Agricultural Pricing Policy and Income Distribution in a Multi-Objective Framework: A Dominican Republic Example

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Introduction

Government intervention to affect agricultural pricing takes place in many less-developed countries. Such action has many objectives. These have been reviewed by numerous authors (for example, Krishna 1967, Mellor 1976, Arkin 1976, Sadan 1976) and include inter- and intra-year price stabilization, returns to increased production, import substitution, and lowered consumer food cost. Until recently these objectives have not often included equity issues like income distribution within the agricultural sector, between agriculture and the rest of the economy or the meeting of basic human needs. Now the position of those in poverty, both in an absolute sense and relative to others in society, has become an added area of concern.

To meet these objectives prices may be supported above or below free market equilibrium, or at some long-run estimate of normal free-market level. In each case, decision makers need to decide on the price level they will attempt to achieve.[1]

Considerable work has been done in developed countries on estimating the multiple outcomes of pricing policies (for example, Ippolito and Mason 1978, Turnovsky 1976, Walter 1977), but much less has been attempted for less-developed countries. Efficiency/social welfare effects have been evaluted for less-developed countries using consumer and producer surplus (for example, Haessel and Vickery 1975, Barker and

Hayami 1976, Bale and Greenshield 1978). Equity and income distribution effects have been estimated for some developed countries (e.g. Schultze 1971 for the U.S. indicating price supports as regressive), but authors examining this issue in less-developed countries have concentrated on the price-stabilization case (eg. Lipton 1970, Bale 1979).[2] These studies also relate to a single policy objective. Decision makers in less-developed countries need to know the likely outcomes of their pricing decisions in terms of the trade-offs and complementarities among multiple objectives, including those related to the situation of the poor. These relationships must also be expressed in terms which assist the pricing decision.

The purpose of this paper is twofold. First, to estimate empirically for the Dominican Republic tradeoffs and complementarities when income effects are taken into account in their agricultural pricing policy; second, to present these results in a form which may readily be used by the decision-makers. Although the numerical results form a special case, both the method and some of the relationships observed are of more general significance.

Dominican Republic Pricing Policies and Goals

In the Dominican Republic , INESPRE (Instituto Nacional de Estabilizacion de Precios) acts to support prices of corn, peanuts, rice and beans: all presently imported corps. Immediate objectives of the

agency (as suggested by its name) are to reduce intra-year price variation. A second objective is to set domestic prices to encourage production and reduce imports, while maintaining 'reasonable' consumer prices.[3] Pricing policy is also expected to complement other government objectives such as increased employment, and more equal income distribution. These last two objectives have been important in stated Government policy over the past five years, and seem to be of relevance to the new government (Secretaria de Estado de Agricultura 1976).

INESPRE controls imports[4] and sets producer prices which can be above import equivalent, although at this point not high enough to guarantee domestic self-sufficiency. Consumers usually pay the support equivalent price.[5] In summary, the stated pricing policy is one in which prices would be chosen which are above free-market equilibrium.

Description of the Model

Simulation of alternative pricing policies for INESPRE has involved the use of CEMI - a price-endogenous linear programming (LP) model of the Dominican crop sector.[6] Market equilibria for each crop (including intervention) are determined through maximization of the sum of producer plus consumer surplus (see Duloy and Norton 1975, McCarl and Spreen 1980).

Much pricing policy analysis has involved models, either single or multiple equation, using time series data. Such data are not available

for any reasonable time period for the Dominican Republic. A sector LP model does not require such data. Further, it includes detailed specification of product and factor markets; production units and resource constraints are specified for various farm size groups. As a result, indirect supply changes due to support pricing can be taken into account for crops, factors and disaggregate income categories. This type of interaction is not dealt with in any partial single crop analysis.

The supply side of the agriculture sector model is divided geographically into three zones (Zone A, North; Zone B, Southwest; Zone C, Southeast). Production units are specified for four farm size groups (small, 8-79 tareas; medium, 80-499 tareas; large 500 plus tareas; collectives).[7] The ten major annual crops of Dominican agriculture are included in the model along with one interplanted combination of crops (rice, red beans, corn, interplanted red beans and corn, cassava, industrial tomatoes, sweet potatoes, tobacco, peanuts, pigeon peas, and black beans). Production activities are specified for either irrigated or nonirrigated land type. Up to six different production techniques are specified for each combination of crop and zone. Each production technique is specified for as many as four different planting dates depending on the crop, zone and agroclimatic conditions. The production credit market is specified with three sources of supply (government, private institutions, private noninstitutional) at different interest rates. The labor market has family labor (assumed to have a reservation wage 50 percent of the hired wage rate), small farmer hiring out (75

percent of hired wage) and landless laborers. Land is constrained at the 1975 level. The demand side of the model consists of a downward sloping curve for each commodity, each approximated linearly with fifteen demand curve segments. Demand curves are bounded at the bottom by export prices and at the top by either import or INESPRE support prices.[8] A foreign exchange accounting row for factor inputs, product exports and imports is also included. More details of the model are provided in equation form in the Appendix.

Simulation of Rice and Bean Price Increases

Rice and beans are major crops in the Dominican Republic with some price support but continuing imports.[9] Price increases have been under consideraton by INESPRE for either or both crops in order to reduce imports. These two crops therefore seemed appropriate for analysis.

To describe briefly the process used for the price policy simulations: first the model, CEMI, is used to generate a base year pattern of production, prices, consumption, imports and exports which forms the starting point for the analyses. The base year used is 1975.[10] Then the model is altered by respecifying the upper price bound to establish a higher support price for rice and/or beans. This new version is then solved and the resulting levels of production, consumption and factor use simulate the equilibrium situation under the altered policy. Further price changes are then made, the model resolved,

and in this fashion a series of policy simulation solutions is generated. The stepwise increases in INESPRE price move first toward domestic self-sufficiency, then into a situation in which domestic production is greater than consumption and the surplus must be stored (or exported below cost).

Rice and beans prices in RD$[11] per pound are presented in Table 1a for the base year solution (BY) and the thirteen simulations. Three series of simulations were run:
rice price increases (R1-R5), bean price increases (H1-H4) and joint rice and bean price increases (RH1-RH4).[12]

Evaluation of Price Policy Simulations

For analysis of rice and red bean pricing a basic set of policy objectives was chosen. These are: a) increased production of rice and/or beans, b) self-sufficiency in beans and rice, c) foreign exchange savings, d) higher agriculture sector income, e) higher small farm income, f) more equal income distribution, g) greater employment in agriculture, h) improved efficiency of agriculture, and i) holding consumer food price increases to a minimum. Alternate price policy simulations are compared and judged on how well they perform with respect to these objectives.

Performance on these general policy objectives is measured for

Table 1.a : Price Policy Simulations from 1975 Base Year

	BASE	RICE SERIES					BEAN SERIES				JOINT SERIES			
	BY	R1	R2	R3	R4	R5	H1	H2	H3	H4	RH1	RH2	RH3	RH4
Rice Price	.114	.12	.13	.14	.15	.16	.114	.114	.114	.114	.12	.13	.14	.15
% Increase	-	5.60	14.00	23.00	32.00	41.00	0.00	0.00	0.00	0.00	5.60	14.00	23.00	32.00
Bean Price	.25	.25	.25	.25	.25	.25	.27	.29	.31	.33	.27	.29	.31	.33
% Increase	-	0.00	0.00	0.00	0.00	0.00	8.00	16.00	24.00	32.00	8.00	16.00	24.00	32.00

agriculture sector model simulations by the values of specific target policy variables. There are usually several target variables in the model which indicate performance with respect to any particular policy objective.

It is not the purpose of this paper to examine in detail the effect of the price changes on each objective, looking at various measures and examining in detail why these results occurred, although some of the major findings will be discussed in the course of the analysis. This description can be found in House and Erickson 1980. Instead, a set of summary target variables are used to examine the interrelationships among objectives for alternative pricing strategies.

Policy Objectives and Target Variables

The set of variables which were chosen as summary measures for this analysis are presented in Table 1. Rows 1 and 2 are production levels for rice and beans for each of the simulations. The measures of self-sufficiency are the levels of imports for rice and beans (Rows 3 and 4). Foreign exchange is measured in Row 5. Sector income (SI) measures total farm income from all agricultural sources. Row 6 lists the proportional change in SI over the base year. Similarly, the addition to small farm income (SFI) is measured as the percentage addition over the base year (Row 7).

Table 1
Target Policy Variable by Price Policy Simulation

Target Policy Variables	Units	Alternative Price Policy Simulations												
		BY	R1	R2	R3	R4	R5	H1	H2	H3	H4	RH1	RH2	RH3	RH4
Production															
Red Beans	10^6 lbs	53.9	49.5	45.9	45.9	49.7	49.7	56.9	65.8	83.9	85.0	54.8	54.8	68.2	69.6
Rice		461.0	487.2	509.6	573.3	604.3	604.3	461.6	436.3	428.9	427.8	478.6	492.3	559.1	579.8
Self-Sufficiency															
Red Beans	10^6 lbs	-14.4	-18.9	-22.5	-22.5	-18.6	-18.5	-11.0	-1.7	0.	0.	-13.1	-12.8	0.	0.
Rice		-94.0	-66.1	-41.2	0.	0.	0.	-93.4	-118.	-126.	-127	-74.8	-58.5	0.	0.
Foreign Exchange Savings	10^6 RD$	0.	2.0	3.9	3.8	1.5	1.5	0.9	0.7	-2.9	-3.2	2.5	4.5	8.1	6.1
Sector Income	% Change	0.	1.0	1.9	3.2	4.0	5.2	0.5	0.5	1.1	1.9	1.0	2.4	3.8	5.6
Small Farm Income	% Change	0.	2.3	2.5	4.4	2.3	6.9	2.1	0.4	1.4	4.1	1.7	3.8	4.0	6.6
Employment	10^6 DA	20.81	21.15	21.41	21.97	22.89	22.29	20.94	21.19	21.78	21.82	21.10	21.39	22.16	22.35
Labor/ Capital	Days/RD$	.62	.61	.60	.58	.56	.56	.62	.63	.64	.64	.61	.60	.56	.56
Cost of Subsistence Consumption	% Change	0.	0.9	2.3	3.7	5.1	6.5	0.4	0.8	1.1	1.5	1.3	3.1	4.8	6.6

The effects of price changes on income distribution among small, medium, large and collective farms are also important, and were measured from the results of the simulations. Analysis of these results determined an unusual and important result: none of the simulations significantly affected the distribution of farm sector income among the four farm groups. Even though large farms often received more of the farm income benefits of a price increase, the income gains were only a small proportion of their existing income base. The smaller absolute gains of small farms were a much greater proportional increase in income. Since income distribution does not change significantly in these simulations it is not used as a target variable for tradeoff analysis.

Employment is measured by the number of man days used across all farm sizes (Row 8). This measure covers demand for labor from all sources thus including employment of landless laborers as well as small farmers. As a surrogate for the income situation of the poor this could be misleading if large farms met additional labor requirements with family labor. In fact this is generally not the case. The labor/capital ratio calculation is taken as an efficiency measure (Row 9). Assuming that the Dominican economy is relatively labor rich and capital poor and that the present system overuses capital, a shift towards greater relative labor use is an improvement in performance. Change in cost of subsistence consumption (Row 10) is a welfare measure which takes into account the effect of the price increases on the real incomes of rural and urban subsistence consumers.[13]

As can be seen in Table 1, examination of price policy impacts requires analyzing the performance of ten target variables across fourteen model solutions. This process can be simplified by recognizing that subsets of the target variables are highly intercorrelated. Factor analysis is a useful ad hoc technique for describing these variable interrelationships since it clarifies the correlations in such a multivariate system.[14]

The "common factor analysis" model was applied and two factors were identified which explain 88 percent of the total variance of the system of ten target variables. The rotated factor loadings, which measure correlation between a factor and a variable, are presented in Table 2 and plotted in Figure 1. The factor loadings indicate which subsets of variables are correlated - both positively and negatively - and which variable subsets are uncorrelated.

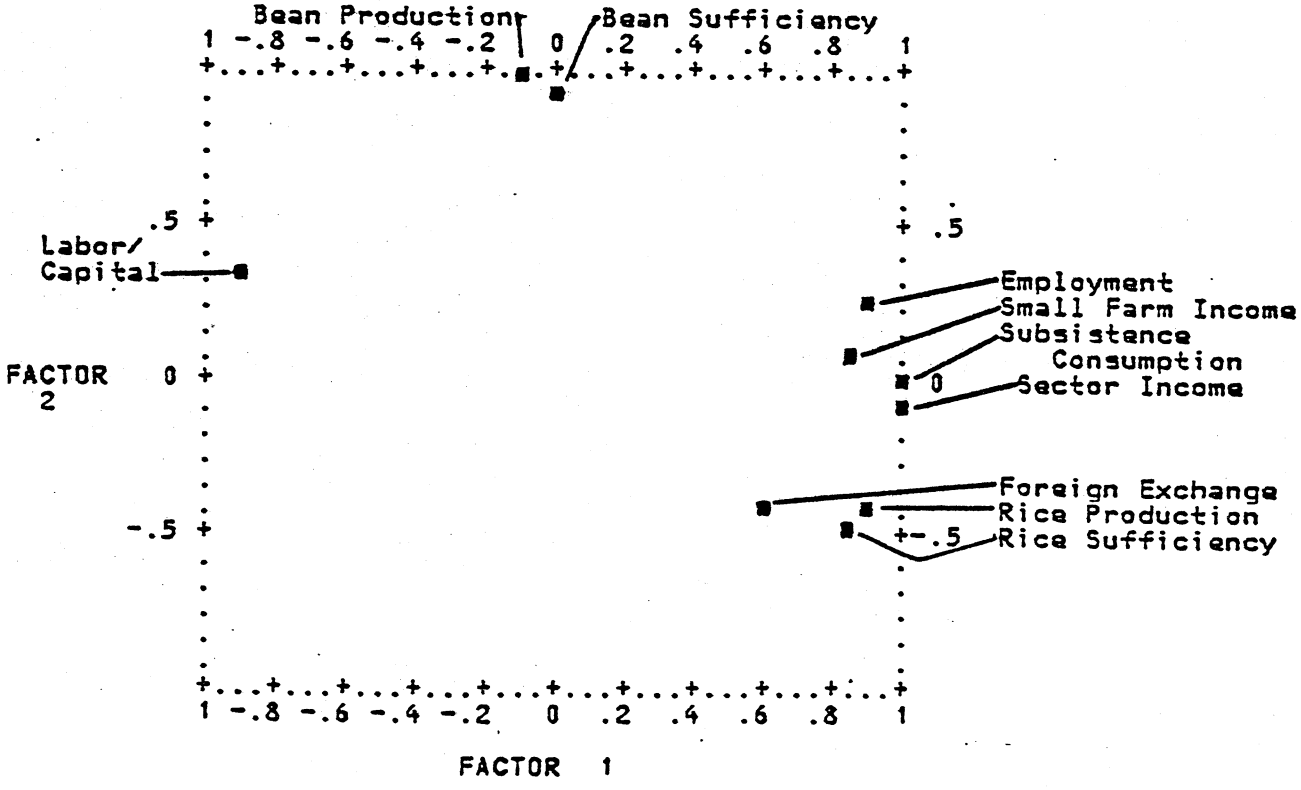
Eight of the ten variables are highly associated with Factor 1 which is plotted on the horizontal axis of Figure 1. The figure gives a good graphic idea of the relative correlations among target variables. It is evident that rice production, rice self-sufficiency, and foreign exchange balances are a highly correlated subset of variables. They are strongly correlated with another set of target variables consisting of sector income, small farm income and employment. These six variables are in turn correlated fairly negatively with the labor/capital ratio and positively with increases in the cost of subsistence consumption.

Table 2

Rotated Factor Loadings by Target Policy Variables

	Factor 1	Factor 2
Bean Production	-0.077	0.989
Rice Production	0.889	-0.416
Bean Sufficiency	0.008	0.921
Rice Sufficiency	0.869	-0.470
Foreign Exchange	0.597	-0.391
Sector Income	0.987	0.012
Small Farm Income	0.866	0.097
Employment	0.903	0.263
Labor/Capital	-0.914	0.361
Subsistence Consumption	0.987	-0.063

Figure 1 ROTATED FACTOR LOADINGS BY TARGET POLICY VARIABLES



These measures indicate that the price policy stimulation of rice production has both benefits and costs. On the plus side there is a strong positive influence on foriegn exchange, sector income and small farm income, as well as rural employment. On the minus side, the policy of increasing rice prices leads to increases in consumer food costs, and a decreased labor intensity of production which is at odds with the relative factor supplies of labor and capital in the Dominican Republic.[15]

These are the basic target-objective tradeoffs associated with policies of increasing rice production. It is interesting to note that the labor/capital ratio is inversely related to employment. This indicates that both labor and capital use rise, with capital use rising more than labor.

The remaining policy variables, bean production and bean self-sufficiency, are highly associated with Factor 2 (which by definition is completely uncorrelated with Factor 1). Rice production, self-sufficiency and foreign exchange balances are all moderately negatively affected by price policy stimulation of red bean production. The labor/capital ratio and employment show a modest positive influence from policies raising red beans prices. The remaining target objectives are largely unaffected. When bean prices are increased, more beans are produced and labor use increases, but rice production falls and the foreign exchange situation worsens.

This basic difference in response to rice price increases compared

with bean price increases can be explained to a large extent by differences in crop substitution. Expansion of one crop's production, unless unutilized land is brought into production, comes from reduction in other crops or more intensive land use. As price rises, rice production increases occur at the expense of small reductions in several crops, including beans, and a substantial decrease in tobacco. Bean price increases lead to somewhat similar crop substitutions: rice production drops somewhat, but tobacco falls more. 16/ Corn planting rises because of intercropping. However, a given area of land freed from tobacco production generates a much greater production increase in rice than beans. The marginal increases in planted land are, in a sense, used more efficiently in rice than bean production. Bean yields are relatively much lower than rice yields (little is fertilized), and despite more intensive multiple-cropping (two or three bean crops per year), the effects of the yield difference predominate.

Reduction of Target Variables

To use the simulations to assist in pricing policy decisions it should be possible to compare quantitatively the various effects of each alternative price change. It would be helpful to first reduce the number of variables which need to be compared. The previous section has shown that there are a number of close interrelationships among target variables. A more detailed look at the objectives which they measure indicates that a number of objectives are really interrelated and represent intermediate goals rather than final objectives. In other