were of the linear and log forms. The original equation is designated by its number, like (6); the same equation reestimated with transformed variables to take account of the autoregressive structure is designated (6)'. The "short run" sales supply function for groundnuts was postulated in two forms as:

$$Y_{1t} = \beta_0 + \beta_1 X_{2t} + \beta_2 X_{3t} + \epsilon_t \quad (6)$$

$$\log Y_{1t} = \beta_0 + \beta_1 \log X_{2t} + \beta_2 \log X_{3t} + \epsilon_t \quad (7)$$

where:

Y_{1t} is the quantity (tons) of sales of groundnuts to the Northern States Marketing Board in year t ; X_{2t} is the net producer price of groundnuts paid by the board in year t (£N/ton) and X_{3t} , standing for the real income of consumers of groundnuts, is GDP at factor cost (£N), and where the disturbance terms (ϵ_t) are assumed to obey normal classical linear regression assumptions. The estimated equations and their transformed counterparts for the Northern States (1950-51 through 1967-68), with standard errors of estimates in brackets, are:

$\hat{Y}_{1t} = -440875.6 + 12729.7X_{2t} + 588.6X_{3t},$	$R^2 = .83$
(224368.5) (6267.2) (69.3)	$d = 2.25$
	$\hat{\rho} = -0.1448 \quad (6)$
$\hat{\hat{Y}}_{1t} = -354514.3 + 9224.9X_{2t} + 577.2X_{3t},$	$R^2 = .86$
(524678.5) (11945.3) (79.1)	$d = 2.17 \quad (6)'$

$$\log \hat{y}_{1t} = .6013 + 1.3139 \log x_{2t} + 1.0492 \log x_{3t}, \quad R^2 = .86$$

$$(.6023) \quad (.3379) \quad (.1255) \quad d = 2.03$$

$$\hat{p} = -0.0230 \quad (7)$$

$$\log \hat{y}_{1t} = 2.0636 + .5901 \log x_{2t} + .9305 \log x_{3t}, \quad R^2 = .74$$

$$(1.4566) \quad (.7323) \quad (.1625) \quad d = .2.22 \quad (7)'$$

In equation (6) the sign of the groundnut price coefficient is consistent with theory; it is significantly positive at the 5 per cent level. The elasticity of sales of groundnuts to the marketing board with respect to the board's net producer price is .714, calculated at the sample means. The real income coefficient is positive and significant at the .5 per cent level. The sign could be due to two reasons: an implication that groundnuts in the form sold to the board are an inferior good¹⁵ so that with rising incomes less is consumed in the domestic market and more is sold to the board, or it could be due to the effect of the measure of income we used on the ability of farmers, producers, and middlemen to produce and sell more groundnuts to the board as incomes rise, especially in a world of imperfect capital markets. The fit of the model is quite good ($R^2 = .83$); the calculated partial correlation coefficient between groundnuts sales and groundnut prices is .464 while the partial correlation coefficient between groundnut sales and income is .909. The null hypothesis of zero autocorrelation was not rejected at the 5 per cent level (the Durbin-Watson Statistic, $d, = 2.25$). Equation (6)' is the transformed

counterpart of (6): the autocorrelation coefficient is calculated as -0.14475 from the residuals of (6); this is then used to transform the variables in (6) after which ordinary least squares (OLS) is used to estimate the transformed equation.¹⁶ Though (6)' improves the overall fit of the model ($R^2 = .86$) and reduces the autocorrelation, the statistical significance of the groundnut price coefficient is drastically reduced.

In equation (7), the groundnut price coefficient has the expected sign and it is statistically significant at the .5 per cent level. A two tailed t-test finds the coefficient statistically significant at the 1 per cent level. From (7), the elasticity of sales of groundnuts to the marketing board with respect to the board's net producer price is 1.3139, meaning that if the board raises groundnut producer prices by 1 per cent, groundnut sales to the board will increase by 1.3139 per cent. The income coefficient is positive and is statistically significant at the .5 per cent level. The fit of the model is quite good: $R^2 = .86$; the partial correlation coefficient between groundnut sales and its net producer price is .708, the partial correlation coefficient between groundnut sales and income is .907 and the Durbin-Watson statistic is 2.03. " R^2 deletes" for equation (7) show that 72 per cent of the variation in sales of groundnuts is explained by the model if we regress sales only on income and 21 per cent is explained if we regress sales only on net producer

price. The transformation of (7) with the estimated autocorrelation coefficient ($\hat{\rho} = -0.0230$) did not improve my results: the price coefficient fell drastically in statistical significance (significantly positive only at the 25 per cent level); the income coefficient, though statistically significant at the .5 per cent level, fell; R^2 fell to .74 and the Durbin-Watson statistic rose to 2.22.

From (4) above, total stocks of groundnuts in a given marketing period should be one of our regressors. We have no data or reliable estimates of total output of groundnuts. It can be presumed that the marketing board in deciding on the net producer price it pays to farmers in any given year is to some extent influenced by the expected output of the crop for that year. Thus, anticipation of a small crop would induce the board to pay producers higher net producer prices in that year and conversely for anticipations of large crops. It is plausible then to expect some negative correlation between the output series and the net producer price series. To this extent, the omission of output from our short run equations may underestimate the price elasticity of sales of groundnuts to the board. We would expect the elasticity of sales to the board with respect to stock output to be positive.

To capture some long run influences on groundnut sales to the board, the prices of competitive crops were

included in some regression equations. X_5 is the guinea corn price relative to the groundnut price, and X_6 is the millet price relative to the groundnut price. If millets and guinea corn are each competitive with groundnuts in production, we would expect the elasticity of groundnut sales to the board with respect to X_5 and X_6 to be negative.

The Institute of Agricultural Research, Samaru, Zaria has been breeding and recommending new varieties and practices for groundnut farmers over the last twenty years. If groundnut farmers have been applying fertilizers, seed dressing and spraying, new varieties and new cultural practices, then there should have been a secular trend in yields per acre which in turn should have given an upward trend to groundnut sales to the marketing board. This would render the coefficient of the trend variable, X_4 , positive. On the other hand, transportation facilities have steadily improved over the years, thus facilitating the shipment of groundnuts from surplus to deficit areas. This might render the trend coefficient negative in sign.

The estimated equations, with standard errors of coefficients in brackets, are:

$$\hat{Y}_{1t} = 783789.1 + 12813.3X_{2t} + 1003.8X_{3t} - 27866X_{4t}, \quad R^2 = .85$$

$$\begin{array}{ccccccc} (997276.3) & (6148.7) & (336.7) & (22132.9) & d & = & 2.26 \\ & & & & \hat{p} & = & -.135 \end{array} \quad (8)$$

$$\hat{Y}_{1t} = 1004923.2 + 7629.4X_{2t} + 988.3X_{3t} - 28323.9X_{4t}, \quad R^2 = .80$$

$$\begin{array}{ccccccc} (1306147.8) & (11865.8) & (355.8) & (22569.6) & d & = & 2.19 \end{array} \quad (8)'$$

$$\log \hat{Y}_{1t} = 3.096 + .899 \log X_{3t} + .378 \log X_{6t} - .101 X_{6t-1} \quad (9)$$

(.433) (.140) (.159) (.160)

$$\begin{aligned} R^2 &= .81 \\ d &= 2.72 \\ \hat{p} &= -0.305 \end{aligned}$$

$$\log \hat{Y}_{1t} = 2.892 + .956 \log X_{3t} + .332 \log X_{6t} - .082 \log X_{6t}, \quad (9)'$$

(.310) (.097) (.127) .125)

$$\begin{aligned} R^2 &= .91 \\ d &= 2.44 \end{aligned}$$

The trend coefficient in (8) and (8)' is significantly negative at the 25 per cent level. The negative sign could be due to several reasons: improved transportation and market information networks that facilitate diversion of the crop from producing areas to other domestic markets; a probable upward trend in the demand for indigenously crushed groundnut oil, or exogenous increases in population.¹⁷

Relative to equation (7), the income coefficient has increased substantially while the price coefficient remains remarkably stable; both are statistically significant at the 5 per cent level. The overall fit of the model is good: $R^2 = .86$; the calculated partial correlation coefficients between groundnut sales and the individual variables are: $\rho_{Y_1 X_2} = .486$; $\rho_{Y_1 X_3} = .623$ and $\rho_{Y_1 X_4} = -.318$. The " R^2 deletes" indicate that when groundnut sales are regressed only on income and time, 80 per cent of the variation in groundnut sales is

explained; when sales are regressed only on groundnut prices and time, 75 per cent of the variation in groundnut sales is explained and when sales are regressed only on groundnut prices and income, 83 per cent of the variation in groundnut sales is explained. Transformation of (8) into (8)' using the calculated autocorrelation coefficient from the residuals of (8) did not improve the results: the statistical significance of the price coefficient is drastically reduced and R^2 falls. The income coefficient is fairly stable, falling from 1003.8 to 988.3 but still statistically significant at the 5 per cent level.

Regressing groundnut sales on last year's groundnut price yielded poor results. Regressing sales on last year's groundnut price and this year's income improved the overall fit of the model:

$$\log \hat{Y}_{1t} = 7.8426 + 1.5342 \log X_{2t-1}; \quad R^2 = .37$$

$$(1.7226) \quad (.4994) \quad d = 1.20 \quad (10)$$

$$\log \hat{Y}_{1t} = 3.9516 + 1.1084 \log X_{3t} + .4500 \log X_{2t-1}; \quad R^2 = .76$$

$$(1.3556) \quad (.2249) \quad .3873) \quad d = 2.43 \quad (11)$$

The coefficient of the log of groundnuts price is significantly positive at the 0.5 per cent level in (10); this is reduced to 25 per cent in (11). The coefficient of the log of income is significantly positive at the 0.5 per cent level. The reduction in the elasticity of groundnut sales with respect to last year's price when income is included as one of the regressors suggests

positive correlation between income and lagged groundnut price.¹⁸

To check for irreversibilities in the sales supply curve, we postulated a model of the form

$$Y_{1t} = \beta_0 + \beta_2 X_{2t-1} + \beta_3 X_{3t} + \beta_4 (X_{2t-1} \cdot Z_{1t}) + \epsilon_t$$

where:

$$Z_{1t} = 1 \text{ if } X_{2t-1} \leq X_{2t-2}$$

= 0 otherwise; the other variables are defined as before. If irreversibilities in the underlying investment-disinvestment process are significant enough to transmit their influence to the groundnut sales supply curve, then β_4 is not zero. Alternatively, the model could be stated as

$$Y_{1t} = \beta_0 + (\beta_2 + \beta_4) X_{2t-1} + \beta_3 X_{3t} + \epsilon_t \quad \begin{array}{l} \text{(when the board's groundnut} \\ \text{net producer prices are not} \\ \text{rising);} \end{array}$$

$$Y_{1t} = \beta_0 + \beta_2 X_{2t-1} + \beta_3 X_{3t} + \epsilon_t \quad \begin{array}{l} \text{(when the board's groundnut net} \\ \text{producer prices are rising).} \end{array}$$

A test of whether the elasticity of groundnut sales to the board with respect to the board's net producer price differs according to whether prices are rising or falling is a test of the hypothesis that $\beta_4 = 0$.¹⁹ The estimated equation is:

$$\hat{y}_{1t} = -133373.9 + 3295.4x_{2t-1} + 597.7x_{3t} - 1565.1(x_{2t-1} \cdot z_t)$$

(186118.1)
(6232.2)
(101.7)
(1940.6)

$$R^2 = .76$$

$$d = 2.04 \tag{12}$$

In (12), the lagged price coefficient is of the right sign but is not significant at the 25 per cent level; the income coefficient is significantly positive at the .5 per cent level; the coefficient of the interaction effect between the dummy variable and the lagged groundnut price is significantly negative at the 25 per cent level, significantly non-zero at the 50 per cent level for a two-tailed test. The fit of the model is good: $R^2 = .76$ and the Dubin Watson statistic is around 2. Thus, the influence of these irreversibilities is not particularly strong on the sales supply curve. They are likely to be important if we focused solely on supply (output) considerations; our model admits these long run influences through the side door, as it were. A model focusing solely on output (supply) response to producer price might produce different results. A non-significant difference between expansion sales supply price elasticities and contraction sales supply price elasticities does not necessarily imply that there are no irreversibilities in the underlying investment and disinvestment response to groundnuts price changes. The most recent history of the board's groundnut producer prices,²⁰ the factors influencing the way Northern States

farmers form and revise their expectations of the board's prices are all factors that influence the investment-disinvestment decisions of farmers and thus influence groundnut sales to the board.

For sales of cotton to the marketing board, the following equation was estimated by ordinary least squares.

$$\log Y_{2t} = \beta_0 + \beta_1 \log X_{2t} + \beta_2 \log X_{3t} + \epsilon_t$$

where Y_{2t} is the sales of cotton (tons) to the Northern States Marketing Board in year t , X_{2t} is the net producer price of cotton (£N/ton) based on the price series that I have constructed (see p. 109), X_{3t} is the income variable (£N) meant to capture the same effects as in the case of groundnuts: in this case, it is the effect of income on the demand for indigenously woven material and probably the effect of the producer income effect on sales of cotton to the board. The estimated equation for the period 1950/51-1967/68 is:

$$\begin{array}{l} \log Y_{2t}^A = .6768 + .9028 \log X_{2t} + .9212 \log X_{3t} : R^2 = .73 \\ \quad \quad \quad (.4204) \quad \quad \quad (.1454) \quad \quad \quad d = 2.55 \end{array} \quad (13)$$

The price coefficient is of the right sign; it is significantly positive at the 2.5 per cent level. Since (13) depicts mainly short run influences, the "short run" elasticity of sales of cotton to the marketing board with respect to the board's net producer price is .9028,

meaning that an increase in the board's net producer price of 1 per cent would lead to an increase in sales of cotton to the board of almost 1 per cent, all other variables remaining constant. The positive sign of the income coefficient may reflect the fact that as incomes have risen, the demand for most indigenous weaving (except for specialty fabrics like Okene cloth) has declined and thus has led to an increase in cotton sales to the board or it may capture the effect of generally rising incomes on the ability of cotton farmers, producers, and middlemen to produce and sell cotton to the board, especially in a world of imperfect capital markets. The fit of the model is good: $R^2 = .73$, the calculated partial correlation coefficient between cotton sales and its producer price is .48 while the partial correlation coefficient between cotton sales and income is .85. Based on our results from the groundnut equations, we found no compelling reason to reestimate (13) with the calculated autocorrelation coefficient from the residuals of (13). Our sales price elasticity of cotton exceeds Oni's price elasticity of supply of cotton (output) as would be expected since output supply as such is more likely to be affected by certain irreversibilities in the underlying investment-disinvestment process.²¹

To capture some long run influences on cotton sales to the board, we regressed cotton sales on lagged

producer price of cotton (X_{2t-1}) and income. We obtained poor results. The estimated equation (1951-67), with standard errors of estimates in brackets, was:

$$\log Y_{2t} = 2.4398 + \frac{.1714}{(.4859)} \log X_{2t-1} + \frac{.7492}{(.1795)} \log X_{3t}; \quad R^2 = .56 \quad d = 2.54 \quad (14)$$

The lagged price coefficient is of the right sign but is insignificant at the 25 per cent level; the income coefficient is significantly positive at the 0.5 per cent level. The null hypothesis of zero autocorrelation was rejected at the 5 per cent level.

To capture the substitution effects in production, we introduced the lagged price of groundnuts relative to the lagged price of cotton ($\frac{X_{4t-1}}{X_{2t-1}}$), the lagged price of millets relative to the lagged cotton price ($\frac{X_{5t-1}}{X_{2t-1}}$) and the lagged price of guinea corn relative to the lagged cotton price ($\frac{X_{6t-1}}{X_{2t-1}}$). To the extent that a crop is competitive with cotton in production, we expect the elasticity of sales of cotton to the board with respect to this crop's (lagged) price relative to cotton's (lagged) price to be negative. The estimated equations for the period 1951-67, with standard errors of estimates in brackets, were:

$$\log \hat{Y}_{2t} = 1.04828 + \frac{.2088}{(.4401)} \log X_{2t-1} - \frac{2.0905}{(1.0324)} \log \left(\frac{X_{4t-1}}{X_{2t-1}} \right) + \frac{1.0687}{(.2264)} \log X_{3t}; \quad R^2 = .67 \quad d = 2.97 \quad (15)$$

$$\log \hat{y}_{2t} = 2.2157 + \frac{.0992 \log x_{2t-1}}{(1.1764)} - \frac{.4059 \log \left(\frac{x_{5t-1}}{x_{2t-1}} \right)}{(.2359)} + \frac{.8196 \log x_{3t}}{(.3870)};$$

$$R^2 = .51$$

$$d = 3.16 \quad (16)$$

$$\log \hat{y}_{2t} = 2.4222 + \frac{.0975 \log x_{2t-1}}{(1.2108)} - \frac{.3109 \log \left(\frac{x_{6t-1}}{x_{2t-1}} \right)}{(.2049)} + \frac{.7589 \log x_{3t}}{(.3935)};$$

$$R^2 = .48$$

$$d = 3.18 \quad (17)$$

In (15) the lagged own price coefficient (x_{2t-1}) is of the right sign but is insignificant at the 25 per cent level; the price of groundnuts relative to cotton is of the right sign and is significant at the 5 per cent level while the income coefficient is significantly positive at the 0.5 per cent level.²² The overall fit of the model is fair ($R^2 = .67$).

In (16) the own lagged price coefficient is of the right sign but is insignificant at the 25 per cent level; the lagged millet price relative to lagged cotton price is of the right sign and is significantly negative at the 10 per cent level while the income coefficient is significant at the 1 per cent level. In (17), the own lagged price is of the right sign but is insignificant at the 25 per cent level; the lagged guinea corn price relative to lagged cotton price is of the right sign and is significant at the 10 per cent level; the income coefficient is significant at the 10 per cent level. Both (16) and (17) are fair in overall fit; in both, the null hypothesis of

zero autocorrelation was rejected at the 5 per cent level. There appears to have been competition in production between cotton, groundnuts, millet, and guinea corn.

Our attempt to include a trend variable (X_7) in equation (14) changed the sign of lagged cotton price. The estimated equation was:²³

$$\log Y_{2t} = .3772 - .1602 \log X_{2t-1} + 2.8052 \log X_{3t} - .0603 X_{7t}$$

$$\begin{matrix} & (.4046) & & (.7058) & & (.0202) \end{matrix}$$

$$R^2 = .74$$

$$d = 2.80 \quad (18)$$

The lagged cotton price has the wrong sign; the trend variable is negative and is significant at 1 per cent. The negative sign may reflect structural changes in the transportation and market information networks over time, thus facilitating the shipment of cotton from surplus to deficit areas particularly for the specialty woven fabrics.

To test for the effects of certain irreversibilities of the underlying investment-disinvestment process on sales of cotton to the board, we postulated a model of the forms:

$$\log Y_{2t} = \beta_0 + \beta_1 \log X_{2t-1} + \beta_2 \log X_{3t} + \beta_3 (\bar{X}_{1t} \log X_{2t-1}) + \epsilon_t$$

$$Y_{2t} = \beta_0 + \beta_1 \log X_{2t-1} + \beta_2 X_{3t} + \beta_3 (X_{2t-1} \cdot \bar{X}_{1t}) + \epsilon_t$$

where:

$$\delta_{1t} = 1 \text{ if } X_{2t-1} \leq X_{2t-2}$$

= 0 otherwise; the other variables are defined as before. If irreversibilities in the underlying investment-disinvestment process are significant enough to transmit their influence to the cotton sales supply curve, then β_3 is not zero.²⁴ Alternatively, the model could be stated as

$$\log Y_{2t} = \beta_0 + (\beta_1 + \beta_3) \log X_{2t-1} + \beta_2 \log X_{3t} + \epsilon_t \text{ (when the board's cotton net producer prices are not rising);}$$

$$\log Y_{2t} = \beta_0 + \beta_1 \log X_{2t-1} + \beta_2 \log X_{3t} + \epsilon_t \text{ (when the board's cotton net producer prices are rising);}$$

and

$$Y_{2t} = \beta_0 + (\beta_1 + \beta_3) X_{2t-1} + \beta_2 X_{3t} \text{ (when the board's cotton net producer prices are not rising);}$$

$$Y_{2t} = \beta_0 + \beta_1 X_{2t-1} + \beta_2 X_{3t} \text{ (when the board's cotton net producer prices are rising).}$$

A test of whether the elasticity of cotton sales to the board with respect to the board's net producer differs according to whether prices are rising or not is a test of the hypothesis that $\beta_3 = 0$. The estimated

equations, with standard errors of estimates in brackets, were:

$$\log \hat{Y}_{2t} = 2.5885 + \frac{.0855 \log X_{2t-1}}{(.5274)} + \frac{.7544 \log X_{3t}}{(.1847)} - \frac{.0167}{(.0328)} (Z_{1t} \log X_{2t-1})$$

$$R^2 = .57$$

$$d = 2.50 \quad (19)$$

$$\hat{Y}_{2t} = 7262.4 + \frac{445.7 X_{2t-1}}{(1131.4)} + \frac{72.1 X_{3t}}{(19.1)} - \frac{175.1 (X_{2t-1} \cdot Z_{1t})}{(247.1)}$$

$$R^2 = .54$$

$$d = 2.59 \quad (20)$$

In (19), the coefficient of the lagged cotton price is of the right sign but is insignificant at the 25 per cent level; the income coefficient is significantly positive at the 0.5 per cent level, while the coefficient of the interaction term between the dummy variable and the lagged cotton price is not significant at the 25 per cent level. In (20) the coefficient of the lagged cotton price is of the right sign but is insignificant at the 25 per cent level; the income coefficient is significantly positive at the 0.5 per cent level while the coefficient of the interaction term between the dummy variable and the lagged cotton price is significantly negative at the 25 per cent level. The fit of both models is fair; the null hypothesis of zero autocorrelation was rejected at the 5 per cent level. Though our results do not indicate any particularly strong influence of irreversibilities on the sales supply curve, two things must be noted: first, our test is weak

insofar as it fails to take into account the influence of magnitudes of price changes on the investment-disinvestment decisions of farmers and second, we are not directly focusing on output (supply) and all its relevant long run considerations.

The following conclusions can be drawn. In all the equations for both groundnuts and cotton, sales to the marketing board are very price responsive on the average; both the price coefficient and the income coefficient are stable with respect to exclusion and inclusion of several other variables. We tried to cope with the autoregression problem in the following way. We estimated the groundnut equations in the original variables and calculated the autocorrelation coefficient from the residuals of our first stage OLS estimates. The calculated autocorrelation coefficient was then used to transform the original variables after which OLS was used to estimate the transformed equation. The results of this exercise are mixed: in some cases, the overall fit of the model improved and autocorrelation was reduced; in others, things got worse.²⁵ That is why no transformation was performed for the cotton equations. Our efforts to detect irreversibilities in the underling investment-disinvestment relations produced rather inconclusive results. This was probably partly due to our rudimentary knowledge of the factors influencing farmers individually and in the aggregate with regards

to their formation and revision of expectations about the board's net producer prices and partly because we were not mainly concerned with the long run factors.

The multicollinearity problem was not as serious as might be expected; for example, the simple correlation coefficient between X_{6t} and X_{6t-1} was 0.165.

Prediction

Our efforts at correcting for the autoregressive structure yielded mixed results. We, therefore, predict sales of groundnuts to the board using both the original estimated regression equations as well as some reestimated regression equations that do incorporate knowledge of the autoregressive structure and predict sales of cotton using the untransformed estimated equations.

For the 1948-67 period, groundnut net producer prices paid by the board had a mean percentage of world groundnut market prices of 55.01 per cent.²⁶ Three different series of annual groundnut net producer prices were then constructed on the assumption that the board paid groundnut farmers the following percentages of world market groundnut prices for each of the years 1950-1967; 55 per cent, 60 per cent, and 67.8 per cent. We stay on one side of the actual mean percentage that obtained during the period 1948-67 (= 55 per cent) because we want to investigate the sales and government and marketing board revenue consequences of paying farmers higher

producer prices. It is assumed that the other variables in the estimated equations used for predicting sales stay at their initial values: there is only a new value for groundnut price for each of the years 1950-67. The results are shown in Tables 5.1, 5.2, 5.3, and 5.4, with the standard errors of predictions in brackets.

It is evident from these tables that in terms of receiving a percentage of world prices, Northern States groundnut farmers did much better in the 1960's than in the 1950's: in the 1950's, they received less than 55 per cent of world prices while in the 1960's they received more than 55 per cent of world prices. Thus, predicted sales, assuming farmers received 55 per cent of world prices, tend to be higher than actual sales to the board in the 1950's and lower than actual sales to the board in the 1960's. This same trend is exhibited even if we suppose that farmers were paid 60 per cent of world prices as shown in Tables 5.3 and 5.4.

To avoid cases in which our new hypothetical prices are lower than the actual prices farmers received, we suppose the board paid farmers a price:

$$P'_{Njt} = \max(P_{Njt}, .6 P_{wt})$$

where P_{Njt} is the board's actual price that was paid to farmers in year t and P_{wt} is the world price of groundnuts in year t .²⁷ The constructed price series and the resulting predicted sales are shown in Table 5.5.

TABLE 5.1.--Predicted Groundnut Sales Assuming Marketing Board Prices at 55 Per Cent of World Level, Northern States, Nigeria, 1950-1967.

Year	Predicted Sales Based on				
	Actual Producer Prices Paid by the Board	Producer Prices if Board Paid 55 Per Cent of World Price	Actual Sales to the Board	Equation (6)	
				Equation (6)' (Excluding Knowledge of Autoregressive Structure)	
				Knowledge of Autoregressive Structure)	
	£N/Ton			Tons	
1950	21.2	51.5	142743	511546(155541)	412863
1951	36.0	43.3	425588	447963(124316)	375994
1952	35.0	45.7	430696	502824(131799)	421975
1953	35.5	42.3	424643	489013(119777)	419577
1954	35.4	39.1	3723776	511917(110338)	452633
1955	32.4	42.2	530215	583770(117736)	512736
1956	37.4	33.0	357932	491644(106575)	452469
1957	33.9	40.6	714698	611198(112671)	545046
1958	36.4	45.5	533354	681991(127993)	598503
1959	37.4	31.6	445441	539765(106043)	504161
1960	33.7	25.8	619051	548141(103145)	531346
1961	30.3	24.1	685549	564769(105238)	553115
1962	30.3	22.9	871524	625139(106464)	616246
1963	32.7	24.6	786727	698332(106106)	682520
1964	34.1	28.3	676797	776590(109189)	747340
1965	34.2	37.5	977320	815182(108843)	787861
1966	29.0	28.2	1026427	862812(113457)	832128
1967	26.0	23.9	679401	677708(115261)	664575

Source: For actual producer prices and sales, see p. 111.

TABLE 5.2.--Predicted Groundnut Sales Assuming Board Prices at 55 Per Cent of World Level, Northern States, Nigeria, 1950/51-1967/68.

Year	Actual Producer Prices Paid by the Board	Producer Prices if Board Paid 55 Per Cent of World Price	Predicted Sales Based on		Tons
			Equation (7) (Excluding Knowledge of Autoregressive Structure)	Equation (7)' (Incorporating Knowledge of Autoregressive Structure)	
1950	21.2	51.5	142743	488587	391797
1951	36.0	43.3	425588	442186	394530
1952	35.0	45.7	430696	510592	434525
1953	35.5	42.3	424648	500836	446689
1954	35.4	39.1	372776	528879	490862
1955	32.4	42.2	530215	628587	546926
1956	37.4	33.0	357932	479483	495725
1957	33.9	40.6	714698	658848	583520
1958	36.4	45.5	533354	777953	633257
1959	37.4	31.6	445441	514463	540796
1960	33.7	25.8	619051	452937	542983
1961	30.3	24.1	685549	439822	459773
1962	30.3	22.9	871524	457969	586959
1963	32.7	24.6	786727	538113	650059
1964	34.1	28.3	67697	671632	730618
1965	34.2	27.5	977320	684965	756161
1966	29.0	28.2	1026427	740966	798272
1967	26.0	23.9	679401	510387	630645

Source: For actual producer prices and sales, see p. 111.

Note: The same trend in hypothesized prices and predicted sales as in Table 5.1 also obtain here. Predicted sales with this equation are generally lower than the linear equation in Table 5.1.

TABLE 5.3.--Predicted Groundnut Sales Assuming Board Prices at 60 Per Cent of World Level, Northern States, Nigeria, 1950/51-1967/68 (Based on Equation 6).

Year	Actual Producer Prices Paid by the Board	Producer Prices if Board Paid 60 Per Cent of World Price	Predicted Sales Based on			Tons
			Actual Sales to the Board	Equation (6) (Excluding Knowledge of Autoregressive Structure)	Equation (6) (Incorporating Knowledge of Autoregressive Structure)	
1950	21.2	55.8	142743	570611(177528)	455667(220103)	
1951	36.0	47.3	425588	498118(138422)	412341(144140)	
1952	35.0	49.9	430696	555779(148615)	460351(164239)	
1953	35.5	46.2	424648	538022(132883)	455093(135476)	
1954	35.4	42.6	372776	557107(119334)	485381(115411)	
1955	32.4	46.1	5302.5	632652(130881)	548160(133488)	
1956	37.4	36.0	357932	529833(106575)	480144(111438)	
1957	33.9	44.3	714698	658171(123854)	579086(121844)	
1958	36.4	49.6	533354	734565(144802)	636602(161584)	
1959	37.4	34.5	445441	576426(106043)	530729(109200)	
1960	33.7	28.2	619051	578056(103145)	553024(123747)	
1961	30.3	26.3	685549	592667(105238)	573318(147994)	
1962	30.3	25.0	871524	651617(106464)	635434(146239)	
1963	32.7	26.9	786727	726847(106106)	703184(127550)	
1964	34.1	30.8	676797	809305(109189)	771048(119601)	
1965	34.2	29.9	977320	847007(108843)	810923(118978)	
1966	29.0	30.8	1026427	895400(111321)	855744(141004)	
1967	26.0	26.1	679401	705332(115013)	684593(183691)	

Source: For actual producer prices and sales, see p. 111.

Note: Predicted sales are higher with higher prices than in Tables 5.1 and 5.2. In the 1960's except for 1966, actual producer prices were higher than the postulated 60 per cent of world prices, in contrast to the 1950's when farmers received less than 60 per cent of world prices (except 1956). Predicted sales incorporating knowledge of the autoregressive structure are generally lower.

TABLE 5.4.--Predicted Groundnut Sales Assuming Board Prices at 60 Per Cent of World Level, Northern States, Nigeria, 1950/51-1967/68 (Based on Equation 7).

Year	Actual		Actual Sales to the Board	Predicted Sales Based on		Tons
	Producers Prices Paid by the Board	Producers Prices if Board Paid 60 Per Cent of World Price		Equation (7) (Excluding Knowledge of Autoregressive Structure)	Equation (7)' (Incorporating Knowledge of Autoregressive Structure)	
1950	21.2	55.8	142743	547645	412401	
1951	36.0	47.3	425588	495766	415326	
1952	35.0	49.9	430696	572488	457439	
1953	35.5	46.2	424648	561568	470251	
1954	35.4	42.6	372776	592934	516724	
1955	32.4	46.1	530215	704736	575749	
1956	37.4	36.0	357932	537555	521844	
1957	33.9	44.3	714698	738684	614280	
1958	36.4	49.6	533354	872091	666593	
1959	37.4	34.5	445441	576892	569343	
1960	33.7	28.2	619051	507903	571646	
1961	30.3	26.3	685549	493001	578693	
1962	30.3	25.0	871524	513338	617832	
1963	32.7	26.9	786727	603367	684350	
1964	34.1	30.8	676797	752977	769113	
1965	34.2	29.9	977320	768078	796074	
1966	29.0	30.8	1026427	830579	840273	
1967	26.0	26.1	679401	572097	663818	

Source: For actual producer prices and sales, see p. 111.

Note: Predicted sales with this equation are generally lower than the linear equation in Table 5.3.

TABLE 5.5.--Predicted Groundnut Sales Assuming Board Price at $P'_{Nj} = \max(P_{Nj}, .6P_w)$ where P_{Nj} is the Actual Producer Price and P_w is the World Price, Northern States, Nigeria, 1950/51-1967/68.

Year	Predicted Sales Based on				
	Actual Producer Prices Paid by the Board	Producer Prices if Board Paid $P_{Nj}' = \max$ (P_{Nj} , . 6 P_w)	Actual Sales to the Board	Equation (6)	Equation (6)'
				Knowledge of	(Incorporating
				Autoregressive Structure)	Autoregressive Structure)
£N/Ton			Tons		
1950	21.2	55.8	142743	570611	455667
1951	36.0	47.3	425588	498118	412341
1952	35.0	49.9	430696	555779	460351
1953	35.5	46.2	424648	538022	455093
1954	35.4	42.6	372776	557107	485381
1955	32.4	46.1	530215	632652	548160
1956	37.4	37.4	357932	547650	493094
1957	33.9	44.3	714698	658171	579086
1958	36.4	49.6	533354	634565	636602
1959	37.4	37.4	445441	613338	557521
1960	33.7	33.7	619051	648701	604268
1961	30.3	30.3	685549	643325	610082
1962	30.3	30.3	871524	679616	684380
1963	32.7	32.7	786727	759213	757207
1964	34.1	34.1	676797	850797	801180
1965	34.2	34.2	977320	901100	850192
1966	29.0	30.8	1026427	895400	855744
1967	26.0	26.1	679401	705332	684593

Source: For actual producer prices and sales, see p. 111.

Note: The hypothetical pricing leaves the farmer not worse off as prices are greater than or equal to the actual prices he received. The predicted sales here are therefore higher, on the average, than those when prices in each year are 60 per cent of world prices. Predictions incorporating knowledge of the autoregressive structure are lower.

A pricing policy of paying farmers 55 per cent of world prices would have benefitted farmers most of the 1950's but would have hurt them most of the 1960's. This fact is also reflected in the predicted sales relative to actual sales. Preference for this policy over the actual one that was followed could be justified thus: first, if there are any substantial irreversibilities in the underlying investment-disinvestment relations in groundnut production, then paying farmers higher net producer prices in the 1950's would have expanded productive capacity with the result that in the presence of taxes in the 1960's there would have been much more over production relative to the present state of affairs as there would have been no tendency towards investment or disinvestment in these resources because of these irreversibilities; second, for long run allocative purposes marketing board prices that are linear functions of world prices that should ultimately guide farmers' production decisions are preferable to prices that either have no functional relationship to world prices (as when election year politics and the political party in power determine board prices) or prices that may be nonlinear functions of world prices. These comments are applicable to subsequent tables.

Tables 5.6 and 5.7 show the effects of hypothesized new groundnut prices on government and marketing board tax revenue from groundnuts. Over the period, there are more

TABLE 5.6.--Tax Revenue: Estimated Changes From Higher Groundnut Prices, Larger Volume, Individually and in Total, Nigeria, 1950-1965.*

Year	Change From ^a Higher Prices $-(P'_{Nj} - P_{Nj})M_j$	Change From ^b Higher Prices and Larger Volume $(P - P'_{Nj})(M'_j - M_j)$	Net Change in Tax Revenue: a + b
£N			
1950	-4,938,907.8	513,441.6	-4,425,466.2
1951	-4,809,144.4	43,518.0	-4,765,626.4
1952	-6,417,370.4	50,033.2	-6,367,337.2
1953	-4,543,733.6	1,009,028.6	-3,534,705.0
1954	-2,683,987.2	1,695,845.2	-988,142.0
1955	-7,263,945.5	-491,697.5	-7,755,643.1
1956	501,104.8	859,505.0	1,360,609.8
1957	-7,432,859.2	-503,090.3	-7,935,949.5
1958	-7,040,272.8	-3,501,071.4	-10,933,930.6
1959	1,291,778.9	615,629.5	1,907,408.4
1960	3,404,780.5	-713,313.0	3,691,467.5
1961	2,742,196.0	-1,133,160.4	1,609,035.6
1962	4,619,077.2	-213,215.7	4,405,861.5
1963	4,563,016.6	-574,848.0	3,988,168.6
1964	2,233,430.1	1,431,086.4	3,664,516.5
1965	4,202,476.0	-1,759,225.5	2,443,250.5

Note: For P'_{Nj} , P_{Nj} , M_j and M'_j figures, see Table 5.3. The potential producer price figures were obtained by adding the composite tax per ton on groundnuts for each year (see Table 4.3, p. 111) to P_{Nj} , the actual net producer price. For derivation of the three columns, see p. 168. In the first column the change is negative (a reduction in the revenue from groundnuts) for most of the 1950's when hypothetical prices exceed actual prices; the converse holds for the 1960's: the 1950's thus correspond to a gain to farmers while the 1960's correspond to losses to them due to the new prices, relative to actual prices and actual sales. The second column corresponds to neither gains nor losses to farmers. The last column is defined as the net change in government and marketing board tax revenue from groundnuts as a result of the new prices. It is the second column plus the first, i.e.,

$$(P_p - P'_{Nj})(M'_j - M_j) - (P'_{Nj} - P_{Nj})M_j = M'_jP_p - M_jP_p - M'_jP'_{Nj} + M_jP'_{Nj} + P_{Nj}M_j = \\ P_p(M'_j - M_j) + P_{Nj}M_j - M'_jP'_{Nj}$$

Now, we can derive the last column from first principles. It is the difference between total government and marketing board tax revenue from groundnuts using the new hypothetical prices and total government and marketing board tax revenue from groundnuts using the actual producer prices paid by the board, i.e.,

$$M_j(P_p - P'_{Nj}) - M_j(P_p - P_{Nj}) = M'_jP_p - M_jP'_{Nj} - M_jP_p + M_jP_{Nj} = P_p(M'_j - M_j) + M_jP_{Nj} - M'_jP'_{Nj}$$

which is exactly the same expression for the third column derived above. *For M'_j see Table 5.1, equation (6).

years in which the hypothetical prices exceed actual prices than those in which they fall below them. In Tables 5.6-5.8, the first column shows the change in government and marketing board tax revenue from groundnuts due to the new prices (P'_{Nj}). The change involves a reduction in tax revenue if the new price exceeded the actual price and an increase in tax revenue if new prices were below actual prices. The second column shows the change in government and marketing board tax revenue due to the new prices when account is taken of the effect of the new prices on sales to the board. It is defined as the "tax" using the new price multiplied by the difference between the predicted sales to the board using the new prices and sales to the board under actual prices. An increase in tax revenue occurs when sales to the marketing board increase. A reduction obtains when predicted sales are less than actual sales. A positive change in one year in the second column is not the negative of the corresponding change in the first column because the two columns are derived differently. The third column shows the net change in government and marketing board tax revenue from groundnuts when everything is considered: actual price, (new) hypothetical price, potential producer price, actual sales, and predicted sales. With the definition given to the elements of column one, the third column is the sum of the first and second columns.

Advocates of the revenue role of marketing boards have implicitly or explicitly assumed that all elements of the second column are zero: that sales do not change as producer prices rise or fall, so that $M'_j - M_j = \Delta M_j \equiv 0$ (see Table 5.6). Our entries in this column, particularly in the 1950's when hypothetical prices exceed actual prices show that these sales effects of price changes are not definitionally zero. The significance of the entries in the second column is that they partially offset the change in tax revenue from groundnuts due to the new prices relative to the actual prices and actual sales. How big is this offset?

The offset is very significant in some years. In 1954 for example, as a result of higher producer prices, farmers would have gained £N 2,683,987.2, the government and marketing board would have gained £N 1,695,845.2 from the positive price sales effect, leaving the government and marketing board a net (groundnut tax) revenue loss of £N 988,142.0. Total tax revenue from groundnuts in the same year was £N 5,125,384,424,²⁸ thus still leaving government and marketing board revenue at £N 4,137,242.4. Thus, even though taxes could have been drastically cut down in this year leading to extra income for farmers of over two and a half million pounds,²⁹ total tax revenue from groundnuts would have been little affected. Similarly, in 1953, as a result of the postulated higher

producer prices, groundnut farmers in the Northern States would have gained £N 4,543,733.6, the government and marketing board would have gained £N 1,009,028.6 from the positive price sales effect, thus leaving the government and marketing board with a net revenue loss of £N 3,534,705.0. With total tax revenue from groundnuts of £N 4,788,395.8³⁰ in the same year, the government and the marketing board would still have been left with a handsome positive balance of well over one and a quarter million pounds from groundnuts alone. In 1952, with higher producer prices, farmers would have gained in increased income £N 6,417,370.4; the government and marketing board from the positive price sales effect would have gained £N 50,033.2, thus leaving a net tax revenue loss of £N 6,367,337.2. But with a total tax revenue from groundnuts of £N 7,375,800 in 1952,³¹ this could have still left a positive balance with the government and marketing board. In 1950 and 1951 would the government and marketing board have ended up in a net total revenue deficit. For most of the other years (see Table 5.6), the government and marketing board would have been better off in revenue terms because on the average, 60 per cent of world price was less than actual producer prices. Roughly the same trends in terms of the degree to which revenue losses are offset by the positive price sales effect can be observed in Table 5.7.

TABLE 5.7.--Tax Revenue: Estimated Changes From Higher Groundnut Prices, Larger Volume, Individually and in Total, Nigeria, 1950-1965. **

Year	Change From ^a Higher Prices $-(P'_{Nj} - P_{Nj})M_j$	Change From ^b Larger Volume and Higher Price $(P_p - P'_{Nj})(M'_j - M_j)$	Net Change in Tax Revenue: a + b
	₦N		
1950	-4,938,907.8	485,882.4	-4,453,025.4
1951	-4,889,144.4	421,068.0	-4,388,076.4
1952	-6,417,370.4	228,995.2	-6,188,375.2
1953	-4,543,733.6	1,218,588.0	-3,325,145.6
1954	-2,683,987.2	2,025,453.6	-658,533.6
1955	-7,263,945.5	-837,700.8	-8,101,646.3
1956	501,104.8	898,115.0	1,399,219.8
1957	-7,432,859.2	213,475.4	-7,219,383.8
1958	-7,040,272.8	-5,894,023.8	-12,934,296.6
1959	1,291,778.9	617,819.7	1,909,598.6
1960	3,404,780.5	-1,933,975.2	1,470,805.3
1961	2,742,196.0	-2,349,085.6	393,110.4
1962	4,619,077.2	-3,474,404.2	1,144,673.0
1963	4,563,016.6	-1,760,256.0	2,802,760.6
1964	2,233,430.1	822,744.0	3,056,174.1
1965	4,202,476.0	-2,824,767.0	1,377,709.0

Source: For P'_{Nj} , P_{Nj} , M_j , and P_p , see Table 5.4. For derivation of columns, see p. 168, and note to Table 5.6. **For M'_j see Table 5.4, equation (7).

With the price series $P_{Nj} = \max (P_{Nj}, \cdot 6P_w)$, the overall extent to which lost tax revenue is offset by the positive price sales effect is even larger.³² Because the new hypothetical prices never fall below actual producer prices, farmers are not worse off. In Table 5.3, it is evident that government and marketing board are better off in the 1960's while the farmers are worse off. In Table 5.5 with a new pricing policy, the farmers are not worse off at any time.

In Table 5.8 the net change in tax revenue from groundnuts due to the new hypothetical prices relative to actual producer price, potential producer price, actual sales, and predicted sales to the board is shown in the third column. The zero entries in the last seven rows of the first column reflect the fact that the new prices were the same as actual prices in those years.

Relative to the price series in Tables 5.6 and 5.7, the prices underlying Table 5.8 are higher in the 1960's. Farmers therefore gained. The net losses in tax revenue as a result of these higher prices in the 1960's are insignificant (third column): £N 104,553.2 in 1963. With this new pricing policy, government and marketing board policy would not have been substantially affected, on the average. Farmers would have gained without the government and marketing board being significantly worse off in revenue terms.

TABLE 5.8.--Tax Revenue From Groundnuts: Estimated Changes From Higher Prices, Larger Volume, Individually and in Total, Nigeria, 1950-1965.

Year	Change From ^a Higher Prices $-(P'_{Nj} - P_{Nj})M_j$	Change From ^b Larger Volume and Higher Price $(P_p - P'_{Nj})(M'_j - M_j)$	Net Change in Tax Revenue: a + b
£N			
1950	-4,938,907.8	513,441.6	-4,425,466.2
1951	-4,809,144.4	43,518.0	-4,765,626.4
1952	-6,417,370.4	50,033.2	-6,376,337.2
1953	-4,543,733.6	1,009,028.6	-3,534,705.0
1954	-2,683,987.2	1,695,845.2	-988,142.0
1955	-7,263,945.5	-491,697.6	-7,755,643.1
1956	. .	682,984.8	682,984.8
1957	-7,432,859.2	-503,090.3	-7,935,949.5
1958	-7,040,272.8	-3,501,071.4	-10,933,930.6
1959	. .	302,214.6	302,214.6
1960	. .	352,835.0	352,835.0
1961	. .	-346,220.4	-346,220.4
1962	. .	-844,395.2	-844,395.2
1963	. .	-104,553.2	-104,553.2
1964	. .	1,305,000.0	1,305,000.0
1965	. .	701,224.0	701,224.0

Source: For P'_{Nj} , P_{Nj} , M_j see Table 5.5. For P_p see P. 168
For derivation of columns see P. 111. For M'_j see Table 5.5,
equation (6).

In the case of cotton, only a brief description is given as the procedures for assessing government and marketing board (tax) revenue effects of changes in the board's net producer prices of cotton are the same as those used for groundnuts above.

Actual producer prices paid to Northern States cotton farmers (1950-67) had a mean percentage of potential producer price (world cotton price minus all marketing costs) of 84.6 per cent.³³ Three new hypothetical price series were then constructed on the assumption that the board paid cotton farmers the following percentages of world prices minus all marketing costs (i.e., potential producer price)³⁴ in each year 1950-67: 80 per cent, 85 per cent, and 90 per cent. As with groundnuts, we stay on one side of the actual mean percentage since our primary interest is in the sales and tax revenue consequences of paying cotton farmers higher prices. However, the linear regression model is capable of handling the case of paying cotton farmers lower prices too. This new set of prices is then used to predict cotton sales, assuming other variables remain at their sample values. The results are shown in Table 5.9.

From Table 5.9, our estimates indicate that if farmers were paid 85 per cent of potential producer price in each year, they could have been better off in the 1950's but worse off in the 1960's, relative to the actual

TABLE 5.9.--Predicted Cotton Sales Assuming Marketing Board Prices at 85 Per Cent of Potential Level, Northern States, Nigeria, 1950/51-1967/68.

Year	Actual Producer Prices	Producer Price if Board Paid 85 Per Cent of Potential Price	Actual Sales to the Board	Predicted Sales Using New Prices
	£N/Ton		Tons	
1950	36.37	47.48	42,240	48,550
1951	55.07	71.90	63,679	78,341
1952	55.07	71.90	50,825	83,526
1953	54.81	83.34	75,366	102,639
1954	55.10	67.49	98,663	97,596
1955	54.68	69.47	80,791	106,514
1956	55.13	61.42	72,951	99,869
1957	54.88	58.60	123,906	99,704
1958	54.91	46.67	87,374	82,357
1959	55.07	44.58	85,892	83,569
1960	55.07	45.01	148,962	95,314
1961	46.67	39.70	83,373	89,590
1962	45.27	42.10	144,004	103,865
1963	45.27	44.43	128,585	115,729
1964	66.67	49.59	128,684	132,304
1965	46.67	46.07	127,296	130,301
1966	44.80	37.04	146,368	111,141
1967	42.93	35.50	75,519	93,272

Source: For actual prices and sales, see p. 109. For most of the 1950's, the hypothetical prices were higher than actual prices received by cotton farmers in the Northern States. Consequently, the predicted sales tend to be higher than actual sales from the positive price sales effect. The converse holds for most of the 1960's. For source of actual producer prices, see page 109. The hypothesized price series make producer prices a simple linear function of world prices and marketing costs. This is to be preferred to a situation in which producer prices are either not related to world prices (as when election year politics and the party in power determine producer prices paid by the board) or one in which producer prices are, in some (unknown) way, nonlinear functions of world prices.

prices they received. That is why we have constructed a new price in which we suppose the marketing board paid cotton farmers a price:

$$P'_{Njt} = \max (P_{Njt}, .85P_{pt})$$

where P'_{Njt} is the hypothetical new price in year t , P_{Njt} is actual producer price in year t and P_{pt} is potential producer price of cotton in year t .³⁵ The predictions based on P'_{Njt} above are shown in Table 5.10.

The resulting changes in tax revenue from cotton with the two hypothetical pricing policies are shown in Tables 5.11 and 5.12. The elements of the three columns in each table are arrived at in exactly the same way as with groundnuts. The first column shows the change in tax revenue from cotton due to the new prices, P'_{Nj} , relative to the actual producer price, P_{Nj} , and actual sales to the board, M_j ; it is the difference between the new price and the actual price multiplied by actual sales, being negative (and thus a reduction in tax revenue) when the new price exceeds the actual price, positive (and thus an increase in tax revenue) when the new price is less than the actual price and zero when the new price equals the actual price. When the change represents a reduction in tax revenue, the entries represent a gain to farmers in monetary income; when the change represents an increase in tax revenue, farmers lose, relative to the actual prices received.

TABLE 5.10.--Predicted Cotton Sales Assuming Marketing Board Prices at $P'_{Nj} = \max(P_{Nj}, .85P_p)$, Northern States, Nigeria, 1950-1967.

Year	Actual Producer Prices	Producer Price if Board Paid $P'_{Nj} = \max(P_{Nj}, .85P_p)$	Actual Sales to the Board	Predicted Sales Using New Prices
	₦N/Ton		Tons	
1950	36.37	47.48	42,240	48,550
1951	55.07	71.90	63,679	78,341
1952	55.07	71.90	50,825	83,526
1953	54.81	83.34	75,366	102,639
1954	55.10	67.49	98,663	97,596
1955	54.68	69.47	80,791	106,514
1956	55.13	61.42	72,951	99,869
1957	54.88	54.60	123,906	99,704
1958	54.91	54.91	87,374	95,360
1959	55.07	55.07	85,892	101,200
1960	55.07	55.07	148,962	114,300
1961	46.67	46.67	83,373	103,800
1962	45.27	45.27	144,004	119,000
1963	45.27	45.27	128,585	117,600
1964	66.67	66.67	128,684	179,000
1965	46.67	46.67	127,296	131,800
1966	44.80	44.80	146,368	131,999
1967	42.93	42.93	75,519	110,997

Note: Because farmers are never worse off in this regime as hypothetical prices are never below actual prices, predicted sales are, on the average, higher than actual cotton sales most of the period. For P_{Nj} , P_p see Table 5.9.

TABLE 5.11.--Tax Revenue From Cotton: Estimated Changes From Higher Prices, Larger Volume, Individually and in Total, Nigeria, 1950-1967.

Year	Change From ^a Higher Prices $-(P'_{Nj} - P_{Nj})M_j$	Change From ^b Larger Volume and Higher Price $(P_p - P'_{Nj})(M'_j - M_j)$	Net Change in Tax Revenue: a + b
£N			
1950	-468,864.0	159,479.9	-309,284.1
1951	-1,071,717.6	608,033.1	-463,684.4
1952	-855,384.8	414,321.7	-441,063.1
1953	-2,150,192.0	402,822.2	-1,747,369.8
1954	-1,222,434.6	-12,707.9	-1,235,142.5
1955	-1,194,898.9	314,077.8	-880,821.1
1956	-458,861.8	290,983.6	-167,878.2
1957	-460,930.3	-251,216.8	-712,147.1
1958	719,961.8	-41,139.4	678,822.4
1959	901,007.1	-18,328.5	882,678.6
1960	1,498,557.7	-432,402.9	1,066,154.8
1961	581,109.8	43,332.5	624,442.3
1962	456,492.7	-315,893.9	140,598.8
1963	103,011.4	-99,550.5	8,506.0
1964	2,197,922.7	29,973.6	2,227,896.3
1965	76,377.6	24,641.0	101,018.6
1966	1,135,815.7	227,566.4	1,363,382
1967	561,106.17		

Source: For P_{Nj} , M_j and M'_j see Table 5.9. For derivation of columns see p. 175.

TABLE 5.12.--Tax Revenue From Cotton: Estimated Changes From Higher Prices, Larger Volume, Individually and in Total, Nigeria, 1950-1967.

Year	Change From ^a Higher Prices $-(P'_{Nj} - P_{Nj})M_j$	Change From ^b Larger Volume and Higher Price $(P_p - P'_{Nj})(M'_j - M_j)$	Net Change in Tax Revenue: a + b
		£N	
1950	-468,864.0	159,643.3	-309,220.7
1951	-1,071,717.6	608,033.1	-463,684.5
1952	855,384.8	410,900.77	-444,484.0
1953	-2,150,192.0	402,822.21	-1,747,369.8
1954	-1,222,434.6	12,707	-1,209,727.6
1955	-1,194,898.9	314,077.83	-880,821.1
1956	-458,861.8	290,983.58	-167,878.2
1957	-460,930.3	-251,216.76	-712,147.1
1958	. .	-34,649.04	-34,649.04
1959	. .	-39,800.80	-39,800.80
1960	. .	-159,445.20	-159,445.20
1961	. .	. .	. .
1962	. .	-117,518.80	-117,518.8
1963	. .	-75,796.50	-75,796.5
1964	. .	-442,780.8	-442,780.8
1965	. .	34,230.40	34,230.4
1966	. .	18,679.70	18,679.7
1967	. .		

Source: For P'_{Nj} , P_{Nj} , see p. 175. For derivation of columns see p. 176. For M'_j see Table 5.10.

The second column shows the change in government and marketing board tax revenue from cotton due to the new hypothetical prices and new predicted sales relative to potential producer prices and actual sales. It is the difference between the potential producer price and the new price multiplied by the difference between predicted sales and actual sales. It is positive (and thus an increase in tax revenue from cotton) so long as these two differences are both positive or both negative,³⁶ and negative (and thus a decrease in tax revenue from cotton) so long as these two differences are of opposite signs.

The third column represents the net change in government and marketing board tax revenue from cotton due to the new prices and the predicted sales relative to actual producer prices, actual sales and potential producer price: it is the second column plus the first. Derived from first principles, it is the total tax revenue from cotton with new prices and predicted sales minus total tax revenue from cotton using actual producer prices and actual sales.³⁷ Tables 5.11 and 5.12 show these results for the two hypothetical price series. From Table 5.12 in 1953, with the new higher prices for farmers, farmers would have gained £N 2,150,192.0 (a loss to the government and marketing board), the government and marketing board would have gained £N 402,822.2 as a result of the positive price effect on sales, thus leaving the latter a net

revenue loss of £N 1,747,369.8. Total tax revenue from cotton in 1953, incorporating the price effect on sales, was calculated to be £N 4,788,395.8.³⁸ Thus, tax revenue is not significantly affected. In 1957, as a result of the higher prices, farmers would have gained £N 460,930.3, the government and marketing board would have lost £N 251,216.76, leaving a total loss of £N 712,147.1. Total tax revenue from cotton in 1957 incorporating the positive price effect on sales would have been £N 5,857,721.9.³⁹ The loss from paying farmers higher prices still does not substantially affect tax revenue from cotton. In 1954, with the new higher prices, farmers would have gained £N 1,222,434.6, tax revenue would have increased by £N 12,707 as a result of the positive price effect on sales thus leaving a net revenue loss to the government and the board of £N 1,209,727.6. The calculated total tax revenue from cotton in same year is £N 5,125,384.4. A 20 per cent reduction in revenue with farmers gaining twice what the government and marketing board lose is certainly not a drastic reduction. For given new higher prices and marketing costs, the lower the potential producer price, the lower the gain in tax revenue resulting from the positive effect of tax increases on sales. This gain is in fact zero when potential producer price equals the new higher price as in 1961.

The central point is to show that the elements of the second column are not identically zero as has been implicitly assumed by those concerned about the revenue functions of the marketing boards. It is reassuring that for many years when farmers received higher producer prices, government and marketing board tax revenue from cotton was not substantially affected.

Summary and Conclusions

In the first part of the chapter, I presented a simultaneous equation model in which the sales supply equation of a marketing board crop was one of four structural equations of the system. Identifiability of the sales supply equation was ascertained after which the reduced form solutions of the endogenous variables were derived. The reduced form solution for sales of a crop to the marketing board could not be estimated for lack of data--availability of data on the other endogenous variables in the sales supply equation would have enabled us to estimate the sales supply equation by two stage least squares. The intent here was to provide a model that approximates our apriori knowledge about the variables that influence the sales of a crop to the marketing board. This simultaneous equation approach should prove useful as more data become available.

The model was operationalized to remove obvious sources of biasedness and inconsistency from our ordinary

least squares estimates. In this second section of the chapter, coefficients of regressors in the sales supply equation were estimated. For groundnuts, the sales supply equation reflecting more or less "short run" influences in linear form gave a sales supply elasticity of .714 with respect to the board's net producer price, calculated at the sample means of observations on groundnut sales and net producer prices. The log equation of groundnut sales gave an elasticity of sales of groundnuts to the board with respect to the board's producer prices of 1.3139. My efforts to correct for autocorrelation produced inconclusive results. That was why the transformation of variables with the autocorrelation coefficient calculated from the least squares residuals was done for only the groundnut equations and not done for the cotton equations. For cotton, the sales supply elasticity with respect to the board's producer price was estimated to be .90278.

I tested for a difference between the expansion sales price elasticities and contraction sales price elasticities corresponding to the rising and falling phases of the marketing board's producer prices respectively. I found no significant difference. This does not necessarily mean that there are no significant irreversibilities in the investment-disinvestment relations underlying the production of groundnuts and cotton: our test was not able to capture some important relevant

factors that are known from apriori knowledge to influence farmers' investment-disinvestment decisions.

In the third section of the chapter, I provided quantitative evidence on the effects on tax revenue from cotton and groundnuts of paying Northern States farmers higher prices. Predictions of sales of cotton and groundnuts (to the board) under different hypothetical prices were made. It was found that when hypothetical prices were higher than actual prices, predicted sales exceeded actual sales of these crops to the board. This implies that other things equal, taxes on cotton and groundnuts reduced sales of these crops to the board.

These predicted sales together with the implied lower taxes on farmers were used to compute the revenue effects of (generally) higher prices to groundnut and cotton farmers in the Northern States. When the board paid farmers higher (hypothetical) prices, farmers gained in monetary income. Some of this gain however must be offset by their loss in consumer surplus as they cut down their own home consumption of these crops. We did not estimate this loss in consumer surplus. Our estimates show that the positive effect of higher prices on sales (to the board) partially offsets the loss in tax revenue due to the higher prices. Our main point has been to show that this offset of tax revenue loss is not identically zero as has been implicitly or explicitly assumed by

previous writers. With higher prices than the actual prices received by farmers, this tax revenue loss offset is larger, the larger the difference between predicted and actual sales. This offset is also larger the larger the difference between the potential producer price (i.e., world price minus all marketing costs) and the hypothetical price. The higher the sales price elasticity,⁴⁰ the higher the predicted sales and thus the larger the offset in tax revenue loss from the positive effect of higher prices on sales to the board.

The following conclusions are drawn. Sales of cotton and groundnuts to the board are very responsive to changes in the board's producer prices. The positive effect of higher (hypothetical) prices on sales to the board was able to substantially offset the crop tax revenue loss that results from paying farmers higher prices in many years in the 1950's and 1960's; in other years there would have been sizeable reduction in crop tax revenue.

There is an inevitable shortcoming in the analysis: we have not been able to account for the production effects of higher prices directly because of lack of data or even reliable estimates of total output or production of any of the crops studied. It is hoped that as more data becomes available, this factor will be incorporated in the analysis.

FOOTNOTES

¹We have not included smuggling in this formulation.

²Jan Kmenta, Elements of Econometrics (New York: Macmillan Co., 1971).

³Ibid., pp. 543-45.

⁴With no compelling apriori reason to believe that either the elasticity of supply (output) of any marketing board crop with respect to its net producer price is unity or that the marginal propensity to consume this crop is zero, we shall, respectively, presume ω_0 and α_2 to be non-zero.

⁵Charles R. Frank, Jr., Statistics and Econometrics, (New York: Holt, Rinehart and Winston, Inc., 1971), p. 332.

An alternative statement of the necessary and sufficient condition for identifiability is that we can form at least one nonvanishing determinant of order $G-1$ from the coefficients with which the variables excluded from our equation appear in the $G-1$ other structural equations. By this criterion,

$$\Delta^* = \begin{bmatrix} 1 & -\alpha_2 & 0 & 0 \\ 0 & 0 & -\omega_2 & -\omega_3 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

with at least one largest nonsingular submatrix with rank = $3 = G-1$, again showing that the sales supply equation is identified. For this alternative statement see G. Tintner, Econometrics (New York: John Wiley and Sons, Inc.), p. 157.

⁶Kmenta, op. cit., p. 551.

⁷For evidence which may or may not cast doubts on estimates of total output from existing data in the case of cotton, see footnote 14 on p. 125.

⁸This more or less corresponds to an assumption that in equilibrium, the price per unit of the crop in the domestic market equals the net producer price paid by the board net of transportation and other marketing costs. If the argument were extended to include markets in neighboring countries serviced by smugglers, then this equilibrium price also equals the net producer price in these countries properly adjusted for transportation and normal marketing costs, weighted by the probability of not getting caught (arrested) in the process of smuggling and the probability of not getting a conviction after arrest.

⁹This increased sale to the marketing board and reduced consumption as a result of higher marketing board prices need not be restricted to the usual substitution and income effects describing the response of consumers to price changes in their capacity as consumers per se. Indeed, in the Nigerian case, producers of most marketing board crops are consumers as well as producers of their crops. So there is a producer income effect as well as a consumer income effect. If Nigerian farmers consume a significant proportion of their crop and the (implied) income elasticity of demand for this crop is very low or negative, then an increase in the net producer price paid by the marketing board will lead to less consumption and more sales to the marketing board.

¹⁰For treatment of the dominant firm on the selling side, see G. Stigler, "Notes on the Theory of Duopoly," Journal of Political Economy (1940).

¹¹If this were not the case, the disturbance term and the income variable would be jointly distributed which would make the OLS estimates inconsistent.

¹²Glenn L. Johnson, "The State of Agricultural Supply Analysis," Journal of Farm Economics (1960).

¹³E. Malinvaud, Statistical Methods of Econometrics 2nd revised ed.; Amsterdam-London: North-Holland Publishing Co., 1970), p. 567.

¹⁴For possible usefulness of this exercise, see J. Johnston, Econometric Methods (New York: McGraw Hill Book Company, 1960).

¹⁵This indeed may be the case. A major form in which groundnuts are eaten domestically (and thus diverted away from the marketing board) is through roasting or frying of the nuts. It is not unlikely that consumption in this form falls as income rises.

¹⁶We assume that the disturbance, ε_t , follows a first order autoregressive scheme:

$$\varepsilon_t = \rho\varepsilon_{t-1} + U_t \quad (t = 2, \dots, n)$$

so that the transformed equation which is estimated with OLS to give (6)' above is:

$$y_t - \hat{\rho}y_{t-1} = \beta_0(1-\hat{\rho}) + \beta_1(x_{2t} - \hat{\rho}x_{2t-1}) + \beta_2(x_{3t} - \hat{\rho}x_{3t-1}) + U_t.$$

where $\hat{\rho}$ is the estimated autocorrelation coefficient from the residuals of (6). This method is only a special case of the iterative procedure suggested by Cochrane and Orcutt (see D. Cochrane and G. H. Orcutt, "Application of Least Squares Regressions to Relationships Containing Auto-correlated Error Terms," Journal of the American Statistical Association [March, 1949]). Our two stage procedure which does not go through the whole iterative procedure until convergence of the values of the estimates is attained does, however, possess the same asymptotic properties as the maximum likelihood estimators. Little is known about their small sample properties. See Kmenta, op. cit., p. 288.

¹⁷See the discussion on p. 103, especially footnote 2.

¹⁸The simple correlation coefficient between income and lagged groundnut price is 0.5280.

¹⁹This test is rather weak. The magnitude of the price change, the most recent history of relative prices and the process by which Northern States farmers form and revise their expectations about future board prices are all relevant factors that are not captured by this test.

²⁰See discussion on p. 63.

²¹S. A. Oni, "Econometric Analysis of Supply Response Among Nigerian Cotton Growers," Bulletin of Rural Economics and Sociology (Ibadan: University of Ibadan, 1969). Oni's two estimates were .2069 and .2593 (see Ibid., p. 217). Assuming the change in sales per unit change in the board's price exceeds the corresponding change in output (production), then we expect our sales price elasticity to exceed the output (production) elasticity. This is likely to be so for most marketing board crops that have multiple market outlets.

²²For possible reasons for the sign see p. 151.

²³For reasons for including the trend variable, see p. 145.

²⁴See qualifications on p. 149, especially footnote 19.

²⁵Not all cases of the transformation exercise on the groundnut equations are reported here.

²⁶This mean figure was computed from the annual percentage figures reported in S. O. Olayide and Dupe Olatunbosun, "The Effect of the Marketing Boards on the Output and Income of Primary Producers," (NISER, 1971), p. 17.

²⁷One alternative would have been to go further right of the mean percentage of world prices that was actually paid (mean $[P_{Nj}/P_w]100 = 55.01\%$). The highest percentage of world prices farmers actually received in the sample period was 79.7 per cent in 1961. I could have then hypothesized a new price series with farmers receiving a percentage of world prices in each year in the neighborhood of 79.7 per cent. I, therefore, constructed a price series on the assumption farmers received 70 per cent. The maximum value in this series was £N 110.52 in 1951 and the minimum value was £N 27.61 in 1962. The mean of actual producer prices that farmers received (1950-67), the price series used in estimating the regression equations, was £N 33.38. There were only four years in which the hypothetical prices would have been below this mean; most of the other years, they were much higher (e.g., £N 62.14 in 1959, £N 56.58 in 1953, £N 55.14 in 1952, £N 110.52 in 1951, etc.). Thus, deviations from the mean of our original sample would have been very large. This would have made our predictions of sales to the board more

imprecise. That is why I hypothesize a new price series in which we stay at 60 per cent of world prices but in which we avoid subperiods in which our hypothetical prices are lower than the actual prices farmers received.

²⁸The total tax revenue figures are derived by multiplying the new predicted sales for a given year by the difference between the potential producer price (P_p) and the new hypothetical P_{Nj} (= 60 per cent of world price). For the derivation of potential producer price in each year, see Table 4.3. There is an implicit assumption here and in all calculations of the revenue impact of new hypothetical prices that the change in sales induced by the new hypothetical prices does not affect the world price. Within the relevant price increases permitted with the new hypothetical prices, it is unlikely that the induced increase in sales will significantly affect world prices.

²⁹This represents only the monetary income gain to farmers; real gains may not rise in the same proportion as incremental sales to the board lead to a reduction in the farmers' own home consumption.

³⁰See footnote 28 for method of calculation.

³¹See footnote 28 for method of calculation.

³²For the rationale behind this hypothesized pricing policy, see footnote 37.

³³This mean percentage of potential producer price was calculated from H. C. Kriesel, "Cotton Marketing in Nigeria," CSNRD 24 (East Lansing: Michigan State University, 1968), p. 73.

³⁴For potential producer price figures see p. 109.

³⁵I rejected the alternative of going further to the right of the actual mean (P_{Nj}/P_p) (mean (P_{Nj}/P_p) = .846 for the period 1950-67) by choosing a higher P_{Nj}/P_p ratio because this would have led to large positive deviations between our new hypothetical prices, P_{Nj} and the mean of the actual prices received (calculated to be $\bar{P}_{Nj} = 50.68$) that were used to estimate the regression equation and this in turn would have increased the imprecision of our predictions.

³⁶Though "both negative" is mathematically correct, we doubt its economic importance.

³⁷When the third column is defined as the second column plus the first, it is:

$$(P_p - P'_{Nj}) (M'_j - M_j) - (P'_{Nj} - P_{Nj}) M_j$$

When the third column is derived from first principles, it is: $(P_p - P'_{Nj})M'_j - (P_p - P_{Nj})M_j$. The two expressions are equivalent. See p. 166.

³⁸These are calculated by multiplying the difference between potential producer price (P_p) [for figures on this see Table 4.1] and the new higher price (P'_{Nj}) by the estimated sales (M'_j).

³⁹See footnote 38 for method of calculation.

⁴⁰See p. 144 and pp. 68-69 for reasons that may possibly lead to an underestimate of the sales price elasticity.

CHAPTER VI

MARKETING BOARDS AS POTENTIAL STABILIZERS OF STATE GOVERNMENT REVENUES

Introduction

Stabilization of producer prices or producer incomes was the original raison d'etre for the establishment of the marketing boards.

With the emphasis shifting to the fiscal role of these boards, a new rationalization is emerging: that they can help stabilize State Government revenues.

First, are (crop) tax revenues "stable?" What does our apriori knowledge tell us about the nature of factors influencing the supply and demand for these crops? What do these influences lead us to expect with respect to "stability" in volume of sales of crops to the boards? Second, can fluctuations in (crop) tax revenues offset fluctuations in State Government revenues from other sources apart from taxes on marketing board crops?

The third objective of this study is to examine the extent to which reliance on revenue contributions from

marketing boards and allied statutory corporations can be trusted to stabilize State Government revenues.

This chapter is divided into four sections. The first section examines total variance of revenue from taxes on marketing board crops; the second section looks at the relationship between numbers of crops and stabilization of average revenue yield per crop; in the third section, total variance of (crop tax) revenue is minimized subject to certain constraints while the fourth section looks at variances and covariances of total State Government revenues with and without revenue contributions from marketing boards and allied statutory corporations.

Marketing Boards as Potential
Stabilizers of State
Government Revenue

It has recently been suggested that "one important fiscal implication of the regionalization of the marketing boards is their conversion from potential stabilizers of producer prices into potential stabilizers of Regional Government revenue.¹ This potential is implicitly recognized in Helleiner's strong advocacy for the fiscal role of marketing boards. This is a very important issue because in it lies a potentially powerful new justification for widening the taxing powers of the marketing boards. Many State Government Agricultural Officers did suggest widening the powers of the marketing boards at the (summer) 1971 Seminar of the National Agricultural Development

Committee held at the University of Ibadan. Is the revenue stabilizing potential of marketing boards real?

Suppose stabilization means minimizing deviations from the mean revenue of the State Government over a given plan period so that a factor will be stabilizing if it reduces the variance of total State Government recurrent and capital revenue over a projected plan period of some years into the future. Let total revenue from taxes on m marketing board crops over the given plan period be the sum of revenues from taxes on the m individual crops, i.e.,

$$R = \sum_{j=1}^m R_j = \sum_j t_j M_j \quad (1)$$

where R is total revenue from taxes on all marketing board crops within a given State over the projected State Development plan period; R_j is the total revenue from taxes on the j th crop over the plan period; t_j is the unit tax rate (e.g., £N per ton) on the j th crop assumed constant to simplify arithmetic; M_j is total sales of the j th crop to the board over the plan period. From the point of view of the State Government and the marketing board, sales of any crop to the board can assume any positive value in any given year or when the whole plan period is considered. For all practical purposes then, given the uncertainty about the volume of sales of a given crop over the plan period, this volume of sales to the marketing board can be treated as a random variable. Therefore, total revenue

accruing to the State Government and its marketing board from taxes on marketing board crops is also a random variable.²

The variance of total (crop) tax revenue is:³

$$V(R) = \sum_{i,j=1}^m \sigma_{ij} t_i t_j \quad (2)$$

where σ_{ij} is the covariance between the sales of the i th crop and sales of the j th crop to the marketing board and where we have, for simplicity, regarded the unit taxes as constants. Thus the variance of revenue from taxes on marketing board crops depends on the levels of taxes, the variances of sales of individual crops and the covariances between sales of all the crops. For given positive correlations between sales of crops, the higher the variances of individual crops, the higher the variance of total crop tax revenue.

When the sales of all crops to the marketing board of a given State are independent of one another, then the covariance matrix of sales of these crops is the diagonal matrix with the i th diagonal element being the variance of sales of the i th crop to the board over the plan period and the variance of total revenue from taxes on all m crops is:

$$V(R) = \sum_{j=1}^m t_j^2 \sigma_j^2 \quad (3)$$

where σ_j^2 is the variance of sales of the j th crop to the board. Thus in the case where the covariance matrix of sales of all crops under marketing board control to the board is the diagonal matrix either because the sales are mutually uncorrelated or because they are independent, then it follows that the more crops are brought under the control of the board the greater the (absolute) variance of total revenue from taxes on these marketing board crops.⁴

The same result follows if all the off-diagonal elements of the covariance matrix were positive. If some or all of the off-diagonal elements of the covariance matrix of sales to the board were negative, then it is possible to reduce total variance in (crop tax) revenue by bringing more crops under marketing board control.

With non-independence among sales of crops to a marketing board (or with negative correlation coefficients), stability of State Government revenue from revenue contributions of marketing board crops is therefore determined by the magnitudes of the correlation coefficients and the size of the diagonal elements.

Suppose public authorities are interested, not in the variance of total crop tax revenue, but in the variance of some "average tax revenue yield per crop."

Let the State Government expect from its marketing board and allied statutory corporations a sum equal to the arithmetic mean of total revenue from taxes on m marketing board crops equal to $\bar{R}$:⁵

$$\bar{R} = \frac{1}{m} \left(\sum_{j=1}^m R_j \right)$$

where R_j is total tax revenue from the j th marketing board crop.⁶

The variance of this is:

$$V(\bar{R}) = \left(\frac{1}{m}\right)^2 \left[\sum_{i=1}^m \sigma_{R_i}^2 + 2 \sum_{i < j} \sum \text{Cov} (R_i, R_j) \right] \quad (4)$$

where $\sigma_{R_i}^2$ is the variance in revenue from taxes on the i th crop and $\text{Cov} (R_i, R_j)$ is the covariance between revenue from taxes on the i th crop and revenue from taxes on the j th crop. The variance of the given contribution expected from marketing boards and allied statutory corporations then depends on the number of marketing board crops, the variances in revenues from individual crops and the covariances between revenues from the i th and j th crops ($i \neq j, i, j=1, \dots, m$). The effect of the number of marketing board crops in reducing the variance of this given sum ($\bar{R}$) is limited under present Nigerian circumstances.⁷ But more significant in the Nigerian case are likely to be the variance in sales of individual crops to

the marketing board and the correlations among sales. Marketing boards were set up as export monopsonies. In the past, for most of their crops, either there was no domestic demand (cocoa) or transport and storage facilities were so poor that surplus producing areas could not profitably send much of their products to deficit areas so that the marketing board was the effective "dominant firm" on the buying side (palm produce, beniseed, ground-nuts, etc.). There is now a large and expanding internal market for these crops (except cocoa) as population and real incomes have risen and transport and storage facilities are expected to improve in the years ahead. These internal market possibilities are even greater for any new food crops marketing boards may be contemplating to bring under their control. On the supply side, the usual uncertainties with respect to yield and weather exist, uncertainties which will increase with the transformation of agriculture from one depending mainly on traditional and farm-produced inputs to one depending increasingly on new inputs from the non-farm sector. With these demand and supply considerations it is only realistic under Nigerian circumstances to expect the variances of sales of present (and potential) marketing board crops to the boards to increase and thus increase the variance in expected revenue from the board, i.e., destabilize State government revenue. General economic conditions in

Nigeria will exercise influence on sales of some crops to the marketing board in the same direction, e.g., if expected relative food prices are rising in the Northern States, farmers will reduce their production of both cotton and groundnuts and conversely for a sufficient fall in expected relative food prices. These substitutions seem to have occurred in the Northern States in recent years. In such cases we expect sales of crops to the marketing board to be positively correlated. In the Northern States for the period 1947/48-1969/70, the correlation coefficient between all sales of seed cotton and groundnuts to the Northern States Marketing Board is 0.5713, that between groundnut sales and beniseed sales is 0.5475, that between groundnut sales and soyabean sales is 0.1344, that between seed cotton sales and beniseed sales is 0.2037, that between beniseed sales and soyabean sales is 0.4094 and the least correlation coefficient is that between seed cotton sales and soyabeans, 0.0567. An implied influence here is the common influence of supply factors on crops that can be grown in the same area; for some pairs of these crops the random variables influencing production as such are probably jointly and identically distributed.

In North Central State for the period 1956/57-1970/71, the correlation coefficient between sales of groundnuts and sales of seed cotton to the Northern States Marketing Board is 0.2737. On the other hand, in Katsina

Province, the correlation coefficient between sales of groundnuts and sales of seed cotton to the Northern States Marketing Board is $-.3263$ while in Zaria Province this correlation coefficient for the same period was $-.1105$. These negative coefficients most probably reflect the competition between these two crops in production in the two provinces. Large positive correlations among sales of crops to the board increase the variance of a given expected revenue contribution from the marketing board and allied statutory corporations, i.e., they destabilize total State Government revenue over a given plan period. Thus, if crops are taxed by the board whose variances in sales to the board are progressively larger than the variances of the present marketing board crops and which have large positive correlations, State Government revenue would be destabilized even if the number of marketing board crops becomes large.

The strongest argument to justify widening the taxing powers of the marketing boards so that they can help stabilize State Government revenues lies in the fact that the variance of the amount the State Government expects to receive from them and allied statutory corporations over a given plan period ($\bar{R}$) approaches the average covariance of the individual tax revenues from all the crops as the number of crops taxed by the government and the marketing board becomes very large. From (4) above,

$$V(\bar{R}) = \left(\frac{1}{m}\right)^2 \left[\sum_{i=1}^m \sigma_{R_i}^2 + \frac{(m-1)m}{2} \cdot \frac{\sum_{i < j} \text{Cov}(R_i, R_j)}{\frac{(m-1)m}{2}} \right] \quad (5)$$

$$= \sum_{i=1}^m \frac{\sigma_{R_i}^2}{m^2} + \frac{m-1}{m} \cdot (\text{average covariance})$$

$$\lim_{m \rightarrow m^*} \text{var}(\bar{R}) = \text{average covariance} \quad (6)$$

$m \rightarrow m^*$

where m^* is a very large number of marketing board crops.⁸ However, from our earlier arguments about the nature of the variances and covariances and the evidence below, there is no room for comfort. The most favorable circumstance is when this average covariance is zero. Our argument is that the average covariance in Nigerian circumstances is unlikely to be small. Using the covariances of sales of all crops to the Northern States Marketing Board as a proxy, we find the average covariance with four crops (cotton, groundnuts, beniseed, and soya-beans) for the period 1947/48-1970/71 to be 1,676,292,118.28. If the average covariance of revenues from these four crops comes close to this, then the potential for stabilizing State Government revenues through reliance on revenue contributions from marketing boards and allied corporations is small.

Let us now take account of the institutional set up. The Northern States Marketing Board is responsible

mainly for five crops: groundnuts, cotton, beniseed, soybeans, and palm produce.⁹ The board in each year (implicitly) decides how much of desired total crop tax revenue shall be borne by each crop. We could then ask the question: how should desired total crop tax revenue be distributed between these crops, so as to minimize the variance of total crop tax revenue subject to the constraint that the desired crop tax revenue is indeed realized?

In this case, we want to minimize:

$$\sigma_R^2 = \sum_{j=1}^5 W_j^2 \sigma_j^2 \text{ subject to}$$

$$(i) \quad \sum_{j=1}^5 W_j E(R_j) = \sum_{j=1}^5 W_j \mu_{R_j} = R^*, \text{ and}$$

$$(ii) \quad \sum_{j=1}^5 W_j = 1$$

where μ_{R_j} is the expected value of the tax revenue from the j th crop, W_j is the share of total desired crop tax revenue borne by the j th crop and R^* is the desired total crop tax revenue the board (implicitly) wants to raise over the given period. Form the Lagrangian:

$$L = \sum_{i,j} W_i W_j \sigma_{ij}^2 + \lambda_1 \left[\sum_j W_j E(R_j) - R^* \right] + \lambda_2 (\sum_j W_j - 1) \quad (7)$$

The necessary conditions for minimum variance are:

$$\frac{\partial L}{\partial w_i} = 2w_i \sigma_{R_i}^2 + \sum_{i < j} w_j \sigma'_{ij} + \lambda_1 E(R_i) + \lambda_2 = 0, \quad i, j = 1, \dots, 5$$

$$\frac{\partial L}{\partial \lambda_1} = \sum_j^5 w_j E(R_j) = R^*$$

$$\frac{\partial L}{\partial \lambda_2} = \sum w_j = 1,$$

where σ'_{ij} is the covariance between tax revenues from the i th and j th crops. The seven equations in the seven unknowns can be written as

$$\Gamma B = K$$

where

$$\Gamma = \begin{bmatrix} 2\sigma_1^2 & 2\rho_{12}\sigma_1\sigma_2 & 2\rho_{13}\sigma_1\sigma_3 & 2\rho_{14}\sigma_1\sigma_4 & 2\rho_{15}\sigma_1\sigma_5 & E(R_1) & 1 \\ 2\rho_{12}\sigma_1\sigma_2 & 2\sigma_2^2 & 2\rho_{23}\sigma_2\sigma_3 & 2\rho_{24}\sigma_2\sigma_4 & 2\rho_{25}\sigma_2\sigma_5 & E(R_2) & 1 \\ 2\rho_{13}\sigma_1\sigma_3 & 2\rho_{23}\sigma_2\sigma_3 & 2\sigma_3^2 & 2\rho_{34}\sigma_3\sigma_4 & 2\rho_{35}\sigma_3\sigma_5 & E(R_3) & 1 \\ 2\rho_{14}\sigma_1\sigma_4 & 2\rho_{24}\sigma_2\sigma_4 & 2\rho_{34}\sigma_3\sigma_4 & 2\sigma_4^2 & 2\rho_{45}\sigma_4\sigma_5 & E(R_4) & 1 \\ 2\rho_{15}\sigma_1\sigma_5 & 2\rho_{25}\sigma_2\sigma_5 & 2\rho_{35}\sigma_3\sigma_5 & 2\rho_{45}\sigma_4\sigma_5 & 2\sigma_5^2 & E(R_5) & 1 \\ E(R_1) & E(R_2) & E(R_3) & E(R_4) & E(R_5) & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 0 & 0 \end{bmatrix}; \quad B = \begin{bmatrix} w_1 \\ w_2 \\ w_3 \\ w_4 \\ w_5 \\ \lambda_1 \\ \lambda_2 \end{bmatrix}$$

and

$$K = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ R^* \\ 1 \end{bmatrix}$$

We can then solve for B:

$$B = \Gamma^{-1}K \quad (8)$$

From (8) it is evident that the shares of total (crop tax) revenue borne by any crop depends on the variances and covariances of individual crop tax revenue yields as well as the expected (tax) revenue yield of each crop. Expected tax revenue from a crop depends principally on expected sales of the crop to the board. To use weights derived from historical data for future planning requires an assumption that past trends continue into the future.

We expect the variance of (crop) tax revenues to be large on account of the large variances and positive covariances of sales of crops to the marketing boards.¹⁰ Let us now look at the relationship between revenue contributions from the boards and allied statutory corporations and State Government revenue from other sources.

Total State Government Revenues With
and Without Revenue Contributions
From the Marketing Board

Suppose R_T is total State Government revenue over the plan period inclusive of revenue contributions from the marketing board and allied statutory corporations made possible by continued taxes on marketing board crops over the plan period, R is revenue contribution from the board and allied corporations to State Government revenues over the plan period and Z is total revenue of the State Government over the plan period exclusive of contributions from the marketing board and allied statutory corporations.¹¹ For our measure of the "instability" or "fluctuations" in State Government revenue over the plan period, we use the variance of the revenue series. Thus, the variance of R_T will measure fluctuations in State Government revenue inclusive of contributions from the marketing board and allied statutory corporations (loans and grants) and the variance of Z will measure fluctuations in total State Government revenues exclusive of contributions from the marketing board and allied statutory corporations during the plan.

Within the context of this model, a suggestion that the boards will stabilize State Government revenues over a given period would mean that the variance of R_T will be less than the variance of Z . If the variance of $R_T(\sigma_{R_T}^2)$ exceeds the variance of $Z(\sigma_Z^2)$, then State

Government dependence on revenue from the marketing board and allied statutory corporations will actually destabilize State Government revenue. We know from

$$R_T = Z + R, \text{ that}$$

$$\sigma_{R_T}^2 = \sigma_Z^2 + \sigma_R^2 + 2\rho_{RZ} \sigma_R \sigma_Z \quad (9)$$

where σ_R^2 is the variance of revenue contributions from the board and allied statutory corporations and ρ_{RZ} , the correlation coefficient, measures how well the revenue contribution from the board and its allied statutory corporations help to stabilize State Government revenue over the plan period.

When $\rho_{RZ} = 0$, then the net (average) effect of revenue contributions from the marketing board and allied statutory corporations on deviations of Z from its mean would be zero, a neutral result with respect to the objective of stabilizing State Government revenue.

When $\rho_{RZ} = 1$, then dependence on contributions from marketing boards and allied statutory corporations in the form of loans and grants would be perfectly destabilizing for State Government revenues over a given plan period; in this case fluctuations in State Government revenues would be amplified the most as a result of dependence on revenue contributions from the marketing board and allied statutory corporations. As government

revenues from other sources tend to fall, those from its marketing board and allied statutory corporations would tend to fall and similarly for a rise in government revenues from other sources.

Dividing (9) through by σ_Z^2 , we find that if $\sigma_{R_T}^2 / \sigma_Z^2 < 1$, then the revenue contributions of the board and allied statutory corporations in the plan period have indeed helped to stabilize State Government revenue as suggested explicitly by Teriba and Olakanpo and implicitly by Helleiner; if $\sigma_{R_T}^2 / \sigma_Z^2 > 1$, then revenue contributions from the marketing board and allied statutory corporations during the plan period would actually destabilize State Government revenue; if $\sigma_{R_T}^2 / \sigma_Z^2 = 1$, then revenue contributions from the marketing board and allied statutory corporations would contribute nothing to the stability of State Government revenue in the plan period, i.e.,

$$\frac{\sigma_{R_T}^2}{\sigma_Z^2} \leq 1 \text{ according as } \rho_{RZ} \leq -\frac{1}{2} \frac{\sigma_R}{\sigma_Z} \quad (10)$$

from which if $\sigma_R = \sigma_Z$, then, $\sigma_{R_T}^2 / \sigma_Z^2 \leq 1$ according as $\rho_{RZ} \leq -\frac{1}{2}$

From equation (9) civil servants in state governments and academicians who believe or advocate the revenue stabilizing role of marketing boards and allied statutory corporations would be most delighted if $\sigma_R = \sigma_Z$ and $\rho_{RZ} = -1$ because this would be saying that the variance of state

government revenue over the plan period inclusive of revenue contributions (loans and grants) from the board and allied statutory corporations is zero. Factors causing fluctuations in their revenue contributions include the many random factors that influence planned output of crops (weather, technological uncertainty, etc.) and the many factors which influence planned sales to the marketing board (demand conditions in the country, demand conditions in neighboring countries, expected relative crop prices in these markets, etc.). The factors influencing State Government revenue exclusive of revenue contribution of boards and allied corporations include those factors that influence the revenue yield of personal income taxes and other direct taxes, Federal Government allocations that actually materialize, etc. It is only by accident that these sets of factors will operate in such a way as to render $\sigma_R = \sigma_Z$. The more responsive sales to the board of a marketing board crop are to changes in demand conditions on the home market and in neighboring countries, the larger would be the fluctuations of the revenue contributions of the marketing board and allied statutory corporations and therefore the more likely that State Government revenue would be destabilized.

There is growing evidence that reliance on revenue contributions from marketing boards and allied statutory corporations is actually destabilizing State Government

revenues and plan budget operations. For the 1971/72 Budget Year for the Western State,

Capital receipts of some ₦N 7 mill fell ₦N 5 mill short of estimates because the state of world markets, particularly for cocoa, made it impossible for the marketing board to make a contribution. . . . The Governor, Brigadier C. O. Rotimi, said that prospects for the coming year were better, although cocoa prices remained low and they still had to deal with smuggling, food shortage and inflation. . . .¹²

For most other marketing board crops including cotton and groundnuts, the factors making it "impossible for the marketing board to make a contribution" and thus leading to capital receipts falling short of estimates include an increasing diversion or sale of large quantities of these crops to the Nigerian domestic market through private marketing channels, the increasing amount of smuggling across Nigerian borders as expected relative crop prices in neighboring countries have been consistently higher than Nigerian marketing board prices and also increasing on-farm consumption by the farmers themselves.

Reliance on marketing board revenue contributions has also destabilized revenues of statutory corporations especially when marketing boards made so-called trading losses. Thus, in the Eastern States in the 1950's,

In order to enable the Production Development Boards to plan their programmes more effectively the Oil Palm Produce Marketing Board guaranteed them a minimum allocation of ₦N 800,000 for each of the years 1950-55. . . . In order to fulfil this obligation during its two years of trading losses it was necessary actually to reduce reserves which were not originally to be employed for development purposes at all.¹³

From our earlier analysis, positive correlation between a State Government's revenues exclusive of any revenue contributions from its marketing board and allied statutory corporations and revenue contributions of these agencies would indicate that these contributions do indeed tend to destabilize total State Government revenue, i.e., when State Government revenues from all other sources apart from the marketing boards and corporations tend to fall, the revenue contributions of the board and corporations also tend to fall and conversely for a tendency towards a rise. The empirical evidence supports the view that reliance on revenue contributions from marketing boards and allied statutory corporations has destabilized State Government revenues for all the states in the 1950's and 1960's. For the Northern States, this correlation coefficient was .6286 ($\rho_{RZ} = .6286$); for Western Nigeria, $\rho_{RZ} = .0171$; for the Eastern States, $\rho_{RZ} = .7049$.

Implied in our earlier analysis is the fact that reliance on revenue contributions from the marketing board and allied corporations has the greatest potential for destabilizing State Government revenue when: first the crop has a large (and fluctuating) domestic market and/or markets in neighboring countries and secondly, the crop does not have significant irreversibilities in the investment-disinvestment process underlying its production.¹⁴ We would expect, therefore, that the State

Government relying on tax revenues from a crop subject to the most uncertain influences on the demand side and the least irreversibilities in the underlying investment-disinvestment process to be subject to the greatest danger of destabilization of State Government revenue, and the State Government relying on tax revenues from a crop subject to the least uncertain influences on the demand side and the greatest irreversibilities in the underlying investment-disinvestment process to be least exposed to the danger of destabilization of State Government revenue. This indeed is the case. The Western State, relying on revenue contributions from taxes on cocoa, had the least potential for destabilization (the most potential for stabilization) with, $\rho_{RZ} = .0171$; the Eastern States, relying on revenue contributions from mainly palm oil and palm kernel, had the most potential for destabilization (the least potential for stabilization), with $\rho_{RZ} = .7049$, while the Northern States, relying on revenue contributions from cotton, groundnuts, beniseed, and soybeans, also had high potential for destabilization (low potential for stabilization), with $\rho_{RZ} = .6286$. Table 6.1 summarizes these findings.

Summary and Conclusions

This chapter has been mainly concerned with the problems of relying on revenue contributions from marketing boards and allied statutory corporations for purposes of

TABLE 6.1.--Variances and Covariances of State Revenues With and Without Revenue Contributions From Marketing Boards and Allied Corporations, Nigeria, 1956-1966.^a

State	Variance-Covariance Matrix			Simple Correlation Matrix		
	R_T	Z	R	R_T	Z	R
Northern States (1956-64)	R_T 43.1382			R_T 1.000		
	Z 37.2994	32.9289		Z .9897	1.0000	
	R 5.8387	4.3705	1.4682	R .7337	.6286	1.0000
Western Nigeria (1956-66)	R_T 100.6345			R_T 1.0000		
	Z 46.6994	45.6473		Z .6861	1.0000	
	R 54.1214	.8437	53.2725	R .7392	.0171	1.0000
Eastern States (1956-65)	R_T 100.3004			R_T 1.0000		
	Z 86.9524	76.4864		Z .9927	1.0000	
	R 13.3480	10.4659	2.8821	R .7851	.7049	1.0000

^a R_T is Total State Revenues inclusive of revenue contributions from the marketing boards and allied statutory corporations, Z is Total State Revenues exclusive of these contributions and R is the Revenue contribution from the marketing boards and allied corporations.

stabilizing State Government revenues. It was shown that when total crop tax revenue is considered, the variance of this revenue depends on variances and covariances of sales of crops to the board and the level of taxes. For the four main crops under the Northern States Marketing Board, it was found that for the period 1947/48-1969/70, sales to the board were all positively correlated. This positive correlation was probably mainly due to supply and demand considerations and other common influences within the general economy. These positive correlations and the large variances must have contributed to instability in expected total crop tax revenue from these crops. If there had been negative correlations between sales to the board at the all-states level, the additional taxation of new crops, particularly those with smaller variances in sales (to the board) than those now being taxed, might have reduced total (crop tax) revenue variance.

The next step was to take account of the institutional set up. The Northern States Marketing Board is responsible for five major crops: groundnuts, cotton, beniseed, soybeans, and palm produce. At the beginning of each season, it decides how much to be paid to farmers-- how much tax to levy on the producers of these crops. The board is perceived to have a desired level of total (crop tax) revenue. When it decides on annual producer prices for the various crops, it is implicitly deciding the

proportions in which the desired total (crop tax) revenue will be shared by the crops. We then asked the question: how should this desired total (crop tax) revenue be shared between these crops so as to minimize the variance in crop tax revenue subject to the condition that the desired total (crop tax) revenue will indeed be raised or realized?

The weights (shares) for the five crops under the Northern States Marketing Board (including here palm produce from Idah, Ankpa, and Dekina Divisions) were found to be functions of the elements of the Jacobian matrix: the variances and covariances of individual crop tax revenues as well as the expected crop tax revenue from each crop, and the desired total (crop tax) revenue from the five crops.

The final section of this paper looked at variances and covariances of total State Government Revenues with and without revenue contributions from the marketing boards and allied statutory corporations. Our intuitive expectations were borne out by the empirical results. The Western State relying mainly on a perennial crop--cocoa--that is likely to be most subject to irreversibilities in the underlying investment-disinvestment process and also least subject to domestic demand fluctuations experienced the least destabilization of total state revenue through reliance on revenue contributions from the marketing board and allied statutory corporations. The

Eastern States relying on palm produce picked mainly from the wild trees--a crop least likely to be subject to irreversibilities on the supply side, but having a large and fluctuating domestic market--experienced the greatest destabilization in total state revenue through reliance on revenue contributions from the marketing board and allied statutory corporations. The Northern States relying mainly on annual crops--groundnuts, cotton, beniseed, and soybeans--occupied middle ground between the Western and Eastern States.

FOOTNOTES

¹O. Teriba and O. Olakanpo, "Fiscal, Monetary and Investment Implications of the Marketing Boards" (International Conference on the Marketing Board System, NISER, Ibadan, 1971), p. 10.

²R, being a linear combination of random variables, is also a random variable.

³S. S. Wilks, Mathematical Statistics (New York: John Wiley and Sons, Inc., 1962).

⁴There may be some reduction in tax revenue variance from reductions in some taxes.

⁵We can give meaning to the concept of an "average tax revenue yield per crop," $\bar{R}$. First, different states have different numbers of marketing board crops and the concept is useful for interstate comparisons of crop tax yields. Second, an individual crop's tax revenue yield can be compared with the average for all crops. Third, the concept may be useful in decisions as to whether more or fewer crops should be brought under marketing board control (what does a marginal change in number of crops do to average crop tax revenue yield?).

⁶ $\bar{R}$, being a linear combination of random variables (the R_j 's) is also a random variable.

⁷That increasing the number of crops tends to reduce $V(\bar{R})$ can be seen in the case of mutual zero correlation from

$$\frac{d V(\bar{R})}{d m} = -\frac{2}{m^3} \sum_{i=1}^m \sigma^2_{R_i} < 0 \quad (6')$$

Even in this case, the contribution of the i th new crop to $V(R)$ which also depends on the variance of sales and therefore of revenue from taxes on this crop is given by:

$$\frac{\sigma^2_{R_i}}{m^2} ;$$

and given the present nature of demand and supply of Nigerian agricultural crops, any new crop to be taxed is likely to have large $\sigma^2_{R_i}$ than those now being taxed.

⁸This is only an analytic result with no obvious practical significance.

⁹The palm produce is mainly from Idah, Dekina, and Ankpa Divisions of Kwara State.

¹⁰This becomes evident from the following variance-covariance matrix of sales of cotton, groundnuts, beniseed, and soybeans to the Northern States Marketing Board, Nigeria, 1947/48-1969/70:

Groundnut Sales	66,805,459,138			
Seed Cotton				
Sales	8,590,375,363	3,384,704,988		
Beniseed Sales	1,091,769,796	91,429,158	59,513,615	
Soybean Sales	239,623,846	22,762,873	21,791,670	47,608,633
	Groundnut	Seed Cotton	Beniseed	Soybean
	Sales	Sales	Sales	Sales

¹¹Friedman, in his analysis of countercyclical policies has used this method. See M. Friedman, "The Effects of a Full-Employment Policy on Economic Stability: A Formal Analysis," in his Essays in Positive Economics (Chicago: University of Chicago Press, 1953). Don Patinkin has argued in the February 1969 issue of the Journal of Money, Credit and Banking that Friedman's 1956 essay, "The Quantity Theory--A Restatement" in M. Friedman, ed., Studies in the Quantity Theory of Money (Chicago: University of Chicago Press, 1956), is mistitled, on the grounds that Friedman's essay is an eloquent reformulation of Keynesian liquidity theory that borrows heavily from the modern asset portfolio school headed by James Tobin. Patinkin's argument is convincing. Similarly, the title of Friedman's book, Essays in Positive Economics is misleading in the sense that there is hardly any unified (and meaningful) body of economics without substantial normative content. For a modern development of these

themes, see Glenn L. Johnson and Lewis K. Zerby, 150 Plates of Spaghetti (East Lansing: Michigan State University); and Glenn L. Johnson, et al., A Generalized Simulation Approach to Agricultural Sector Analysis With Special Reference to Nigeria (East Lansing: Michigan State University, November, 1971), Chapter X.

¹²See West Africa, #2865 (Apapa: Times Press, May 12, 1972), p. 587. (Emphasis in passage my own.)

¹³G. K. Helleiner, "The Fiscal Role of the Marketing Boards in Nigerian Economic Development, 1947-61," in C. K. Eicher and C. Leidholm, eds, Growth and Development of the Nigerian Economy (East Lansing: Michigan State University Press, 1970), p. 129. (Emphasis in passage my own.)

¹⁴A third possible condition is the degree to which the marketing board is committed to the stabilization of the producer price of this crop.

CHAPTER VII

SUMMARY AND CONCLUSIONS

This study had three main aims: first to provide a framework for analyzing the effects of government and marketing board taxation on cotton and groundnuts in the Northern States on resource use in these crops; second, to examine the quantitative impact of paying groundnut and cotton farmers higher prices on tax revenue from these crops and third, to examine the extent to which these crop tax revenues can be trusted to stabilize State Government revenue for planning purposes.

It was shown (see Table 3.1, Chapter III) that government and marketing board taxes on cotton and groundnuts introduced allocative distortions in the relative quantities of these crops produced in the Northern States during the period 1950-66, as farmers have substituted (in production) along given transformation curves in response to changing relative (crop) net producer prices induced by differential tax rates. With differential taxation of cotton and groundnuts detrimental to groundnuts, the relative quantity of cotton was higher than would have

been the case in the absence of all taxation, wherever cotton and groundnuts were substitutes in production. Implicit in the model is the fact that food crops, relative to cotton and groundnuts, were produced in quantities larger than would have been the case in the absence of all taxation since food crops bore zero rates of taxation and cotton and groundnuts bore (and still bear) positive rates of taxation most of the period examined, wherever food crops and these marketing board crops were substitutes in production. Taxes on marketing board crops have distorted patterns of specialization in Nigerian farming, either in terms of the production patterns for food and marketing board crops on the one hand or in terms of the production patterns of marketing board crops bearing different rates of taxation.¹

A model was developed in Chapter III to explain the effects of these taxes on the scale of farming in the Northern States (1950-66), measured either in terms of acreage or labor. When the model was extended to account for the differential between off-farm acquisition and salvage values, the investment-disinvestment responses to changes in taxes and subsidies differed, in many cases, from those predicted by the neoclassical model that assumes equality between acquisition and salvage values for durable inputs.

The empirical evidence on the effects of these taxes on resource use provided in Chapter III is revealing.

It was shown that cotton and groundnuts farms (acreage) in the Northern States are smaller than they would have been in the absence of taxation of marketing board crops. At a time when state governors and other policy makers are very concerned about the diversion of acreages away from marketing board crops to other crops, this is significant evidence indeed. As a result of these taxes, farmers have not found it profitable to expand acreages under cotton and groundnuts as fast as they would have done in the absence of these taxes. Strong logical reasons were also provided, based on the levels of taxes on cotton and groundnuts (1950-66), to show that the amounts of labor (family labor and hired labor) employed on Northern States cotton and groundnut farms during the period 1950-66 were lower than would have been the case in the absence of taxes on these crops. Not only were the stocks of these resources employed on these farms less than they would have been, but they were also worked less intensively than would have been the case in the absence of taxes on these crops. These taxes thus directly affect resource use as these relate to the underemployment and unemployment of human resources in rural areas. Marginal farms have been forced to close as a result of these taxes; people released from these marginal farms are induced to migrate to the towns by higher expected present value of life time earnings in the urban areas like metropolitan Kano, Zaria, Kaduna, Sokoto, and Lagos.

These adverse effects on resource use operate at two levels: first, taxes reduce acquisitions of labor and land below what they would have been in the absence of taxes and thus reduce the rate of entry of new resources into the farm sector and second, taxes induce salvaging and disinvestment of used resources on hand and thus increase the rate of exit of resources from the farm sector.

These adverse effects implied by our analysis can be inferred from available empirical evidence for three reasons. First, even if resources are fixed with respect to off-farm acquisition and salvage values, they are allocated among competing crops according to their on-farm opportunity costs. Farmers are known to be reallocating these resources in response to the effects of taxes on these on-farm opportunity costs.² Second, these resources are heterogeneous. Older farmers in response to taxes on marketing board crops may simply reallocate their skills between these crops and non-marketing board crops on the basis of their on-farm opportunity cost while younger farmers and rural farm youth may quit farming altogether and move to the urban centers³ when their off-farm market salvage values exceed their on-farm opportunity costs. Third, farms of different sizes are differently endowed with resources and have different initial quantities on hand.

With less resources being used as a result of these taxes, less cotton and groundnuts were produced (and presumably less was therefore sold to the marketing board) relative to the (profit maximizing) quantities of these crops that would have been produced in the absence of any taxes on them. This has obvious implications for those states that have production campaigns for marketing board crops in their development plans. Suppose a state wishes to increase its production (output) of a marketing board crop (e.g., cotton, groundnuts) by a given annual percentage for each year of the development plan. Starting with a production function, we can express the percentage increase in the output of the marketing board crop as the weighted sum of the percentage increases in the resources used to produce this crop, where the weights are the output elasticities of these resources.⁴ For given output elasticities of these resources, the annual percentage increase in the output of the marketing board crop is higher, the higher the percentage increases in the quantities of resources used to produce this crop. To the extent that taxes on marketing board crops have impeded annual percentage increases in resources used in the production of marketing board crops, they have consequently impeded the rate of growth of output of these crops. The evidence in Chapter III implies that this must have been the case (see pp. 58-59.

The last part of Chapter III was of the nature of providing policy makers with a policy variable: given that labor and land produce the bulk of value added in Nigerian agriculture and if we are willing to assume the institutional reality of the marketing boards, then, if State planners wish to minimize the allocative distortions with respect to the use of land and labor introduced by these taxes, what are the compensating subsidies on fertilizers, chemicals, land, labor, etc.? It was shown that these compensating subsidies are related to the output elasticities of these resources. Using a Cobb-Douglas production function and the available estimates on the output elasticity of land, it was calculated that to keep the acreage in groundnuts production from falling, given a 1 per cent decrease in the net producer price of groundnuts received by farmers, then, the net acquisition price of land that groundnuts farmers have to pay has to fall by 2.9317 per cent. In cotton production, the corresponding compensating subsidy is 1.8860 per cent. It was also calculated that to keep the quantity of labor employed in groundnuts production from falling, given a 1 per cent decrease in the net producer price of groundnuts received by farmers, then the net acquisition price of land that groundnut farmers have to pay has to fall by 2.746 per cent. In cotton production, the corresponding compensating subsidy is 2.422 per cent. In this way, programs for

subsidies on resources used in Northern States farming in the future can be rationally related to expected tax rates on the crops in which these resources are employed.

If resources are fixed where their MVP's are between their off-farm market acquisition and salvage values, small taxes have no effect on resource employment and thus would require no compensating subsidies. Large taxes will lead to disinvestment which may be necessary until resources are being employed at levels where acquisition costs are being covered.

The link between the response of tax revenue from cotton and groundnuts to producer price changes and the response of sales of these crops to the board to changes in the net producer price was established in Chapter IV. The more responsive sales of a crop (to the board) are to changes in its price, the more responsive (in absolute value) is tax revenue to these producer price changes (see pp. 105-113). The illustrative calculations in Chapter IV using actual data on taxes and net producer prices for the period 1950-66 bring out clearly the link between the elasticity of (crop tax) revenue with respect to producer prices paid out by the board and the elasticity of sales (to the board) with respect to the board's net producer prices: the more elastic sales to the board are of a crop with respect to its net producer price, the more elastic (in absolute value) is the tax revenue from this crop with respect to the board's net producer price for

the crop (see Tables 4.1-4.4). Attempts to raise more (tax) revenue from a crop by paying producers lower prices might become self-defeating if sales of this crop to the board are very price responsive or even moderately price responsive. In the last section of Chapter IV, it was argued that when long run influences are considered, questions about the (tax) revenue potential of marketing board crops and the farm sector as a whole depend importantly on the crop price response of the underlying investment-disinvestment process.

In the first section of Chapter V, we sketched a simultaneous equation system in which the sales supply equation was one of four structural equations. Previous econometric treatments of sales (to the board) of marketing board crops have not provided any system structure of which the sales supply equation was only one component. The system incorporates our apriori knowledge of the factors influencing the sale of a crop to the board. Identifiability of the sales supply relation was then investigated after which reduced form solutions for the endogenous variables of the system were derived. Availability of data would then have permitted two-stage least squares estimation of the (structural) sales supply equation.

A modified model which removes obvious sources of biasedness and inconsistency from our ordinary least squares estimates of the parameters of single sales supply

equations for groundnuts and cotton was then estimated. The elasticity of sales of groundnuts to the Northern States Marketing Board with respect to the board's producer price was estimated to be 1.3139 and that of cotton to be .90278.

It was then postulated that farmers were to be paid (on the average) higher prices than they actually received (1950-67). Predictions of sales were made, on the basis of the estimated equations, using the postulated hypothetical prices. It was found for both cotton and groundnuts that when the postulated prices were higher than actual prices the board paid the farmers, predicted sales were higher than actual sales. The predicted sales incorporating the "price effect" on sales and the implied lower taxes were then used to show the quantitative impact of (generally) higher producer prices on tax revenue from these two crops. It was shown that in many years with the new higher producer prices, farmers would have gained substantially in monetary income without the government and marketing board being significantly worse off in revenue terms (where "significantly worse off" is defined in terms of net (tax) revenue loss relative to new total tax revenue). For cotton, with the postulated new higher prices in 1951, farmers would have gained £N 1,071,717.6 in monetary income; total (tax) revenue incorporating the positive effect of higher prices on cotton sales would

have been £N 3,248,801.3.⁵ The net loss in (crop tax) revenue would have been £N 463,684.4 (see Table 5.12), thus leaving the government and marketing board a positive net (crop tax) revenue balance of £N 2,785,116.9. Thus, total net revenue would not have been significantly affected.⁶ Further, when this is compared with the total tax withdrawals of £N 1,742,200⁷ from cotton in 1951 using actual producer prices and actual sales that were both lower than the hypothetical price and the predicted sales respectively that were used in the above computations, it is evident that the government and the marketing board were not significantly worse off revenue-wise paying farmers higher prices than the prices actually paid. In 1957, with farmers receiving (the new) higher prices, they would have gained £N 460,930.1 in monetary income while the government and the marketing board would have lost £N 712,147.1 (see Table 5.12). Total tax revenue from cotton in this year after incorporating the positive effect of higher prices on sales was calculated to be £N 1,034,927.5,⁸ thus leaving a net (crop tax) revenue of £N 322,780.4. Relative to the actual total tax revenue of £N 77,600⁹ using actual prices and actual sales, the government and marketing board were better off, revenue-wise.¹⁰

For groundnuts in 1954, with the postulated new higher prices, farmers would have gained £N 2,683,987.2 in monetary income. The government and the Northern States

Marketing Board would have suffered a net revenue loss of £N 988.142.0 (see Table 5.8); in the same year incorporating the positive effect of higher prices on sales, total tax revenue from groundnuts was calculated to be £N 5,125,384.4, thus leaving a net tax withdrawal from groundnuts of £N 4,337,242.4.¹¹ The net loss in total (crop tax) revenue is not very significant.¹² In 1950 and 1951, the net losses in (crop tax) revenue were significant. For the other years for both groundnuts and cotton, there are varying degrees of offsets of revenue loss by the positive effect of higher prices on sales. On the average, the net revenue losses do not appear to be very substantial, relative to the new total tax revenues and the gain in monetary income to farmers.

Any assessment of the total effects of taxation of marketing board crops must take into account the effects on production (output) of the crop and the effects on its sales to the board. Chapter III provided indirect evidence on production by examining the effects of these taxes on resource use. To the extent that resources were being employed on a smaller scale than would have been the case in the absence of these taxes, then production (output) was less than would have been the case in the absence of taxes on these crops. The estimates and predictions of Chapter V showed that sales of crops to the board were lower than would have been the case if the board paid

farmers higher prices. We were not able to take the production effect of these taxes into account directly because of lack of data on total output of any of the crops treated. This production effect of these taxes would then have been incorporated in our analysis of the impact on (crop tax) revenue of paying farmers higher (hypothetical) prices. It is hoped that this shortcoming will be remedied as data on total output of these crops become available.

The CSNRD series were a landmark in studying the effects of marketing board taxation of Nigerian agriculture. We have extended these studies by explicitly specifying, identifying and estimating the sales supply relation for marketing board crops as a basis for estimating the quantitative impact on tax revenue from these crops of paying farmers higher prices and also by explicitly treating the resource employment effects of these taxes.

The major justification for the past and present roles of marketing boards has been their potential ability to stabilize producer prices and producer incomes. Their success in this regard has not concerned us in this study. Their potential for stabilizing State Government revenues is the newly emerging rationale for not only retaining these boards but also for widening their taxing powers. Treating sales to the board of any crop as a random variable, it is shown in Chapter VI that the (State Government) revenue stabilizing potential of marketing boards and

allied statutory corporations is very small. In the case of total revenues from taxes on all crops within marketing board control, it is shown that the variance of total revenue depends largely on the elements of the covariance matrix of sales to the board of these crops. Arguments and empirical evidence are used to show that not only are the diagonal elements of this covariance matrix large, but that the off-diagonal elements are likely to be positive. In this case, the larger the number of crops under the board's control, the larger the variance in tax revenues. Using crops under the control of the Northern States Marketing Board as an example, it was found that the correlation coefficient between groundnut sales and cotton sales to the board over the period 1947-1970 was .5713, between groundnuts sales and beniseed sales .5475, between groundnut sales and soybeans sales .1344, between seed cotton sales and beniseed sales .2037, between beniseed sales and soybeans sales .4094 and the least correlation coefficient (still positive!) was that between seed cotton sales and soybeans sales, .0567. The variances of sales of groundnuts, cotton, beniseed, and soybeans were respectively: 166,805,459,138.30, 3,384,704,988.61, 59,513,615.71, and 47,608,633.87. Thus, the variances of sales to the board are large; and their covariances are also large and positive. Thus, the potential for stabilizing total revenue by increasing the taxing powers of the boards is small for the present composition of

marketing board crops in the Northern States. Most of the variation in tax revenues from these crops is likely to come not from variations in tax rates on these crops but from variations in sales of these crops to the board. Using sales as a proxy for revenue, we found that the average covariance of sales for the four marketing board crops of the Northern States (1947-40/1969-70) was 1,676,292,118.28. If the average covariance of (tax) revenues from these crops is some (nondecreasing) linear function of this, then prospects for stabilizing State Government revenues from reliance on marketing boards and allied statutory corporations are very small indeed.

Using actual budget figures for the Northern States, the Eastern States and the old Western Region, it was also shown that reliance on revenue contributions from marketing boards and allied statutory corporations destabilized State Government revenues. It was argued that such reliance was potentially destabilizing when, first, the crop has a large (and fluctuating) domestic market and/or markets in neighboring countries and second, when the crop does not have significant irreversibilities in the underlying investment-disinvestment process.¹³ The old Western Region, relying on revenue contributions from taxes on cocoa--a perennial crop--had the least potential for destabilization (the most potential for stabilization) of State Government revenue. The correlation coefficient between State Government revenues in the absence of

contributions from the marketing board and allied statutory corporations and revenue contributions from them for the period 1956-66 (i.e., P_{RZ}) was .0171. The Eastern States relying on revenue contributions from taxes mainly on palm oil and palm kernels had the most potential for destabilization (the least potential for stabilization) of State Government revenue. The corresponding correlation coefficient (P_{RZ}) for the Eastern States for the period 1956-65 was calculated to be .7049. The Northern States, relying mainly on revenue contributions from taxes on cotton, soybeans, groundnuts, and beniseeds--all annual crops--occupied the middle ground between the Eastern States and the old Western Region. Such reliance had high potential for destabilization (low potential for stabilization) of State Government revenues. The corresponding correlation coefficient (P_{RZ}) for the Northern States for the Period 1956-64 was calculated to be .6286.¹⁴

Implications of Findings

For the past two decades, some form of price or income stabilization role for producers has been used to justify the existence of marketing boards. There is still no conclusive evidence that marketing boards have succeeded in this regard. A new emerging role is that of state revenue stabilization. Our analysis in Chapter VI indicated that the potential of marketing boards and allied statutory corporations as stabilizers of State Government

revenues is almost nil. Unless a new cogent reason is found, we find it difficult to justify the present marketing structure.¹⁵

Unemployment is currently a major problem in Nigeria. It was shown in Chapter III that taxes on marketing board crops have distorted the relationships between on-farm and off-farm opportunity costs of labor, and, by implication, that the ratio of the present values of the latter to the former is higher than would have been the case in the absence of these taxes. This has induced the drift of people from the rural to the urban areas. Any attempt to arrest this drift must seriously consider the elimination of these taxes.¹⁶ The high social costs of artificially induced unemployment of people in the urban areas can then be minimized or avoided.

The existence of these taxes is one major reason why cotton and groundnut farms are small. It is possible for most farmers in cotton and groundnut production to increase their acreages in these crops if it is profitable. In the Report of the Study Group on Groundnuts it is stated: "In some parts of the North, particularly in the North Eastern State, substantial areas of land are unused at present and could be available for expansion of groundnuts."¹⁷

If the increased acreages are to be forthcoming, these taxes must be drastically reduced or eliminated.

A current problem is the transformation of Northern States agriculture from one relying mainly on traditional inputs to one that employs new and superior inputs. This transformation is proceeding rather slowly.¹⁸ The demand for new inputs has been adversely affected by taxes on marketing board crops. A minimum requirement in the presence of these taxes is the urgent need for compensating subsidies on resources to minimize allocative distortions introduced by these taxes. It was shown in Chapter III that these compensating subsidies are related to the output elasticities of these resources used in production. In this way, programs in State Development Plans and production campaign projects for subsidizing chemicals, fertilizers, insecticides, land, skilled labor, etc., can rationally be related to expected taxes on the crops in which these resources are used.

We do expect structural changes like improved transportation network and improved marketing information about crop prices in different parts of the country. These changes will raise the elasticity of sales (to the board) of a marketing board crop with respect to the board's net producer price for the crop. Such changes may indeed render policies that seek to raise (tax) revenue by paying farmers lower prices self-defeating.

FOOTNOTES

¹See pp. 26-27 for evidence and discussion on the policy of self-sufficiency in cotton being pursued by the Western State.

²From our apriori knowledge of the ease with which labor and land are shifted between crops in the cotton-groundnuts-foods economy of the Northern States, we infer that the allocation of fixed resources must be on the basis of their on-farm opportunity costs. Let us see the effects of taxes on this opportunity costs. Suppose labor of a given age and skill is fixed in the sense that it does not pay to invest or disinvest in it. Let this fixed labor (L^0) be allocated between groundnuts (G) and food production (F). The farmer's production function is, in implicit form,

$$f(L, G, F) = 0 \quad (1)'$$

which can be written explicitly as

$$L^0 = f(G, F)$$

Let the farmer then maximize his revenue from food and groundnut production subject to the constraint that he has this fixed amount of labor to allocate between them. Form the Lagrangian.

$$L = P_F F + (\mu_G P_G) G + \alpha [L^0 - f(G, F)]$$

where P_F and P_G are food and groundnut prices respectively and μ_G is the proportion of potential producer price of groundnuts paid by the board to farmers. The necessary conditions for equilibrium are

$$\frac{\partial L}{\partial F} = P_F - \alpha \frac{\partial f}{\partial F} = 0$$

$$\frac{\partial L}{\partial G} = \mu_G P_G - \alpha \frac{\partial f}{\partial G} = 0$$

$$\frac{\partial L}{\partial \alpha} = L^0 - f(G, F) = 0$$

from which

$$\alpha = \frac{P_f}{\partial f / \partial F} = \frac{\mu_G P_G}{\frac{\partial f}{\partial G}}$$

from which it follows that $\alpha = P_F \frac{\partial F}{\partial L} = \mu_G P_G \frac{\partial G}{\partial L}$

where $\frac{\partial F}{\partial L}$ and $\frac{\partial G}{\partial L}$ are the marginal products of labor in food and groundnut production respectively and α , the undertermined Lagrangian multiplier, turns out to be the on-farm opportunity cost of labor. Without any taxes, $\mu_G = 1$. With an increase in taxes on groundnuts, $0 < \mu_G < 1$, and there is induced reallocation of labor away from groundnut to food production until, in equilibrium, the opportunity cost of labor in food and groundnut production is the same. Fixity of a resource does not therefore preclude these allocative responses in resource use to taxes on marketing board crops.

³In a June 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 (Apapa: Times Press, June 23, 1972). Complaints about the "drift of farmers" to the towns are very frequent these days among state governors. It is evident that taxes on marketing board crops have distorted the relative magnitudes of the mean present values of marginal value products of these farmers on Nigerian farms and the expected present values of their off-farm opportunity costs in the urban areas. It is perfectly rational for these farmers to migrate in the face of these taxes on marketing board crops.

⁴Writing the production function as:

$$Y_j = f(X_1, \dots, X_n),$$

it is evident that

$$\frac{\Delta Y_j}{Y_j} = \sum_{i=1}^n \epsilon_{Y_j X_i} \frac{\Delta X_i}{X_i}$$

where Y_j is the quantity of the j th marketing board crop produced with the resources $X_1, \dots, X_n$, $\epsilon_{Y_j X_i}$ is the elasticity of output of the j th crop with respect to the i th resource, $\frac{\Delta Y_j}{Y_j}$ is the percentage change in Y_j and $\frac{\Delta X_i}{X_i}$ is the percentage change in X_i , ($i = 1, \dots, n$).

⁵For the method used to calculate total tax revenue incorporating the positive effect of higher prices on sales, see footnote

⁶Net (tax) revenue loss is 14 per cent of the new total (tax) revenue.

⁷For this figure on total tax revenue using actual producer prices and actual sales, see G. K. Helleiner, Peasant Agriculture, Government and Economic Growth in Nigeria (Irwin, 1966), Table V-F-5.

⁸See footnote 38.

⁹For this figure, see Helleiner, op. cit.

¹⁰However, with net (tax) revenue loss 68 per cent of the new total tax revenue, government and marketing board tax revenue is significantly affected.

¹¹For method of calculating this figure, see p. 189.

¹²The net loss in tax revenue is 19 per cent of new total (crop tax) revenue.

¹³See discussion on p. 221, especially footnote 2.

¹⁴These relative performances of the states are consistent with our apriori expectations. Cocoa is a perennial crop and therefore most likely to have substantial irreversibilities in the investment-disinvestment process underlying its production; it also has very little domestic demand in the form sold to the board. The bulk of the palm oil and kernels sold to the board comes from wild palm trees, thus making it possible to adjust rapidly to price changes. Palm oil has a large (and fluctuating) domestic market and neighboring country market demand. Cotton and groundnuts occupy middle ground between cocoa and palms both in terms of expected irreversibilities

underlying their production as well as the size of the domestic and neighboring country market conditions.

¹⁵It might be tempting to play down on the need for the extended discussion here given to this issue, on the grounds that petroleum revenues will do the job of stabilization. The present value of petroleum revenues is certainly bounded by the nonreplenishable nature of the resource. Even in the face of the present petroleum revenue boom, not all revenue needs of all states can be met. State Governments continue to seek sources of revenue independent of the Federal Government. Marketing boards are a good source of revenue and given the exposure of the myth that these boards are there to stabilize prices and incomes and help farmers, marketing board advocates are searching for new justifications for the existence of marketing boards. We must avoid replacing old myths with new ones. It should also be recognized that we have not examined other sources of State Government revenues in terms of "stability." Stability might not be important for some purposes, but is vital for state budgetary operations and is important as a potential justification for the existence of the marketing boards.

¹⁶The Governor of Lagos State, Colonel M. Johnson recently called on other State Governments to help him stem the outflow of people from their states into his own state. The Governor will go a long way toward solving this problem if he seriously encourages these State Governments to abolish the present marketing board system. See West Africa (Apapa: Times Press, May-June, 1972).

¹⁷See Report of the Study Group on Groundnuts (Lagos: Federal Department of Agriculture, 1971), p. 13.

¹⁸Ibid.

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