AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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1. SUBJECT CLASSIFICATION

A. PRIMARY: Agriculture — AE10-0000-0000

B. SECONDARY: Agricultural economics

2. TITLE AND SUBTITLE

Policy distortions,subsidies,and rural employment generation: a second-best approach

3. AUTHOR(S)

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4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1973	17p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Mich.State

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

(In Univ.of Ibadan Rural development paper no.11)

9. ABSTRACT

10. CONTROL NUMBER

PN-RAA-516

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Government policies
Models
Production engineering
Subsidy

13. PROJECT NUMBER

14. CONTRACT NUMBER

CSD-3625 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

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AFRICAN RURAL EMPLOYMENT PROJECT
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EAST LANSING 48823

POLICY DISTORTIONS, SUBSIDIES AND RURAL EMPLOYMENT GENERATION: A SECOND - BEST APPROACH*

In many African countries, economic agents live in a world of policy - induced distortions. In most instances, these distortions are explicitly or implicitly accepted as institutional realities and the question becomes not one of removing them but one of adjusting to them in the best possible way. These distortions take many forms. Export crops are subject to export taxes of one vintage or another; urban minimum wages unrelated to labour productivity compound existing labour market distortions; the "urban bias" in the development of physical and social infrastructure and the associated poor and fragmented crop and input information net-works implicitly lower farm gate prices at the same time that they raise the real prices of basic necessities and inputs in the rural sector; closely related to the above, import substitution in a "learning stage" of domestic industrial development consequently places relatively heavier burdens on the rural sector etc. Economic agents are therefore faced with the problem of optimizing in imperfect systems. Policy makers consequently seek an "optimal mix" of institutional

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* Paper presented at the 2nd Annual Conference of the African Rural Employment Network at Njala University, Sierra Leone, Nov. 28 - Dec. 2, 1973.

distortion parameters that, through some second - best optimization process, will achieve stated policy objectives.

One important policy objective of African countries is gainful employment creation or generation, which could be seen as a problem in income distribution [1, 7]. This paper considers the use of one policy instrument - input subsidies - to promote employment in imperfect systems. This second - best approach to the problem yields some interesting results with potential policy relevance.

The effects of marketing board taxes on employment have been highlighted almost to the total neglect of other policy distortions that implicitly impose taxes on all farmers - those in marketing board crop production as well as those in non-marketing board crop production [3]. Analytically, these other distortions - such as the "urban bias" in infrastructural facilities - have the same effect on farmers: they implicitly lower farm gate prices. Such policies have the net effect of inducing large - scale reductions in farm labour force, at least in the rate of entry of labour into this sector. Such reductions - together with the poor information net-works - cause labour shortages particularly during the peak seasons, a situation which leads to higher labour costs both in national and regional labour markets. When we talk of the marketing board tax, it is only a proxy for the total explicit and implicit tax on crops imposed by the set of all distortions.

The paper is divided into five sections. Section I presents the general analytical model in which compensating subsidies are derived. In Section II, the model is operationalized using the two crop Cobb - Douglas production function; Compensating input subsidies to maintain rural (labour) employment at pre-distortion levels are derived. Compensating input subsidies designed to keep crop outputs at predistortion levels are also derived. The net effect of the set of policy - induced distortions is to encourage the massive drift of farmers and young people to the cities. This raises labour costs particularly during peak demand seasons. Input subsidies may specifically be geared towards keeping total production costs at predistortion levels. Such compensating subsidies are given in Section III. Section IV contains the summary and conclusions while section V contains future research agenda.

Section I: The General Model

In the absence of policy - induced distortions listed above, the firm wishes to maximize profits (Π)[1] :

$$\Pi = \sum_{j=1}^{m} P_{yj} \; Y_j - \sum_{i=1}^{n} P_i \, X_i \qquad (1)$$

Subject to the production function in implicit form:

$$F (Y_1 , \ldots\ldots\ldots, X_n) = 0 \qquad (2)$$

Profit maximizing input employment is given by

$$\frac{\partial L}{\partial X_i} = -P_{xi} + Q_1 \frac{\partial F}{\partial X_i} = 0 \quad , i = 1, \ldots\ldots, n \qquad (2a)$$

Where Q_1 is the Lagrange multiplier. Marketing board taxes impose an institutional restraint on this equilibrium condition of the form:

$$P_{Y_j} \frac{\partial Y_j}{\partial X_i} = K_1 P_{xi} \qquad (2b)$$

Where $K_1 = \frac{1}{uj} \neq 1$ or 0 , where u_j is the proportion of unit market (potential) price of the jth crop received by the farmer. Then, maximizing (1) subject to (2) and (2b), we get, for the ith and s^{th} inputs,(2)

$$\frac{P_{xi}}{P_{xs}} = \frac{P_{Y_j} \frac{\partial Y_j}{\partial X_i} + Q_2 \; P_{Y_j} \frac{\partial 2Y_j}{\partial X_i^2}}{P_{Y_j} \frac{\partial Y_j}{\partial X_s} + Q_2 \; \frac{\partial 2Y_j}{\partial X_s^2}} \qquad (2c)$$

Note that relative resource employments will be the same as in the no - tax case (i.e. distortion - free case) when $Q_2 = 0$. Policy makers prepared to live with the institutional reality of the marketing boards may decide to subsidize inputs used in the production of marketing board crops. Now, replace K_1 in (2b) with K_2 where $K_2 = \lambda_i K_1$, where λ_i is the proportion of unit market price of the ith input paid by the farmer. Then, maximizing (1) subject to (2) and the new institutional restraint,(3) gives, for the ith and s^{th} inputs:

$$\frac{P_{xi}}{P_{x_s}} = \frac{P_{Y_j} \frac{\partial Y_j}{\partial X_i} + Q_2^* \; P_{Y_j} \frac{\partial 2Y_j}{\partial X_i^2}}{P_{Y_j} \frac{\partial Y_j}{\partial X_s} + Q_2^* \; P_{Y_j} \frac{\partial 2Y_j}{\partial X_s^2}} \qquad (2d)$$

Where Q_2^* is the new Lagrange multiplier in the face of the double institutional restraint. In the absence of stated policy objectives, we cannot <u>apriori</u> say which of (2c) and (2d) is "better". Nigerian policy makers are presently concerned about the tremendous drift of farmers to the cities and the abandonment of land formerly in crop production. Policy makers may therefore be interested in a mix of taxes

and subsidies such that post - distortion equilibrium employment of resources is the same as in the absence of distortions. From (2b), if we explicitly take account of taxes and subsidies, then for the ith input, we have, for equilibrium:

$$\lambda_i P_{x_i} = U_j P_{Y_j} \frac{\partial Y_j}{\partial X_i}$$

$$\text{and } \frac{d \log (\lambda_i P_{x_i})}{d \log (U_j P_{Y_j})} = 1 + \frac{d \log \frac{\partial Y_j}{\partial X_i}}{d \log (U_j P_{Y_j})} \qquad (2e)$$

and with only X_i and X_s in the production function,

$$\frac{d \log (\lambda_i P_{X_i})}{d \log (U_j P_{Y_j})}\Big|_{d \log X_i = 0} = \frac{1 + X_i X_s \frac{\partial^2 Y_j}{\partial X_i X_s} \quad d \log X_s}{Y_j b_i \; d \log (U_j P_{Y_j})}$$

$$= 1 + \frac{X_i X_s \frac{\partial^2 Y_j}{\partial X_i X_s}}{Y_j} \frac{\varepsilon_1}{b_i} \qquad (2f)$$

Where b_i is the output elasticity of X_i and ε_1 is the elasticity of demand for X_s with respect to net crop price. Equation (2f) gives the compensating change in net acquisition price of the ith input per unit percentage change in the net producer price of the marketing board crop if equilibrium employment of X_i is to remain unchanged. Assuming $\varepsilon_1 > 0$,

this compensating elasticity will be positive so long as the inputs are technically complementary. When X_s is fixed, this compensating elasticity becomes unity.

The compensating elasticity in the case where policy workers want to keep the quantity of the other input constant (as when they want to subsidize fertilizers in the presence of marketing board taxes so as to prevent massive off-farm migration) is:

$$\left.\frac{d \log(\lambda_i P_{xi})}{d \log (U_j P_{Y_j})}\right|_{d \log X_s = o} = 1 + X_i^2 \frac{\partial^2 Y_j}{\partial X_i^2} \frac{\mathcal{E}_2}{b_i}$$

Where $\mathcal{E}_2$ is the elasticity of demand for X_i with respect to not crop price.

Multicropping is widespread among Nigerian and African peasant farmers. There is therefore need for knowledge of these compensating subsidies in the resource - mix of, say, the two - crop enterprise. These are derived in the next section.

Section II: The Two-Crp Two-Input Cobb - Douglas Case

With two crops Y_1 and Y_2, the peasant farm - firm operating under taxes and subsidies wishes to maximize profits (π):[4, 5]

$$\pi^1 = \sum_{j=1} U_j P_{yj} A_j X_{1j} X_{2j} - \sum_{j=1} \sum_{i=1} \lambda_i P_{xi} X_{ij} \qquad (3),$$

where U_j is the proportion of potential producer price actually received by the farmer for the jth crop and λ_i is the proportion of potential unit acquisition price of the ith input actually paid by the farmer and where other variables have their obvious meanings. The demand functions for X_{11}, X_{12}, X_{21} and X_{22} are, in log:[6]

$$\log X_{11} = (b_{21} - 1)\left[\log(\lambda_1 P_{x1}) - \log(U_1 P_{y1}) - \log b_{11} - \log A_1\right] - \frac{b_{21}}{k}\left[\log(\lambda_2 P_{x2}) - \log(U_1 P_{y1}) - \log b_{21} - \log A_1\right] \qquad (3a)$$

$$\log X_{21} = \frac{b_{11}}{k}\left[\log(\lambda_1 P_{x1}) - \log(U_1 P_{y1}) - \log b_{11} - \log A_1\right] + \frac{(b_{11} - 1)}{k}\left[\log(\lambda_2 P_{x2}) - \log(U_1 P_{y1}) - \log b_{21} - \log A_1\right] \qquad (3b)$$

$$\log X_{22} = -\frac{b_{12}}{k}\left[\log(\lambda_1 P_{x1}) - \log(U_2 P_{y2}) - \log b_{12} - \log A_2\right] + \frac{(b_{12} - 1)}{k}\left[\log(\lambda_2 P_{x2}) - \log(U_2 P_{y2}) - \log b_{22} - \log A_2\right] \qquad (3c)$$

$$\log X_{12} = \frac{(b_{22} - 1)}{k}\left[\log(\lambda_1 P_{x1}) - \log(U_2 P_{y2}) - \log b_{12} - \log A_2\right] - \frac{b_{22}}{k}\left[\log(\lambda_2 P_{x2}) - \log(U_2 P_{y2}) - \log b_{22} - \log A_2\right] \qquad (3d),$$

Where $K = (b_{21} - 1)\ (b_{11} - 1) - b_{11}\, b_{21}$, and

$$K' = (b_{22} - 1)\ (b_{12} - 1) - b_{12}\ b_{22}$$

Two types of elasticities are computed: the "own" compensating subsidy elasticity of X_1 in Y_1 which gives the required percentage reduction in unit price of X_1 per unit percentage reduction in net crop price of Y_1 so as to keep the quantity of X_1 in the production of Y_1 constant, and the "cross" compensating subsidy elasticity of X_1 in Y_1 which gives the required percentage reution in the unit price of X_2 per unit percentage reduction in the price of Y_1 if the quantity of X_1 employed in Y_1 is to remain unchanged. Table 1 presents our derived elasticities.

Table 1: Derived Compensating Input Subsidy Elasticities[a]

	"Own" Compensating Elasticities	"Cross" Compensating Elasticities
To keep X_1 in Y_1 Constant[b]	$-\dfrac{1}{b_{21}-1}$	$\dfrac{1}{b_{21}}$
To keep X_1 in Y_2 Constant	$-\dfrac{1}{b_{22}-1}$	$\dfrac{1}{b_{22}}$
To keep X_2 in Y_1 Constant	$-\dfrac{1}{b_{11}-1}$	$\dfrac{1}{b_{11}}$
To keep X_2 in Y_2 Constant	$\dfrac{1}{b_{12}-1}$	$\dfrac{1}{b_{12}}$

(a) b_{ij} is the jth output elasticity of the ith input

(b) These compensating input subsidy elasticities are derived by setting $d\log X_{ij} = 0$ in the respective equations of (3a - 3d).

These compensating subsidy elasticities are all positive.(7) The first row, first column element of the elasticities matrix of Table 1 says, for example, that a one percentage reduction in the price of Y_1 requires the percentage reduction in the price of X_1 equal to the inverse of one minus the output elasticity of X_2 in the production of Y_1.(8)

It may be that policy makers in addition to minimizing the resource allocation distortions of taxes and other policies also wish to minimize policy - induced substitution in crop production i.e., induced movements along given transformation curves. This may be an indirect way to tackle the negative effects of these policies on labour employment; it may be dictated by the need to check a rise in prices or it may be due to a need to conserve foreign exchange reserves at levels consistent with the nation's planning efforts. What are the compensating input subsidies to achieve these?

Substitute the optimal employments of X_1 and X_2 of equations (3a - 3d) into equation (3) and solve for the various compensating subsidy elasticities after setting d log Y_1 = 0 and d log Y_2 = 0. The derived elasticities are shown in Tables 2 and 3.

Table 2: Derived Compensating Subsidy Elasticities to Keep Quantity of Y_1 Constant

$$\frac{d \log (\lambda_1 P_{x1})}{d \log (U_1 P_{y1})} : \frac{d \log (\lambda_2 P_{x2})}{d \log (U_1 P_{y1})} : \frac{d \log (\lambda_1 P_{x1})}{d \log (U_1 P_{y1})} + \frac{d \log (\lambda_2 P_{x2})}{d \log (U_1 P_{y1})} ;$$

$$\frac{1 + b_{21}}{b_{11}} \qquad \frac{1 + b_{11}}{b_{21}} \qquad \frac{(b_{11} + b_{21})^2}{b_{11}\ b_{21}}$$

Table 3: Derived Compensating Subsidy Elasticities to Keep Quantity of Y_2 Constant

$$\frac{d \log (\lambda_1 P_{x1})}{d \log (U_2 P_{y2})} : \frac{d \log (\lambda_2 P_{x2})}{d \log (U_2 P_{y_2})} : \frac{d \log (\lambda_1 P_{x1})}{d \log (U_2 P_{y2})} + \frac{d \log (\lambda_2 P_{x2})}{d \log (U_2 P_{y2})}$$

$$\frac{1 + b_{22}}{b_{22}} \qquad \frac{1 + b_{12}}{b_{22}} \qquad \frac{(b_{12} + b_{22})^2}{b_{12}\ b_{22}}$$

From tables 2 and 3, it is clear that the smaller the importance of a given input (as measured by its output elasticity) in a given crop, the larger the compensating percentage input subsidy will be for a given one percentage reduction in the producer price, if the quantity of the crop is to remain constant.

The net impact of the set of policy distortions which implicitly and/or explicitly reduce producer prices is to encourage the massive drift of farmers and young people from the rural to the urban areas. Our current research in Kwara State of Nigeria indicates that one of the most serious constraints facing most farmers is labour shortage during the peak seasons. Such massive drift of people to the urban areas raises labour cost and therefore total costs of producing a given output. Policy makers may therefore want compensating subsidies for given fall in product price if costs are to be kept from rising. This is derived in the next section.

Section III: Subsidies to Prevent Costs from Rising

The effect of the policy distortions is to raise production costs above predistortion levels. What are the compensating input subsidies to prevent costs from rising? To simplify, we use the one crop, two input Cobb - Douglas case. With the Cobb - Douglas function:

$$Y = A X_1^{b_1} X_2^{b_2} \quad (A, b_1, b_2 > 0; \; b_1 + b_2 < 1)$$

Where X_1 is labour input, X_2 is some modern input that can be easily subsidized (e.g. fertilizer) and Y is crop output. Solving for X_1 and X_2 from the equilibrium conditions for cost minimization and plugging these optimal values into the cost function for producing the output Y, we have

$$C = P_{x2} \frac{(b_1 + b_2)}{b_2} \left(\frac{b_2 P_{x1}}{b_1 P_{x2}}\right)^{\frac{b_1}{b_1 + b_2}} \left(\frac{Y}{A}\right)^{\frac{1}{b_1 + b_2}},$$

which in logs, gives

$$\log C = \log P_{x2} + \log\left(\frac{b_1 + b_2}{b_2}\right) + \frac{b_1}{b_1+b_2}\log(b_2 P_{x1}) - \frac{b_1}{b_1+b_2}\log(b_1 P_{x2}) + \frac{1}{b_1+b_2}\log\left(\frac{Y}{A}\right)$$

Setting $d \log C = 0$, assuming a given output and solving for $\frac{d \log P_{x2}}{d \log P_{x1}}$ give

$$\frac{d \log P_{x2}}{d \log P_{x1}} = -\frac{b_1}{b_2} < 0 \qquad (4)$$

which gives us what we may call the "constant output" elasticity of the price of fertilizers with respect to the price of labour: it gives the required percentage change in fertilizer for a given percentage change in labour price as induced by policy distortions that create artificial shortages of labour during the peak farming seasons. The negative sign of the elasticity shows that an induced rise in wage rates will require a fall in the price of fertilizers, if total cost of producing the given output is to remain unchanged. For example, if the output elasticity of fertilizers is .05 and the output elasticity of labour is .6, a 1% rise in labour wages induced by policy distortions will require a subsidy on fertilizers of about 12%. The smaller the output elasticity of fertilizers, the heavier subsidies need to be to compensate for the rise in wages induced by public policy.

Section IV: Summary

This paper has been concerned with providing a frame-work for providing second - best solutions to problems posed by the allocative distortions introduced by public policy. Public policies (crop taxes, unbalanced infrastructural development, minimum wage laws etc) either operate to implicitly or explicitly lower producer prices or to directly or indirectly, raise real labour costs on the farms. This paper has been mainly concerned, as a preliminary to future research, with providing guidelines derived within the framework of production theory for engaging in second - best input subsidy schemes. In the general analytical model, it was shown that these compensating input subsidies are related to output elasticities of inputs, when the objective is the minimization of allocative distortions of these policies. In the two - crop two input case, these compensating input subsidies are functions of output elasticities of resources in the respective crops. Policy makers may wish to attack the rural - urban migration problem through efforts to maintain crop outputs at predistortion levels. Compensating input subsidy elasticities to keep quantities of crops unchanged are derived - these also turn out to be functions of the output elasticities of resources.

The ongoing research project in Kwara State indicates labour shortage during the peak seasons as one of the major constraints of the farmers. Such shortages, induced by policy distortions, raise production costs of

a given output. Policy makers may therefore wish to subsidize inputs in such a way as to keep costs from going up. The required compensating input subsidies are derived - and as before, elements of the elasticities matrix are functions of output elasticities of resources. In this case of the "constant cost" elasticity, it was found that the less important is the input to be subsidized, the more the subsidy would have to be to compensate for the rise in labour costs. For example, with output elasticities of .6 and .05 respectively for labour and fertilizer, this elasticity is -12%, meaning that a 1% increase in farm labour costs would require a 12% subsidy on fertilizers if total costs of producing a given crop output are to remain unchanged.

Section V: A Research Agenda

The intent of the earlier part of the paper was to provide the theoretical underpinnings of our future research in this area. It serves to guide us in what it is we want to look for in the field work.

The analysis above on the compensating input subsidies emphasizes the importance of output elasticities of the inputs in determining these subsidies. The choice of a Cobb - Douglas function was based on computational ease and the fact that there was no apriori reason to believe that another functional form was superior to it.

The research project will fit cross - section Cobb - Douglas production

function in selected villages in Kwara State. These villages will be selected on the basis of crop mixtures, ease of supervision and the existennce of personnel complementarities from the State Ministry of Agriculture and Natural Resources.

We would keep the sample fairly small as we want a favourable farmer - enumerator ratio. Intensive training of enumerators will begin around December, to be followed with a situational survey in January - February. It is hoped that the intensive output - input data collection can begin around March 1974.

FOOTNOTES

1. Available evidence from two recent studies of Nigerian Agriculture [5, 6] is consistent with the profit maximization assumption. It has also been observed in Nigeria that heavy taxation of crops in recent years has led to a fall in exports of these crops. This suggests that farmers are responding to a change in expected profits - working from plausible assumptions, we can predict their real - world response reasonably well.

2. This view is consistent with received theory on second - best [5]

3. The new institutional restraint is of the form:

$$P_{y_j} \frac{\partial Y_j}{\partial X_i} = K_2 P_{x_i} \qquad (2b^1)$$

4. We chose the Cobb - Douglas form partly because of its computational ease and partly because we saw no reasons initially to presume that another functional form was superior to it. Indeed, most production function fitting in Nigerian Agriculture has utilized the Cobb - Douglas form.

5. In an earlier formulation [3], only the one - crop Cobb - Douglas case was investigated. The present formulation is a generalization of the earlier one.

6. For most of the inputs for which explicit subsidy is of immediate relevance, the implicit assumption of infinite elasticities the subsidized prices does no violent injustice to reality. Even for the traditional inputs, it is a reasonable assumption. See for example [2].

7. These positive compensating elasticities in the Cobb - Douglas case are consistent with earlier results obtained with the general model.

8. These compensating subsidy elasticities are derived for given price of the other input.

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