A MATHEMATICAL PROGRAMMING APPROACH TO EVALUATING PRICE STABILIZATION SCHEMES

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A Mathematical Programming Approach to Evaluating Price Stabilization Schemes

Price stabilization schemes for risky agricultural markets continue to attract interest. Applied welfare economics has offered some insights into who gains from stabilization (see Turnovsky). Economic models, such as stochastic simulation and dynamic programming, have been used to evaluate the costs of alternative stock sizes and storage rules (e.g. Reutlinger, Burt et.al.).

A limitation of these analytical approaches is their difficulty in dealing with the following: First, most commodities have demand substitutes and/or compete for scarce resources with other commodities in production. Stabilization interventions in any one market may have important spillover effects in other markets that are not captured in the usual single commodity framework. Second, even though the importance of producers' aversion to price and yield risks has been recognized as a determinant of supply (Just), the implied changes in average supply following price stabilization are typically ignored. Third, nearly all the analytical work on price stabilization has focused on a very narrow set of policy objectives, particularly the changes in producers' and consumers' surplus, producers' income and storage costs. However, price stabilization may affect a much wider range of policy issues when due allowance is made for risk response and multimarket interactions.

Price endogenous mathematical programming models take account of multi-product relationships in supply and demand, and can be specified

to simulate the effects of risk averse behavior at the farm level, They also provide a wealth of detailed information about production, resource use, consumption, prices and trade, both at the micro (farm or regional) and sector wide levels. This paper shows how price endogenous mathematical programming models can be used to evaluate price stabilization schemes. The method is illustrated by using an agricultural sector model of Guatemala to evaluate a hypothetical bean price stabilization scheme.

An Agricultural Sector Model of Guatemala.

Price endogenous mathematical programming models have recently been reviewed by McCarl and Spreen. The Guatemalan model used here is typical of these models, and has a structure which is amenable to linear programming. In particular, the model has a linear demand system, a linear constraint set and a risk behavior specification of the mean standard deviation type. The model is fully described in Pomareda. Our purposes here are simply to establish notation and to review those model features necessary for discussing the price stabilization experiments.

Let the demand system be $P = A - BQ$, where P and Q are n x 1 vectors of domestic prices and market supplies, respectively, and A and B are n x 1 and n x n matrices of demand coefficients. For notational simplicity we ignore representative farm subscripts and assume international trade in all commodities (which may be at zero levels). The model objective function which provides the competitive solution to prices and quantities in all markets is then:

$$(1)\quad \text{Max } \Phi = E(Q')\,[A - 0.5\,BE(Q)] - C_x'X + C_r'R - C_m'M - k(X'\Omega X)^{1/2}$$

Where $E(Q) = E(N)X + M - R$, and X is an n x 1 vector of crop acreages grown, N is an n x n diagonal matrix of stochastic per acre yields, M and R are n x 1 vectors of tons of imports and exports respectively, C_x is an n x 1 vector of production costs per acre, C_m is an n x 1 vector of import costs per tons, C_r is an n x 1 vector of export prices per ton net of export costs, Ω is an n x n covariance matrix of crop revenues [1/] (price times yield) and k is a suitable average of individual farmers' risk aversion parameters. This maximand exists only if B is symmetric (Takayama and Judge). While the model does accomodate multi-commodity relationships in demand, the form is restricted.

As Hazell and Scandizzo (1974) have shown, the maximand (1) provides the market equilibria that would be arrived at if production is lagged and farmers act on the basis of price expectations which are formed independently of their expectations about yields. Such market equilibria are socially inefficient (Hazell and Scandizzo, 1975). However, if producers act on the basis of revenue expectations, thereby taking account of any correlations between prices and yields, socially efficient market equilibria are attained. The maximand:

$$(2)\quad \text{Max } \theta = E\,[Q'(A - \tfrac{1}{2}BQ)] - C_x'X + C_r'R - C_m'M - k(X'\Omega X)^{1/2}$$
$$= \Phi - 0.5\Sigma\Sigma X_i X_j \sigma_{ij} b_{ij}$$

where σ_{ij} denotes the covariance between the yields of the $_i$th and $_j$th

crops provides the socially preferred equilibrium solution (Hazell and Scandizzo, 1977).

The covariance matrix of crop revenues Ω is treated as a constant by Hazell and Scandizzo, and is typically estimated on the basis of time series data on prices and yields. While observed price and yield deviations around their mean (or trend lines) may be an acceptable measure of risk in market equilibrium, the revenue elements of Ω are not invariant with respect to the mean price [2/] Thus, if the expected prices in the equilibrium solution are different from the sample mean prices used in the calculation of Ω, then Ω should be revised. Procedures for endogenizing the Ω matrix have not yet been developed, and in the Guatemalan model we used an iterative procedure. If, at the t^{th} iteration the i, j^{th} element of Ω had mean prices $\bar{P}_{it}$ and $\bar{P}_{jt}$, and these differed from the equilibrium prices $E(P_{it})$ and $E(P_{jt})$ obtained in the corresponding t^{th} model solution, then $E(P_{it}) - P_{it}$ and $E(P_{jt}) - \bar{P}_{jt}$ were added to the sample price observations for the i^{th} and j^{th} crops, ω_{ij} recalculated, and a new solution obtained. This procedure was repeated until $E(P_{it}) - \bar{P}_{it}$ and $E(P_{jt}) - \bar{P}_{jt}$ converged to zero. In practice, Ω typically converged in three or four iterations.

Methodology of Price Stabilization Experiments

We are interested in a stabilization scheme in which the domestic price of beans is fixed at its expected market equilibrium value. Such price stabilization would be achieved through the establishment of buffer stocks. To assure a self-liquidating stock on average, the price at which a market is to be stabilized is the expected market

clearing price in equilibrium. This price can be obtained from the model. The problem is to modify the model to obtain the market equilibrium solution corresponding to the stabilized situation.

The model solutions are conditioned in part by the covariance matrix Ω, and stabilizing the price of the j^{th} crop changes the variance and the covariance terms involving that crop. An important part of the method of experimenting with price stabilization therefore follows: one must re-calculate all the relevant elements of Ω using the stabilized price $\bar{P}_j = E(P_j)$ and then resolve the model for a new equilibrium.

However, producers will adjust their cropping patterns to arrive at a new optimal plan given their assumed E,σ utility functions. This is the risk response effect induced by stabilization, and the original expected market clearing price for the stabilized crop will no longer be the same. The stabilized price $\bar{P}_j = E(P_j)$ will now have to be revised to retain a self-liquidating buffer stock, the elements of Ω recalculated, and the solution process repeated. This iterative procedure is repeated until Ω converges.

As will later become clear, a small modification is also required in the demand specification for the stabilized crop in equation (2). Q_{jt} is no longer stochastic when the stabilizing agency sells a fixed amount $\bar{Q}_j$ to consumers each year; and (2) must be revised so that $E(Q_j^2) = \bar{Q}_j^2$ for the stabilized commodity. This can be done by setting $\sigma_{ij} = 0$, all i, in equation (2).

The post-stabilized solution provides the expected values of all activities in the new market equilibrium. Changes from the pre-stabilized solution stem from two possible sources: (i) from supply adjustments following changes in farm level risk, (ii) from the disappearance of the covariance between price and yield leading to identical revenue and price expectations for the stabilized crop. Assuming producers were (a) risk neutral (k = 0) and (b) that they plan on the basis of price expectations (objective function (1)), then the pre- and post-stabilized solutions would in fact be idenitcal, with $\bar{P}_j$ remaining constant. Even though the model activity levels would not change under these conditions, the removal of price and market supply variations still leads to changes in the expected values of the consumers' surplus, producers' surplus, and income.

The surplus and income changes can be calculated in the model. Given our assumed market structure, prices in the t^{th} year are given by $P_t = A - BQ_t$. Expected consumers' surplus in the prestabilized situation is,

$$(3)\quad E(W_c) = E\left[Q_t'(A - 0.5\,BQ_t) - P_t'Q_t\right] = 0.5\,E(Q'BQ)$$

Expected producers' surplus is,

$$(4)\quad E(W_p) = E\left[Q'(A - BQ)\right] - C_x'X + C_r'R - C_m'M - k\,(X'\,\Omega\,X)^{1/2},$$

where we have used an ex post measure of the surplus, viz. actual revenue less the ex ante costs of production incurred at the time when X is planted (Hazell and Scandizzo, 1975).

The producers' surplus is defined net of the risk term k $(X'\Omega X)^{\frac{1}{2}}$, which is the income compensation they require for accepting the risks associated with X. By deleting this term in (4), the expected value of producers' income in the pre-stabilized markets is obtained.

To measure aggregate social welfare, we follow a common approach and measure expected social welfare as the sum of the expected producers' and consumers' surplus. In the pre-stabilized market, this is the sum of (3) and (4), and is equal to model objective function (2). This welfare interpretation of (2) provides the rationale for the social efficiency of revenue expectations (Hazell and Scandizzo, 1975,1977).

The establishment of a buffer stock agency stabilizes the prices of a subset of the vector P_t. Partition the relevant matrices so that the price and quantity vectors are:

$$(5) \quad \begin{pmatrix} P_{1t} \\ P_{2t} \end{pmatrix} = \begin{pmatrix} A_1 \\ A_2 \end{pmatrix} - \begin{pmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{pmatrix} \begin{pmatrix} Q_{1t} \\ Q_{2t} \end{pmatrix}, \text{ and}$$

$$(6) \quad \begin{pmatrix} Q_{1t} \\ Q_{2t} \end{pmatrix} = \begin{pmatrix} N_{1t} & 0 \\ 0 & N_{2t} \end{pmatrix} \begin{pmatrix} X_1 \\ X_2 \end{pmatrix} + \begin{pmatrix} M_1 \\ M_2 \end{pmatrix} - \begin{pmatrix} R_1 \\ R_2 \end{pmatrix}$$

Suppose that the buffer stock agency wishes to stabilize prices P_1 at $\overline{P}_1$, where $\overline{P}_1$ is the vector of prices which ensure self-liquidating stocks on average. The agency would plan to buy all the production of Q_1 each year and, by controlling imports M_1 and exports R_1, release the quantities of Q_1 to the domestic market each year that are required to maintain prices at $\overline{P}_1$. If Q_1 and Q_2 are demand independent groups,

(i.e. $B_{21} = B_{12} = 0$), the agency trades constant amounts $\overline{M}_1$ and $\overline{R}_1$ each year, and sells constant amounts $\overline{Q}_1 = E(N_1)X_1 + \overline{M}_1 - \overline{R}_1$ to the domestic market.[3/] When Q_1 and Q_2 are not demand independent P_1 is subject to random variations arising from Q_2 as well as from variations in Q_1. Since the agency would not carry stocks of Q_2, the actual quantities of Q_1 sold would have to be varied from year to year to compensate for variations in Q_2. $\overline{Q}_1$ would then only denote the expected value of the amounts sold by the agency to maintain prices at $\overline{P}_1$.

Where $\overline{Q}_1$, $\overline{M}_1$, and $\overline{R}_1$ are non-stochastic, the expected consumers' and producers' surplus in the stabilized situation evaluate as:

$$(7) \qquad E(W_c) = \tfrac{1}{2}\overline{Q}_1'B_{11}\overline{Q}_1 + \tfrac{1}{2}E\left[Q_2'B_{22}Q_2\right].$$

$$(8) \qquad E(W_p) = \overline{Q}_1'(A_1 - B_{11}\overline{Q}_1) + E\left[Q_2'(A_2 - B_{22}Q_2)\right] - C_x'X - C_m'M + C_r'R - k(X'\Omega X)^{\frac{1}{2}}$$

and expected producers' income is (8) with the risk term $k(X'\Omega X)^{\frac{1}{2}}$ omitted.

Summing (7) and (3) , expected social welfare in the stabilized situation is:

$$(9) \qquad E(W) = \overline{Q}_1'(A_1 - \tfrac{1}{2}B_{11}\overline{Q}_1) + E\left[Q_2'(A_2 - \tfrac{1}{2}B_{22}Q_2)\right] - C_x'X - C_m'M + C_r'R - k(X'\Omega X)^{\frac{1}{2}}$$

(9) is a modified version of (2) in which $E(Q_j^2)$ is replaced by $\overline{Q}_j^2$ for all stabilized commodities. It is also the relevant model maximand for obtaining the market equilibria corresponding to revenue forecasting behavior in the stabilized situation. Since prices and yields are

no longer correlated for the stabilized commodities, producers act as price forecasters when planning X_1 and as revenue forecasters when planning X_2.

The gain in expected social welfare from stabilizing P_1 is the value of (9) - (2). If producers are risk neutral and plan on the basis of price forecasts, the values of X, M and R remain constant, $\bar{Q}_1$ equals E (Q_1) in the pre-stabilized situation, and the welfare gain is:

$$(10) \quad E(\Delta W) = \tfrac{1}{2}\left[E(Q_1'B_{11}Q_1) - \bar{Q}_1'B_{11}\bar{Q}_1\right]$$
$$= \tfrac{1}{2} \sum_i \sum_j X_{1i}\, X_{1j}\, \sigma_{1ij}\, b_{1ij}$$

To obtain the values of the surplus and income measures defined above, it is only necessary to incorporate (1),(2) and (4) into the model, and to have access to the value of k $(X'\Omega X)^{\frac{1}{2}}$ from the solution. Since either (1) or (2) would be the model maximand, then only two additional accounting rows are required. These are quadratic equations, but they can be linearized concurrently with the objective function (see Duloy and Norton). 4/

So far all the activity levels X, M, and R are treated as non-stochastic. Since X (the crop areas planted) depends in part on producers' forecasts about prices, this implies that producers hold constant forecasts over time. In reality, forecasts about prices do change from year to year even when the markets are in equilibria and X, R, and M are stochastic.

If the assumption of non-stochastic activities is relaxed, the surplus and income measures used in the model will be incorrect. To derive the correct results consider the generalized supply structure:

$$Q_t = N_tX_t + M_t - R_t$$

where t subscripts denote activities which are stochastic over time. We also assume that trade is undertaken at uncertain prices.

Expected social welfare in period t in the pre-stabilized situation is now:

$$E(W) = E\left[Q'(A - 0.5BQ)\right] - C_x'E(X) - E(C_m')E(M) + E(C_r')E(R) - kV(r'x)^{\frac{1}{2}} + F,$$

where $F = \Sigma_j\left[\text{cov}(c_{rj}, R_j - \text{cov}(C_{mj}, M_j)\right]$ and $V(r'x)$ denotes the variance of total revenue.

Now $V(r'X) = V(\Sigma_j r_j X_j) = \Sigma_i\Sigma_j\left[E(X_iX_jr_ir_j) - E(X_ir_i)E(X_jr_j)\right]$ which after some expansion yields

$$V(r'X) = E(X')\Omega E(X) + G,$$

where $G = \Sigma_i\Sigma_j\left[\text{Cov}(X_iX_j, r_ir_j) + \text{Cov}(X_i, X_j)E(r_ir_j) - \text{cov}(X_i, r_i)E(X_jr_j) - E(X_i)E(r_i)\text{ cov}(X_j, r_j)\right]$.

Letting D denote $E(X')\Omega E(X)$, then a Taylor expansion of $V(r'X)^{\frac{1}{2}} = (D + G)^{\frac{1}{2}}$ around D provides

$V(r'X)^{\frac{1}{2}} = D^{\frac{1}{2}} + \Sigma_s g_s(D)G^s$, where $g_1(D) = \frac{1}{2}D^{-\frac{1}{2}}$, $g_2(D) = -1/8D^{-3/2}$, etc.

Collecting terms, expected social welfare is

$$(11)\quad E(W) = \{E\left[Q'(A - 0.5BQ)\right] - C_x'E(X) - E(C_m')E(M) + E(C_r')E(R) - k\left[E(X')\Omega E(X)\right]^{\frac{1}{2}}\} + F - k\left[\Sigma_s g_s(D)G^s\right].$$

The terms in the curled parentheses of (11) are equivalent to the value of E (W) defined in (2), the only difference being that the activity levels are now defined as expected values. However, whereas (2) correctly measured expected social welfare when the activity levels

were non-stochastic, it is now necessary to evaluate the additional terms F and $\Sigma_s g_s(D)G^s$. All the terms in F and G become zero if X, R, and M are non-stochastic, so their omission from (2) is justified.

X is stochastic because producers adjust their cropping patterns each year according to changes in their forecasts about prices. When the price vector P_1 is stabilized at $\overline{P}_1$, X_1 becomes non-stochastic. The buffer stock agency also takes control of all importing and exporting activities for Q_1, and M_1 and R_1 are stabilized at $\overline{M}_1$ and $\overline{R}_1$. As such, all covariance terms in F and G associated with activities in the vectors X_1, M_1, and R_1 become zero with stabilization, and the expected value of social welfare in the stabilized situation is (9) + F - k $\Sigma_s g_s(D)G^s$ where F and D contain only the relevant covariances.

Estimates of the gain in social welfare from price stabilization based on equations (2) and (9) could be misleading if changes in F and $\Sigma_s g_s(D)G^s$ are large. There is no basis for calculating these terms in a mathematical programming model, but some indication of their value can be obtained from time series data.

A similar analysis of the expected producers' surplus leads to a generalized form of (4) in which the terms F - k $\Sigma_s g_s(D)G^s$ are added. The consumers' surplus is not affected.

The Guatemalan Experiments

Table 1 contains some basic foodcrop results obtained from the model,[5/] together with actual 1976 data; the year for which the model was numerically specified. The results are presented for both price and revenue forecasting behavior (i.e. using model maximands (1) and

(2) respectively), and for three different levels of risk aversion. A k value of zero implies risk neutrality, k values of 1.65 and 3.16 represent "reasonable" and "extreme" levels of risk aversion, respectively. Specifically, k values of 1.65 and 3.16 correspond to producers' maximizing the 0.05 and 0.001 percentiles of their income distributions, providing these are normally distributed [6/] (Baumol).

The results in Table 1 suggest that the model describes 1976 production levels quite well and they are consistent with an assumption of "reasonable" risk behavior (k = 1.65). The results obtained for price and revenue expectations are very similar for given values of k. As risk aversion increases, bean production is significantly curtailed. This is clearly a high risk crop, and a suitable candidate for price stabilization policies.

Price stabilization cannot affect the model's activity levels if producers' are risk neutral, but it does lead to a small gain in uncorrected social welfare of about $5 million for both price and revenue expectations. The more interesting results for k values of 1.65 and 3.16 are summarized in Table 2. Surplus measures are reported as obtained from the model, and after correcting for stochastic variation in activity levels as measured from time series data.

Price stabilization for beans leads to an uncorrected gain in social welfare of about $12 million when k = 1.65. When corrected for observed variations in X over time, the gain is much smaller; $4 million and $1.2 million for price and revenue expectations behavior, respectively. The uncorrected gain is almost $15 millions when k=3.16,

but is essentially zero when the necessary corrections are made. If our calculations are correct, producers in Guatemala appear to be adjusting their cropping patterns each year in a socially efficient manner, and stabilizing the bean price would do little to improve their efficiency.

There are other effects from stabilizing bean prices. When k = 1.65, bean production increases by 4.3 percent and 9 percent for price and revenue expectations, respectively. This additional production is produced with resources that would otherwise be idle, and there is a decline in the standard deviation of producers income. In both cases the domestic price declines by 15 percent. There is also an increase in agricultural employment; of 17 and 33 thousand jobs for price and revenue expectations, respectively. The gains are much more exagerated under "extreme" risk aversion, and bean production more than doubles. However, since beans are imported in the pre-stabilized solution for this value of k, the extra production largely substitutes for imports. This leads to a decline in the domestic price of only 14 percent, and a favorable effect on the agricultural trade balance. The large increase in beans production leads to some loss in maize and rice production, and an increase in the standard deviation of producers' income.

The results in Table 2 show some ambiguity in the gain to producers and consumers. Consumers gain from bean price stabilization when k = 1.65, but lose when k = 3.16. Average producers' income increases when they hold price expectations (by 2.3 percent and 17 per-

cent for k values of 1.65 and 3.16, respectively) but declines when they plan on the basis of revenue expectations.

Conclusion

Price endogenous mathematical programming models have been proposed in this paper as a useful tool for analyzing price stabilization policies. Their particular attractions for this purpose are (i) they take explicit account of interactions between commodities in supply and demand, (ii) they can incorporate risk averse behavior and simulate the supply response effects of stabilization policies, (iii) they can produce a wealth of information about the wider impacts of price stabilization, and (iv) such models are relatively easy to solve, expecially when they can be linearized.

The main limitation of the approach is that it cannot be used to derive storage costs, or to analyze the effects of different stock sizes. The analysis proposed here assumes that prices are to be stabilized at a single value. Nevertheless, the proposed method provides a useful technique for first rounds of analysis, and which could be supplemented with a simulation analysis.

Footnotes

1/ We assume C_x, C_r and C_m are not stochastic, hence the variance of income and total revenue are identical.

2/ Let $P_j^* = P_j + \lambda$ with λ constant, then $Cov(P_j^* n_j, P_i n_i) = cov(P_j n_j, P_i n_i) + \lambda Cov(n_j, P_i n_i)$.

3/ Complications arise when a stabilized commodity is traded at uncertain prices. The agency must then have the financial facilities to stabilize these prices for the domestic market. Fortunately this problem does not arise with beans in Guatemala, since these are not traded.

4/ Inversion of (2) and (4) proved especially easy in the Guatemalan model because B is diagonal. In this case:

$$E\left[Q'(A - \tfrac{1}{2}BQ)\right] = E(Q')\left[A - \tfrac{1}{2} BME(Q)\right];$$

where M is a diagonal matrix with j^{th} diagonal element $m_j = E(j_j^2)/E(n_m)^2 = 1 + R_j^2$, and R_j is the coefficient of variation of the yield of the j^{th} crop. Since M is a constant, then BM can be calculated as part of the input to the model. The matrix BM remains diagonal, and the term $E(Q')\ [A - \text{'}BM\ E(Q)]$ can be linearized using the Duloy-Norton method. Note that M_j must be equated to unity for stabilization experiments on the j^{th} crop.

5/ The model also includes coffee, sugar, cotton and domestic and export bananas, but the production of these crops was insensitive to the experiments reported here.

6/ A χ^2 test of de-trended time series data strongly supported the null hypothesis that incomes were normally distributed.

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Table 1 Model Results for Different Levels of Risk Aversion

And Alternative Expectations Behavior

	PRICE EXPECTATIONS			REVENUE EXPECTATIONS			1976 Actuals
	k = 0	k = 1.65	k = 3.16	k = 0	k = 1.65	k = 3.15	
PRODUCTION (10^3 metric tons)							
Maize	1076.5	1031.6	1031.6	1076.5	1031.6	986.8	1005.7
Rice	27.9	27.9	29.0	26.7	26.7	26.7	34.1
Sorghum	52.3	50.2	48.1	50.2	48.2	46.0	49.2
Beans	98.1	90.2	41.2	93.5	86.3	41.2	92.1
Wheat	67.1	67.1	67.1	67.1	67.1	67.1	56.9
SOCIAL WELFARE* (Millions US$)	1067.0	980.9	898.0	1071.9	981.6	898.7	

* Uncorrected for stochastic activity levels

TABLE 2 Model Results for Different Price Stabilization Experiments

	k = 1.65		k = 3.16		k = 1.65	
	PRE-STABILIZED PRICE MODEL	% CHANGE WITH BEAN PRICE STABILIZED	PRE-STABILIZED PRICE MODEL	% CHANGE WITH BEAN PRICE STABILIZED	PRE-STABILIZED REVENUE MODEL	% CHANGE WITH BEAN PRICE STABILIZED
INCOME AND WELFARE MEASURES (Millions US$)						
A. Uncorrected Measures						
Social Welfare	980.9	1.30	898.0	1.65	981.6	1.22
Consumers' Surplus	906.3	0.02	896.9	- 2.80	891.6	0.87
Producers' Income	275.3	2.36	263.2	17.10	288.9	- 0.12
Standard Deviation of Producers' Income 1/	53.7	-7.60	49.40	1.77	53.1	- 6.54
B. Corrected Measures 2/						
Social Welfare	990.8	0.39	908.3	- 0.26	991.5	0.12
Producers' Income	284.6	2.32	272.5	16.55	298.2	- 0.07
AGRICULTURAL TRADE BALANCE (Millions US$)	281.1	0	260.3	7.88	282.2	0
AGRICULTURAL EMPLOYMENT (Thousands full time jobs)	5083.0	0.33	4946.8	1.34	5059.5	0.65
PRODUCTION (Thousands metric tons)						
Maize	1031.6	0	1031.6	- 4.34	1031.6	0
Rice	27.9	0	29.0	- 3.79	26.7	0
Sorghum	50.2	0	48.1	0.21	48.2	0
Beans	90.2	4.32	41.2	118.93	86.3	9.04
Wheat	67.1	0	67.1	0	67.1	0
PRICES (US$/Metric Ton)						
Maize	175	0	191	7.33	176	0
Rice	301	0	277	10.46	297	0
Sorghum	167	0	204	- 0.98	168	0
Beans	508	-15.35	602	-14.28	508	-15.16
Wheat	498	0	498	0	498	0

1/ Sum of standard deviations over all farm groups.
2/ Corrected for stochastic activity levels.

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