

Price and Output Expectations in Agricultural Policy: The Case of Jamaica

Giorgio Canarella
and
Stephen K. Pollard*

I. Introduction

The analysis of agricultural pricing systems in Less Developed Countries (LDC's) involves the consideration of at least two inter-related problems: on the one hand, there is the problem of compatibility of policy actions with the structure of incentives of producers; and on the other, the problem of adequacy of actual policy measures in terms of intended results. Typically, the agricultural pricing system refers to a system in which two sets of decision makers are involved: (1) a parastatal marketing board (the board) which sets a pricing policy with a set of intended results in mind; and (2) the farmers, who respond to such a pricing policy in terms of actual results. In this paper, we attempt an evaluation of such policies by extending the rational expectations approach, which has received wide attention in the macroeconomic literature, to the analysis of the strategies and interrelations involved in agricultural pricing policies.

It is the contention of this paper that such an approach can overcome the drawbacks and fragmentarity of the findings in recent contributions in the literature on agricultural policy. The analysis of the impact of such policy on incentives faced by

* Professor and Associate Professor, Department of Economics and Statistics, California State University, L.A., U.S.A.

pectational reaction functions that describe the responsiveness of the farmers and the Board to each others anticipated actions.¹ The analytical framework depicting this equilibrium is set forth in the next section and the econometric specification and testable hypothesis are presented in Section III. Our conclusions and implications comprise the final section.

II. Analytical Framework

Consider the following structural model which describes the profit/welfare maximizing strategies of the Board and the farmers:

$$(1) \quad Q_t = a_0 + a_1 E(P_t | \Omega) + a_2 Q_{t-1} + u_t$$

$$(2) \quad P_t = b_0 + b_1 E(Q_t | \Lambda) + c_2 X_{t-1} + v_t$$

where E is the expectation operator; Q_t is the quantity of output delivered by the farmers to the Board in time t ; P_t is the price offered by the Board to the farmers in time t ; X_{t-1} is a vector of lagged exogenous variables; Ω is the information set utilized by farmers to construct price expectations; Λ is the information set utilized by the Board to construct output expectations; and u_t , v_t are serially uncorrelated jointly covariance stationary random variables with zero mean, finite variances σ_u^2 and σ_v^2 and a finite covariance σ_{uv} .

The Board maximizes its objective function by choosing a price subject to their expectation of the quantity supplied by the farmer [eq. (2)] and the farmers maximize their profits by choos-

¹ This responsiveness by both farmers and the Boards to the others actions are reflected in the annual reports of the Boards and the growers associations. Board members have expressed concern over continuing decreases in output and do consider future levels of output when undertaking contractual arrangements and negotiations of quotas in international markets. Sugar cane farmers, through their growers association, have been commented in the leading Jamaican newspaper about the price they receive (*Daily Gleaner*, March 17, 1984). Stone (1980) in a review of Board-farmer relationships states that the All Island Cane Farmers Association bargains hard for member benefits and discusses the "close" relationship that exists between the Sugar Industry Authority (the Sugar Board) and the Sugar Cane Growers Association.

$$(3) \quad Q_t = a_0 + a_1 E(P_t | \Omega) + a_2 Q_{t-1} + U_t$$

$$(4) \quad P_t = b_0 + b_1 E(Q_t | \Lambda) + b_2 WP_{t-1} + b_3 RE_{t-1} \\ + b_4 CSR_{t-1} + v_t$$

where Q is the natural log of sugar cane output measured in tons; P is the natural log of the nominal farmgate price of sugar cane per ton deflated by the GDP deflator; WP is the natural log of the nominal F.O.B. price for sugar received by the Board; RE is the natural log of the nominal exchange rate ($\$/\text{\$US}$) deflated by the GDP deflator; and CSR is the natural log of the ratio of sugar cane output to sugar output.

The expected signs of these parameters are: $a_1 > 0$, $b_1 < 0$, $b_2 > 0$, $b_3 > 0$, and $b_4 < 0$. Economic theory suggests that farmers will deliver more output if they anticipate a higher offer price, while the Board will offer a lower price if a higher quantity is expected. Increases in the world price or a devaluation of the exchange rate raises the domestic value of the crop and such increases in value could be passed on to the farmers in higher offer prices. An increase in CSR implies that more sugar cane is needed to make a ton of sugar which results in a decrease in the value of sugar cane output and the offer price.

As in the case of sugar cane, the Coffee Board also uses the world prices and exchange rate as a means of determining the offer price to farmers. This is reflected in interviews with the manager of the Board and such information is published in the annual reports of the Board and distributed to farmers at the annual meetings. Specification of the structural model for coffee is then as follows:

$$(5) \quad Q_t = a_0 + a_1 E(P_t | \Omega) + a_2 Q_{t-1} + u_t$$

$$(6) \quad P_t = b_0 + b_1 E(Q_t | \Lambda) + b_2 WP_{t-1} + b_3 RE_{t-1} + v_t$$

where Q is the natural log of coffee output in boxes (10 lbs. per box); P is the natural log of the nominal farmgate price per box deflated by the GDP deflator; WP is the natural log of the

Proceeding analogously with eqs. (5)-(6) yields:

$$(11) \quad Q_t = [(a_0 + a_1 b_0)/(1-a_1 b_1)] + [(a_1 b_2)/(1-a_1 b_1)] WP_{t-1} \\ + [(a_1 b_3)/(1-a_1 b_1)] RE_{t-1} + [a_2/(1-a_1 b_1)] Q_{t-1} + u_t$$

$$(12) \quad P_t = [(b_0 + b_1 a_0)/(1-a_1 b_1)] + [b_2/(1-a_1 b_1)] WP_{t-1} \\ + [b_3/(1-a_1 b_1)] RE_{t-1} + [(a_2 b_1)/(1-a_1 b_1)] Q_{t-1} + v_t$$

Eqs. (9)-(10) and eqs. (11)-(12) show explicitly the interdependence of the Board and farmers behavior since the structural parameters of the Board's strategy (b_i 's) constrain the reduced form strategy of the farmers and the structural parameters of the farmers' strategy (a_i 's) constrain the reduced form strategy of the Board.

The rational expectations hypothesis imposes a set of non-linear constraints on the coefficients of the two reduced form systems: the ten coefficients of the reduced form model, eqs. (9)-(10), depend upon the eight coefficients of the structural model, eqs. (3)-(4), and the eight coefficients of the reduced form model, eqs. (11)-(12), depend upon the seven coefficients of the structural model, eqs. (5)-(6). Consequently, the reduced form coefficients are policy invariant since the structural coefficients are.

A test of the validity of the constraints imposed by the rational expectations hypothesis can be based on a likelihood ratio test, which requires obtaining the restricted estimates of eqs. (9)-(10) and eqs. (11)-(12) and the unrestricted estimates (i.e., estimates of eqs. (9)-(10) and eqs. (11)-(12) without the imposition of the constraints). The full information maximum likelihood (FIML) approach which is designed to estimate systems containing cross-and-within equation constraints is utilized to obtain the restricted and unrestricted estimates.

The likelihood ratio test requires computation of $\lambda = L_r/L_u$ where L_r and L_u are the maximized values of the likelihood function of the restricted and unrestricted reduced form models, respectively. Then, under the null hypothesis that the constraints

Table 1
FIML REDUCED FORM PARAMETER ESTIMATES
OF EQS. (9)-(10): SUGAR CANE

	Restricted	Unrestricted
Quantity Equation		
Constant	8.7172 (3.2069)	10.9503 (3.5634)
Q_{t-1}	.4613 (.2073)	.3022 (.2280)
WP_{t-1}	.0605 (.0342)	.0252 (.0663)
RE_{t-1}	.1666 (.0659)	.1923 (.1044)
CSR_{t-1}	-.5498 (.1920)	-.4438 (.2566)
Price Equation		
Constant	16.5175 (6.6391)	13.2065 (7.0505)
Q_{t-1}	-.7585 (.4271)	-.5226 (.4511)
WP_{t-1}	.1975 (.1001)	.2498 (.1312)
RE_{t-1}	.5438 (.1675)	.5058 (.2066)
CSR_{t-1}	-1.7947 (.4392)	-1.9518 (.5077)
L	37.9497	38.9655
LRTS		2.0316 [.3621]

Notes: Asymptotic standard errors in parentheses.
Marginal significance levels in brackets.

quantity necessary to maximize farm profits (i.e., OQ_2 requires OP_2). Farmers will reduce their deliveries, which "forces" the Board to raise its offer price until equilibrium is restored at point E. This analysis demonstrates that even though either group can exhibit market power (including one group having complete domination in the form of monopoly or monopsony power), ignoring the incentives faced by the other renders such power useless.

A different picture emerges when the results for coffee are analyzed. In particular, the examination of the likelihood ratio test statistic in Table 2 reveals that the hypothesis of a rational expectations-Nash equilibrium solution is rejected at the five percent level of significance. The apparent reason for this rejection can be found in the lack of significance of b_1 , the parameter of

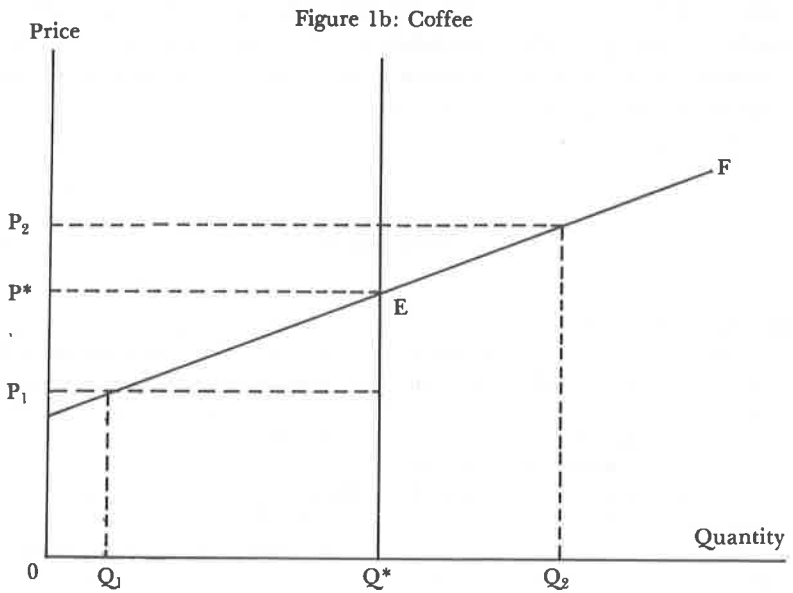
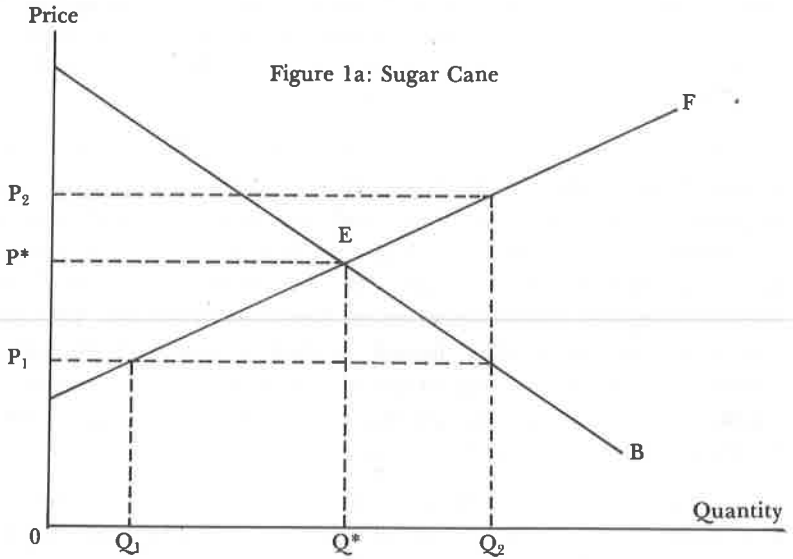
Table 3

FIML PARAMETER ESTIMATES OF EQS. (3)-(4) AND EQS. (5)-(6)

Parameter	Sugar Cane	Coffee
a_0	3.6567 (3.0657)	22.6228 (2.0127)
a_1	.3064 (.1249)	.1342 (.0501)
a_2	.6937 (.2174)	-.8314 (.1629)
b_0	30.8508 (17.1294)	-11.4491 (6.8131)
b_1	-1.6443 (1.0818)	.1178 (.4754)
b_2	.2969 (.1507)	1.4152 (.4889)
b_3	.8178 (.3279)	.8209 (.8364)
b_4	-2.6987 (.9065)	

Note: Asymptotic standard errors in parentheses.

Figure 1
PRICE-QUANTITY RELATIONSHIPS IN THE
SUGAR AND COFFEE INDUSTRIES



- Bloomington: Indiana University Press, 1978.
- Cuddihy, W., *Agricultural Price Management in Egypt*, World Bank Staff Working Paper 398.
- de Janvry, A., "Why Do Governments Do What They Do? The Case of Food Price Policy," Paper presented at the Conference on the Role of Markets in the World Food Economy, Minneapolis, Oct. 1982, 14-16.
- Hertford, R., "Government Price Policies for Wheat, Rice, and Tractors in Colombia," in *Distortions of Agricultural Incentives*, T. W. Schultz, ed., Bloomington: Indiana University Press, 1978.
- Lewis, B. C., "Political Variables and Food and Price Policy in West Africa." Paper prepared for the USAID/USDA, 1980.
- Reca, L. G., *Argentina: Country Case Study of Agricultural Price, Taxes and Subsidies*, World Bank Staff Working Paper 386, 1980.
- Schultz, T. W., "Constraints on Agricultural Production," in *Distortions of Agricultural Incentives*, T. W. Schultz, ed., Bloomington: Indiana University Press, 1978.
- Stone, C., *Democracy and Clientelism in Jamaica*, New Brunswick, New Jersey and London: Transaction Books, 1980.
- Tolley, G. S., Thomas, and Ching Ming Wong, *Agricultural Price Policies and the Developing Countries*, Baltimore and London: The Johns Hopkins University Press, 1982.
- Williams, R. L., *The Coffee Industry in Jamaica*, Mona, Jamaica: ISER, 1974.
- Zusman, P. and A. Amiad, "A Quantitative Investigation of Political Economy-The Israeli Dairy Program," *American Journal of Agricultural Economics*, 54, 1977, 88-98.