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PRICE RESPONSE OF MARKETABLE SURPLUS IN A DEVELOPING ECONOMY: A THEORETICAL FRAMEWORK

by

SAYED MUSHTAQ HUSSAIN*

Introduction: The role of the agricultural marketable surplus in the process of economic development is well emphasized. However, the knowledge about the price response of the marketable surplus is rather poor.

For the last few decades, economists have been intrigued by the probable sign of the price elasticity of the marketable surplus for subsistence crops. Only recently, some of the economists have shown inclination that the marketable surplus response to price positively. The beliefs on the positive price response are based on indirect estimates from the theoretically derived expression on the price elasticity of marketable surplus ($\eta^*$).

Among the theoretical attempts made at deriving the $\eta^*$, attempts by Raj Krishna and Behrman are the basic ones. Both the attempts, though useful in throwing light on the problems involved, suffer from certain drawbacks - hence the greater need for developing a more comprehensive theoretical framework through which one could predict the nature of the price response of

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1/ The main obstacle in verifying the sign of the price elasticity of marketable surplus is the lack of time series data.
marketable surplus.

At the empirical level, most studies use cross-sectional data and try to identify the important factors that affect the marketable surplus of various food crops (or marketed) surplus from crops 1, 3, 4, 8, 9, 11, 12, 14, 15. The information gathered from the empirical studies is of great value in policy making. In some cases, however, the empirical results are vague and inconsistent in that they verify conflicting hypotheses. In order to give a meaningful interpretation to the empirical results and to obtain maximum benefit from the research effort, theoretical frameworks are badly needed.

It is the purpose of this paper to set up a theoretical model which will help us to identify some of the important factors influencing the marketable surplus of agricultural commodities, and will enable us to draw conclusions about the nature of the price response of marketable surplus (i.e., the sign of $\gamma_s$).

Raj Krishna was the first to develop a theoretical model on the price elasticity of the marketable surplus of a subsistence crop. He started with the identity:

\[ \ln y = \ln C \]  

(1) where, $y$, $C$, and $n$ are the quantity of wheat produced, consumed, and marketed, respectively. Since (1) is an identity, Krishna proceeded by differentiating both sides with respect to $P$:

\[ \frac{d\ln y}{dP} = \frac{d\ln C}{dP} \]  

(2)

where, $P =$ relative price of wheat. Examination of (2) shows that in order to estimate $d\ln y/dP$, one needs price of wheat relative to the production substitutes, whereas to estimate $d\ln C/dP$, one needs price of wheat relative to the consumption substitutes. But Krishna does not distinguish between the two relative prices and hence the derivation of (2) is erroneous.

Behrman has the basic Krishna model for the ambiguity in the prices involved. We think, however, that both models suffer from the following drawbacks: i) although the models are supposed to be consistent with utility maximization on the part of the farmers, no formal and explicit model of utility maximization exists, ii) both models ignore the survival constraint which arises from the fact that farmers, in order to be alive, need some minimum food consumption, iii) both models treat the farmer as producer-consumer type economic unit, but fail to explain the reasons for it and to draw the full implications.

(continued on page ... 3)
II. THE THEORETICAL MODEL

II.1. In this section, a utility maximization model will be developed for a farmer who is both a potential producer and an actual consumer of a subsistence crop. The model is primarily developed in the context of an under-developed area like East Pakistan, though it can be extended to other areas very easily by relaxing some of its assumptions.

II.2. In the context of East Pakistan, the following assumptions are made for a single farming unit:

Assumption: (i) Fixed cultivable land to be allocated between the two competing crops: rice and jute.

Assumption: (ii) The farmer's income is derived from the cultivation of rice/jute.

Assumption: (iii) Income is spent on two consumption goods: food (i.e., rice) and a nonfood good.

Assumption: (iv) Constant $Y_j/Y_r$ for the same farm, where,

$Y_j = $ normal yield of jute per unit of land (i.e., acre).

$Y_r = $ normal yield of rice per unit of land (i.e., acre).

Assumption: (v) Heterogeneous land in the farm sector as a whole (i.e., variation in $Y_j/Y_r$ over the various farm units).

Assumption: (vi) Farmer's utility function is of the form:

$$U(F_H, H) = \theta \log \left( F_H + F_{Li} - F_S \right) + (1 - \theta) \log H$$

where,

$F_H$ = food produced at the farm for consumption.

$F_{Li}$ = food purchased from the market for consumption.

$F_S$ = minimum food required for farmer's household in order to survive.

of such a role, iv) both models analyse price response of the marketable surplus in the absence of other factors that might complicate matter in the course of time.
\[ F = F_H + F_M - F_S. \]

\( N = \) nonfood consumption good. This might be a single good like cloth, salt, kerosene oil, or a combination of all nonfood goods in the form of a composite commodity.

\( \theta = \) weight assigned to the utility derived from food.

There is a built-in survival constrain in the utility function:

\[ F_H + F_M \geq F_S. \]

In case \((F_H + F_M) < F_S\), there is no farmer and hence no utility function.

**Farmer's Income:** His income is derived from the cultivation of rice and jute:

\[ P_{F2}^* (A_F Y_F - F_H) + P_J^* (A - A_F) Y_J \]

where:

- \( P_{F2}^* = \) expected sale (or harvest) price of rice per unit of weight (i.e., maund)
- \( P_J^* = \) expected sale (or harvest) price of jute per unit of weight (i.e., maund)
- \( A = \) total land available for allocation
- \( A_F = \) land allocated to produce food (i.e., rice) crop.

The constraint of fixed cultivable land is incorporated in the income-generating expression. The assumption of fixed land is always true at a point of time when land allocation decisions are being made.

**Farmer's Expenditure:** The farmer's expenditures consist of purchasing food and nonfood goods for consumption:

\[ P_{F1}^* F_M + P_N N \]

where:

- \( P_{F1}^* = \) expected purchase price of food (i.e., rice)
- \( P_N = \) purchase price (index) of nonfood consumption goods.
The farmer is assumed to be rational in the sense that his production and consumption decisions are dictated by the maximization of a well-ordered function: i.e., utility function, subject to the various constraints: fixed land ($A$) and the survival of the family ($F_H + F_M \geq F_S$), which are incorporated in the budget constraint and the utility function, respectively.

We introduce another constraint $A_F Y_F \geq F_H$, implying that home consumption of rice cannot be larger than rice production; i.e., marketable surplus of rice must be nonnegative.

Since the problem is to maximize utility subject to the constraints: $F_H + F_M \geq F_S$, fixed land ($A$) and $A_F Y_F \geq F_H$, we set up the Langrangian (3) and proceed to solve it.

$$\mathcal{L} = \left\{ \begin{array}{l}
\log (F_H + F_M - F_S) + (1 - \theta) \log N \\
+ \lambda \left[ P^*_F (A_F Y_F - F_H) \\
+ P^*_J (A_F Y_F - (P^*_F F_M + P^*_N))
\right] \\
+ \mu \left[ A_F Y_F - F_H \right].
\end{array} \right.$$ 

Differentiating $\mathcal{L}$ with respect to $N$, $F_M$, $F_H$, and $A_F$, we get:

$$\frac{\partial \mathcal{L}}{\partial N} = \frac{1 - \theta}{N} - \lambda P_N = 0 \quad (1)$$
$$\frac{\partial \mathcal{L}}{\partial F_M} = \frac{\theta}{F_H + F_M - F_S} - \lambda P^*_F = 0 \quad \text{if} \quad \begin{cases} F_M > 0 \\ F_M = 0 \end{cases} \quad (2)$$
$$\frac{\partial \mathcal{L}}{\partial F_H} = \frac{\theta}{F_H + F_M - F_S} - \lambda P^*_F - \mu = 0 \quad \text{if} \quad \begin{cases} F_H > 0 \\ F_H = 0 \end{cases} \quad (3)$$
$$\frac{\partial \mathcal{L}}{\partial A_F} = \lambda \left[ P^*_F Y_F - P^*_J Y_J \right] + \mu Y_F = 0 \quad \text{for} \quad \begin{cases} A_F = 0 \\ 0 < A_F < A \end{cases} \quad (4)$$

(3) The utility function chosen is St. John in character, the sole reason for using it rather than some other form, is the fact that utility functions of this type have been found to give satisfactory fits to observed demand Behaviour in a variety of studies, and the resulting demand functions are easily adapted to empirical analysis. See Richard Stone 16.
Distinguishing three possible cases, we derive the consumption demand functions for food (rice) and nonfood goods.

II.2. (1) Case I: Complete Jute Specialization: This means that no land is allocated to produce the food crop and all the consumption demand for food is met through purchases from the market:

\[ A_T = 0 \implies Y_H = 0 \implies Y_H \geq F_S \]

Thus, taking \( A_T = 0 \), \( Y_H = 0 \), and \( Y_H > 0 \), we can rewrite:

(2): \[ \frac{\theta}{Y_L - F_S} = \lambda Y_T \]

(3): \[ \frac{\theta}{Y_L - F_S} \leq \lambda Y_T + \mu \]

(2-a) and (3-a) \( \implies \mu X (Y_T - Y_T) \lambda > 0 \)

or \( \lambda (Y_T - Y_T) \leq \mu Y_T > 0 \) (5)

(4): \[ (\lambda Y_T - Y_T) + \mu Y_T \leq 0 \]

By adding (4-a) and (5):

\[ 0 \geq \lambda [Y_T - Y_T] \]

or \( Y_T > Y_T + Y_T \) (as \( Y_T > Y_T \)) (4-b)

(4-b) is necessary for this case, but thus far has not been shown to be sufficient.

The next step is to derive the consumption demand function for the food purchased from the market \( Y_T \). Dividing (2-a) by (1):

\[ \frac{\theta}{1 - \theta} \frac{N_{Y_T}}{Y_L - F_S} = \frac{Y_T}{N_{Y_T}} \]

Budget constraint becomes:

\[ P_T Y_T = P_T Y_T + P_H Y_H \]
Putting the values of $P^*_{1J}$ and $P^*_N$ from (6) into the budget constraint:

$$P^*_N = P^*_{1J} - \left\{ \frac{\theta}{1 - \theta} P^*_N + P^*_{11} \right\}$$

or

$$P^*_N = (1 - \theta) \left[ P^*_{1J} - P^*_{11} \right]$$

$$P^*_{11} = P^*_{11} + \frac{\theta}{1 - \theta} P^*_N$$

$$= \theta P^*_{1J} + (1 - \theta) P^*_{11}$$

(7)

Demands:

$$N = (1 - \theta) \left[ \frac{P^*_J}{P^*_N} = \frac{P^*_{11}}{P^*_N} P^*_S \right]$$

$$P^*_H = \theta \frac{P^*_J}{P^*_S} P^*_J + (1 - \theta) P^*_S$$

(8)

Note: Subsistence requires $P^*_J A^*_J \leq P^*_{11} P^*_S$.

II.2 (ii) Case II. Complete Rice Specialization: In the case of complete rice specialization, $A^*_J = A^*, P^*_H = 0, P^*_H > 0$, since $P^*_1 > P^*_2$, and $\lambda \geq 0$.

In view of the fact that $P^*_H = 0, P^*_H > 0$, and $\lambda > 0$, we can re-write:

(2):

$$\frac{\theta}{P^*_H - P^*_S} \leq \lambda P^*_1$$

(2-b)

(3):

$$\frac{\theta}{P^*_H - P^*_S} = \lambda P^*_2$$

(3-b)

(3-b) divided by (1):

$$\frac{P^*_2}{P^*_N} = \frac{\theta}{1 - \theta} \frac{N}{P^*_H - P^*_S}$$

(9)
\[
\frac{\partial L}{\partial \lambda_r} \geq 0 : \left[ x_{2r}^* Y_r - P^*_r Y_J \right] \geq 0 
\Rightarrow x_{2r}^* Y_r - P^*_r Y_J
\] (4.4a)

\[x_{2r}^* Y_r \geq P^*_r Y_J\] provides two possibilities (a) \(x_{2r}^* Y_r > P^*_r Y_J\),

which would mean complete rice specialization, and (b) \(x_{2r}^* Y_r = P^*_r Y_J\), implying complete rice specialization or that rice is grown to meet the farm consumption demand for food \(x^*_r\) and the remaining land is devoted to the cultivation of jute (i.e., Case II or Case III).

Confining to the complete rice specialization case for which the necessary condition is \(x_{2r}^* Y_r > P^*_r Y_J\), we derive the demand functions.

Budget constraint becomes:
\[ P^*_r Y_r = P^*_r N (Y_r - Y_J) \]

Substituting into (9):
\[ \frac{1 - \theta}{\theta} P^*_r (Y_J - Y_r) = \frac{P^*_r (\theta Y_r - \theta Y_J)}{P^*_r} \]

or
\[ \frac{1}{\theta} x_{2r}^* P_{2r} = \frac{P^*_r AY_r}{P^*_r} + \frac{1 - \theta}{\theta} P^*_r Y_J \]

or
\[ P^*_r = \theta AY_r + (1 - \theta) P^*_J \]

Demands:
\[ P^*_r = P^*_J + \theta (AY_r - P^*_J) \]
\[ N = \frac{P^*_r}{P^*_N} \left( 1 - \theta \right) \left[ AY_r - P^*_J \right] \]
\[ F_r = 0 \]

Equation (11) means that the consumption demand for food is equal to \(P^*_J\) (minimum food needed for survival) plus a proportion
(depending on $\theta$) of the rice left over deducting $F_3$ from the total rice production ($= A_Y - F_3$).

II.2. (iii) Case III. Food Production to Meet the Family Consumption Demand for Food, and Jute Production on the Remaining Land: The So-Called Practice of Subsistence Farming: This involves production of both jute and rice and implies that $Y_H > 0$, $F_H = 0$. We can rewrite:

$$\frac{\partial L}{\partial P_{li}} \leq 0 : \frac{\theta}{P_H - P_S} \leq \lambda P_f^*$$

(2-e)

$$\frac{\lambda}{P_H - P_S} = 0 : \frac{\theta}{P_H - P_S} = \lambda P_f^* + \mu$$

(3-e)

The budget constraint becomes:

$$P_H^N + P_f^* F_2 = P_J^* (\lambda - A_Y) Y_J + P_f^* A_Y Y_F$$

(12)

If $P_J^* Y_J \leq P_f^* Y_F$, income is maximized at $A_Y = \lambda$ (Case II). If $P_J^* Y_J > P_f^* Y_F$, income is maximized subject to $A_Y Y_F \geq F_H$ at

$$A_Y Y_F = F_H$$

(Case III).

From (4):

$$\mu = \lambda F_J^* \frac{Y_J}{Y_F} \cdot \lambda P_f^*$$

(4-d)

From (4-d) and (3-c):

$$\frac{\theta}{P_H - P_S} = \lambda P_J^* \frac{Y_J}{Y_F}$$

(3-d)

(3-d) divided by (1):
\[
\frac{\theta}{1 - \theta} \left( \frac{H - F}{F} \right) = \frac{p_{jj}^* y_j / y_j^*}{p_{jj}^*}, \text{ and }
\]

From the budget constraint:

\[
P_{HH} = p_{jj}^* y_j - p_{jj}^* \frac{y_j}{y_j^*} F_H
\]

\[
\frac{1 - \theta}{\frac{y_j}{y_j^*}} \left( F_H - F_S \right) = -p_{jj}^* \frac{y_j}{y_j^*} F_H + p_{jj}^* y_j^* y_j
\]

\[
\frac{1}{\theta} \frac{F_H}{y_j^*} = A + \frac{1 - \theta}{\theta} \frac{F_S}{y_j^*} \text{ or } F_H = \theta y_j^* + (1 - \theta) F_S
\]

Demands:

\[
F_H = F_S + \theta (\lambda y_j F_S - F_S)
\]

\[
N = (1 - \theta) \frac{p_{jj}^*}{p_{jj}^*} \left[ \lambda y_j - \frac{y_j}{y_j^*} F_S \right], \text{ and }
\]

\[
P_{HH} = 0
\]

Note: Subsistence requires \( \lambda y_j > \frac{y_j F_S}{y_j} \) or \( \lambda y_j^* > F_S \).

Consumption demand function for food is the same in Case II and Case III, although production decisions are different, i.e., complete rice specialization in Case II, and partial rice specialization limited to the extent of family consumption demand for food \( (F_H) \) in Case III.

It is to be emphasized that Case III emerges in place of Case I or Case II, as a result of the fact that the expected purchase price of rice \( (p_{jj}^*) \) is higher than the expected sale price of rice \( (p_{jj}^*) \).

Hence, \( p_{jj}^* > p_{jj}^* \) is a sufficient condition for Case III (subsistence farming) to exist.\(^4\)

\(^4\) Risk and uncertainty about prices and crop yields could be additional factors responsible for the practice of subsistence farming. In our model, the introduction of risk and uncertainty will increase the size of Category III (i.e., (8)). See \( \xi \) 6: 96-97 /.
II.2.(iv) **Concluding Remarks on the Various Production Possibilities**

In the case of a single farm unit for which the $Y_J$ and $Y_F$ are given, three production possibilities exist, depending on the prices and yields involved: $P_{F1}^*Y_F$, $P_{F2}^*Y_F$, and $P_{J}^*Y_J$. The possibilities are:

1. $P_{J}^*Y_J > P_{F1}^*Y_F$ \hspace{1cm} jute specialization (Case I)
2. $P_{J}^*Y_J < P_{F2}^*Y_F$ \hspace{1cm} rice specialization (Case II)
3. $P_{F2}^*Y_F < P_{J}^*Y_J < P_{F1}^*Y_F$ \hspace{1cm} rice production to meet $Y_H$ and jute cultivation on the remaining land (Case III)
4. $P_{J}^*Y_J = P_{F1}^*Y_F$ \hspace{1cm} either (Case I) or (Case III)
5. $P_{J}^*Y_J = P_{F2}^*Y_F$ \hspace{1cm} either (Case II) or (Case III)

Possibility 5 becomes a clear-cut Case III when we introduce risk.

Even if possibilities 4 and 5 retain their dual character, our model remains fully workable at the aggregate level since we lump Case I with Case III, and Case II with Case III; whereas Case I and II are mutually exclusive.

In the above section we have worked out the relevant consumption demand functions for all the three production possibilities. It should be noted that, given the relevant prices and crop yields, only one of the above-mentioned possibilities will prevail in the case of a single farm unit.

II.3.(1) ** Marketable Surplus Function: Cross-sectional Level**

Contrary to jute, the marketed surplus functions for rice are of great interest since a substantial part of the rice produced is consumed by the farmers themselves.
In the framework of our model, marketable surplus of rice can only originate from farm units in Category II if the rice production exceeds the consumption demand for food at the farm. Thus for the i-th farm unit in Category II, the marketable surplus can be derived as:

Production for the i-th farm (Category II) = \( A_i Y_{F1} \) -----(15)

From Equation (15):

Rice consumption for the i-th farm (Category II):

\[ = F_{Si} + \theta (A_i Y_{F1} - F_{Si}) \] -----(16)

Marketable surplus of rice for the i-th farm unit (\( S_i \)) =

\[ A_i Y_{F1} - \left[ F_{Si} + \theta (A_i Y_{F1} - F_{Si}) \right] \] -----(17)

Equation (17) shows that over the various farm units, \( S \) will vary positively with the output and inversely with the dependent family size. In case \( S \) is in relative terms (e.g., \( S \) as a percentage of total rice production), then the variation in \( S \) will be positively related to \( Y_F \) (or some proxy variable to indicate differences in productivity), and negatively with family size. Of course, if farm units are scattered over space and sell their produce in a common market, then any variable indicating the cost of transportation, etc., will also be important in explaining variation in \( S \) over farms.

It should be noted that in getting up the model, the complications arising from the land tenure (or crop sharing) practices are ignored. Our model is that of a farmer who owns the land being cultivated. An additional variable indicating the crop sharing arrangements (i.e., rent paid) will be necessary when the farm unit in question is not owned by the cultivator.

\[ \text{Requibuzzaman's empirical study on East and West Pakistan} \] found results consistent with the implication of our model at the cross-sectional level.
II.3. (ii) Aggregation at the Farm Sector Level

When a large number of farm units within a farm sector are considered we are bound to find variation in the crop yield of jute \( Y_J \) relative to the crop yield of rice \( Y_F \) per unit of land. This is inevitable as land is not homogeneous in productivity due to differences in soil and weather conditions and other factors that influence the crop yields. Some farm units will have higher productivity for rice cultivation, and others for jute cultivation.

Thus, given the level of \( P^*_J \) and \( P^*_F1 \) (and \( P^*_F2 \)), all the three production possibilities mentioned under II.2.(iv) can be found for the farm sector as a whole, though they were mutually exclusive in the case of a single farm unit due to the constant \( Y_J / Y_F \).

For aggregation all the farm units are classified into the above three possible cases. By assigning weights on the basis of land contained in each category relative to the total land in the farm sector, we will sum up the jute and rice acreage separately. The weights for each production mix category are:

\[ \gamma = \text{proportion of total farm land under Category I (Case I): complete jute specialization. It includes farm units for which} \]

\[ P^*_J Y_J \geq P^*_F1 Y_F \]

\[ \lambda = \text{proportion of total farm land under Category II (Case II): complete rice specialization. It includes all farm units for which} \]

\[ P^*_J Y_J \leq P^*_F2 Y_F \]

\[ \beta = \text{proportion of total farm land under Category III (Case III): partial rice specialization to the extent of} \ F_H \geq F_S \ \text{and jute cultivation} \]
on the leftover land. It consists of farm units for which

\[ P^*_F Y_F \leq P^*_J Y_J \leq P^*_F \]

Since \( \gamma, \lambda \) and \( \beta \) are expressed in land in each category as a proportion of the total farm land \( (A) \), \( \gamma + \lambda + \beta = 1 \).

Before proceeding further, we redefine the following notations, and make an additional assumption:

\[ Y_{JI} = \text{normal yield of jute per acre in Category II.} \]
\[ Y_{FI} = \text{normal yield of rice per acre in Category II.} \]
\[ P_s = \text{minimum food required for farmer's household in order to survive in the farm sector as a whole.} \]
\[ F = \text{farm population.} \]

Assumption (vii): The population in the farm sector is evenly distributed over the area under cultivation. Thus, weights \( \gamma, \lambda \) and \( \beta \) also reflect the relative distribution of population in Category I, II, and III, respectively.

This assumption is made for simplification only. Its removal does not upset the model or the results obtained from it.

II.3. (iii) Marketable Surplus Function At the Aggregate Level:

Since Category II is the only source of marketable surplus for rice, we can derive the marketable surplus function as follows, provided the relevant prices \( (P^*_F, P^*_J, \alpha) \) and relative crop yields \( (Y_{FI}/Y_{JI}) \) remain constant:

\[
\begin{align*}
\text{Rice area in Category II} & = \kappa A \\
\text{Rice production in Category II} & = \kappa A Y_{FI}
\end{align*}
\]
Rice Consumption in Category II = \( \alpha \left[ F_S + \theta (A Y_{FII} - F_S) \right] \)

Rice marketable surplus = \( \alpha A Y_{FII} - \alpha \left[ F_S + \theta (A Y_{FII} - F_S) \right] \)

\[ \ldots (18) \]

Equation (18) shows that the aggregate marketable surplus (S) is determined by the relative size of Category II (i.e., \( \alpha \cdot \cdot \cdot \)), rice productivity \( (Y_{FII}) \) and the minimum food required to sustain the dependent farm population in Category II. Equation (18) holds only at a given point of time when the relative size of Category II is constant.

II.3.(iv) Price Response of the Marketable Surplus in the Course of Time.

In the course of time, however, the relative size of Category II cannot remain constant when the relevant prices and crop yields show variation.

From the conditions laid out earlier for the various production possibilities, and assuming linear relationship:

\[ \alpha = g_0 + g_1 \frac{P_{F2}^*}{P_J^*} \quad \text{or} \quad \alpha = g_0 + g_1 \frac{P_{F1}^*}{P_J^*} \]

(assuming that \( P_{F1}^* \) bears a constant relationship with \( P_{F2}^* \) in the course of time)

By putting the values of \( \alpha \), Equation (18) becomes:

\[ S = \left[ (g_0 + g_1 \frac{P_{F1}^*}{P_J^*}) \hat{A} Y_{FII} \right] - \left\{ (g_0 + g_1 \frac{P_{F1}^*}{P_J^*}) \left[ F_S + \theta (\hat{A} Y_{FII} - F_S) \right] \right\} \]

\[ \ldots (19) \]

In the course of time, the dependent farm population will be growing (i.e., \( \frac{\dot{P}}{P} > 0 \)). In case the population is growing faster than rice productivity \( \left( \frac{\dot{P}}{P} > \frac{Y_{FII}}{Y_{FII}} \right) \) when total land is fixed, and
\[
\frac{p}{p} > (1 + \frac{\dot{a}}{a}) \frac{\dot{Y}_{FII}}{Y_{FII}} \quad \text{when land is growing also, the minimum subsistence food requirements (F_s) will tend to grow also.}
\]

Assuming that under the influence of \( \frac{p}{p} > \frac{\dot{Y}_{FII}}{Y_{FII}} \) or \( \frac{p}{p} > (1 + \frac{\dot{a}}{a}) \frac{\dot{Y}_{FII}}{Y_{FII}} \), \( F_s \) takes the following functional form in time.

\[
F_s = d_0 + d_1 T \quad \text{.................................}(20)
\]

Putting the values of \( F_s \) into (19):

\[
S = \left( g_o + g_1 \frac{P_{F1}^*}{P_J^*} \right) \bar{A} \dot{Y}_{FII} - \left( g_o + g_1 \frac{P_{F1}^*}{P_J^*} \right) \left[ d_0 + d_1 T \right]
\]

\[
+ \theta \bar{A} \dot{Y}_{FII} - \theta d_o - d_1 \theta T
\]

or

\[
S = \left[ \left( g_o + g_1 \frac{P_{F1}^*}{P_J^*} \right) \bar{A} \dot{Y}_{FII} \right] - \left[ \left( g_o + g_1 \frac{P_{F1}^*}{P_J^*} \right) \left(C_o + C_1 T + \theta \bar{A} \dot{Y}_{FII} \right) \right]
\]

where, \( C_o = d_o - \theta d_o \) and \( \theta < 1 \).

\[
S = g_o \bar{A} \dot{Y}_{FII} + g_1 \frac{P_{F1}^*}{P_J^*} \bar{A} \dot{Y}_{FII} - g_o C_o - g_o C_1 T - g_o \theta \bar{A} \dot{Y}_{FII}
\]

\[
- \frac{P_{F1}^*}{P_J^*} \left(C_o g_1 \right) - \frac{P_{F1}^*}{P_J^*} T \left(g_1 C_1 \right) - \frac{P_{F1}^*}{P_J^*} \left(g_1 \theta \bar{A} \dot{Y}_{FII} \right)
\]

or

\[
S = b_o + b_1 \frac{P_{F1}^*}{P_J^*} - b_2 T \frac{P_{F1}^*}{P_J^*} - b_3 \theta T \quad \text{..........}(21)
\]

6/ This is only a suggested functional form. We do not mean to exclude other forms.
where, \( b_o = \theta \bar{\alpha} Y_{FII} - \phi_o c_o - \phi_o \theta \bar{\alpha} Y_{FII} \)

\( b_1 = \delta_1 \bar{\alpha} Y_{FII} - c_o \delta_1 - \delta_1 \theta \bar{\alpha} Y_{FII} \)

\( b_2 = \delta_1 c_1 \)

\( b_3 = \theta_o c_1 \)

An examination of Equation (21) shows interesting results. In order to answer the question whether the marketable surplus of rice responds to price or not, we have to examine the probable sign of

\( b_1 = \delta_1 \bar{\alpha} Y_{FII} - c_o \delta_1 - \delta_1 \theta \bar{\alpha} Y_{FII} = \delta_1 (1 - \theta) \bar{\alpha} Y_{FII} - \delta_1 (1 - \theta) d_o \),

as \( c_o = d_o - \theta d_o \).

Since within the framework of our model, the relative size of Category II responds positively to the relative price of rice i.e., \( P_{F1}^*/P_{F2}^* \), \( \delta_1 \) is positive. \( \delta_1 \) being positive and \( \theta < 1 \) (due to the existence of non-food substitutes, one can say that \( \delta_1 (1 - \theta) \bar{\alpha} Y_{FII} > \delta_1 (1 - \theta) d_o \) since \( \bar{\alpha} Y_{FII} (= \text{total rice output in category II}) \) is larger than some constant \((d_o)\) quantity of food required to meet the minimum subsistence requirements. \( \bar{\alpha} Y_{FII} \) has to be larger than \( d_o \) by the mere fact that Category II is a category in which marketable surplus exists. Thus by virtue of the fact that

\[ \bar{\alpha} Y_{FII} > d_o \Rightarrow \delta_1 (1 - \theta) \bar{\alpha} Y_{FII} > \delta_1 (1 - \theta) d_o \Rightarrow \]

\( b_1 > 0 \), since \( \delta_1 > 0 \), \( \theta < 1 \) and

\( b_1 = \delta_1 (1 - \theta) \bar{\alpha} Y_{FII} - \delta_1 (1 - \theta) d_o \), we put forward the following hypothesis:
Hypothesis No.1. If marketable surplus of a subsistence crop ever exists, it will respond positively to price.\(^7\)

An examination of Equation (21) will show that the price response of marketable surplus declines as a result of the population pressure \((i.e., \frac{\dot{P}}{P} > (1 + \frac{\dot{A}}{A}) Y_{III})\). The adverse effect of the population pressure on the price response of \(S\) is unambiguous since the coefficient \(b_2 = g_1 c_1\) is positive, as \(g_1 > 0\) and \(c_1 > 0\).

Hypothesis No.2: The price response of the marketable surplus of a subsistence crop declines in the course of time as a result of the growing population pressure \((i.e., \frac{\dot{P}}{P} > (1 + \frac{\dot{A}}{A}) Y_{III})\).

Hypothesis No.2 is very useful in pointing out the limitations of price policy in the agricultural sector which is growing but not as fast as to offset the population pressure. The hypothesis is also useful in understanding some of the riddles relating to the behaviour of the marketable surplus of agricultural commodities. For example, in the Twentieth Conference of the Indian Society of Agricultural Economics it was noted that:

"The views of the contributors on this point are disconcerting. Quite a few of them contended that the marketable surplus is not increasing in proportion to the rise in food production. Others have expressed the view that there is an absolute decline in it. As against the known current level of marketable surplus of 20 - 25 million tons, one of the contributors indicates that it will be 17 million tons in 1961. The market arrivals indicate a lower marketable surplus than that which obtained in the pre-war years' [7: 115]."

\(^{7}\) It should be noted that the price referred to is not absolute price. The concept of price used is a more complex one due to the existence of production and market alternatives.
The causes of the probable decline in the agricultural marketable surplus can be traced within the framework of our model. They could be the growing population pressure and/or the adverse movements in the agricultural prices.


Whereas Category II is the source of marketable surplus, farm units in Category I purchase food. Taking the sales and purchases made by both the categories into account, we can derive a supply function of rice for the non-farm sector.

Marketable surplus (Category II):

\[ \lambda \Delta Y_{FII} - \lambda \left[ F_S + \theta (\Delta Y_{FII} - F_S) \right] \]  
(Equation 18)

Food demand by Category I:

\[ \gamma \theta (\Delta Y_{JJ}) \frac{P_J}{P_{FII}} + \gamma \left(1 - \theta\right) F_S \]  
(From Equation 8)

Supply function for the non-farm sector \( S_{n.f.} = \)

\[ \lambda \Delta Y_{FII} - \lambda \left[ F_S + \theta (\Delta Y_{FII} - F_S) \right] - \left[ \gamma \left( \theta \Delta Y_{JJ} \right) \frac{P_J}{P_{FII}} \right. \]

\[ + \left. \gamma \left(1 - \theta\right) F_S \right] \]  
(22)

Putting the values for \( \lambda \) and \( F_S \) into Equation (22) and giving the following form:

\[ \gamma = b_0 - b_1 \frac{P_{FI}}{P_{FII}} \]  
(23)

---

8/ Non-farm sector includes the urban-industrial sector and those who reside and draw income in the rural areas but do not cultivate land and depend on those who are engaged in farming.

9/ The rationale underlying this suggested functional form is explained under section II.2.(iv)
$$s_{n.f.} = \left[ (g_o + g_1 \frac{p^*_{FI}}{p^*_{J}}) \tilde{\alpha}_{Y_{III}} \right] - \left[ (g_o + g_1 \frac{p^*_{FI}}{p^*_{J}}) (d_o + d_1 T + \theta \tilde{\alpha}_{Y_{III}} \right]$$
\[- \theta d_o - d_1 \theta \tilde{\alpha} \right] \right] - \left[ (b_o + b_1 \frac{p^*_{FI}}{p^*_{J}}) \theta \tilde{\alpha} Y_{JI} \frac{p^*_{J}}{p^*_{FI}} + (b_o + b_1 \frac{p^*_{FI}}{p^*_{J}})(d_o + d_1 T - \theta d_o - \theta d_1 T) \right]
$$

or
$$= (1 - \theta) \left( g_o \tilde{\alpha} Y_{III} - g_o d_o - b_o d_o \right) - b_1 \theta \tilde{\alpha} Y_{JI} + \frac{p^*_{FI}}{p^*_{J}} \left[ (1 - \theta) (g_1 \tilde{\alpha} Y_{III} - g_1 d_o - b_1 d_o) \right] - \frac{p^*_{FI}}{p^*_{J}} T \left[ (1 - \theta) (g_1 d_1 + b_1 d_1) \right] - \frac{p^*_{J}}{p^*_{FI}} (b_o \theta \tilde{\alpha} Y_{JI}) - T \left[ (1 - \theta) (g_o d_1 + b_o d_1) \right]$$

or
$$s_{n.f.} = T_1 - T_2 \frac{p^*_{FI}}{p^*_{J}} - T_3 \frac{p^*_{FI}}{p^*_{J}} - T_4 \frac{p^*_{J}}{p^*_{FI}}$$

\( \therefore \) (24)

Where,

$$T_0 = (1 - \theta) (g_o \tilde{\alpha} Y_{III} - g_o d_o - b_o d_o) - b_1 \theta \tilde{\alpha} Y_{JI}$$

$$T_1 = (1 - \theta) (g_1 \tilde{\alpha} Y_{III} - g_1 d_o - b_1 d_o)$$

$$T_2 = (1 - \theta) (g_1 d_1 + b_1 d_1)$$

$$T_3 = (1 - \theta) (g_o d_1 + b_o d_1)$$

$$T_4 = b_o \theta \tilde{\alpha} Y_{JI}$$

An examination of Equation (24) shows that the supply/subsistence
crop responds positively to \[ \frac{P_{F1}^*}{P_J^*} \] when \( g_1 \frac{\hat{\bar{a}} Y_{F11}}{d_1} > (g_0 d_0 + b_0 d_0) \)

and this price response definitely declines due to the population pressure through \( \Pi_2 \) and \( \Pi_3 \). The results are similar to those noted in Equation (21).

III. Policy Implications:

As emphasized elsewhere where [6; chapter 7], price incentives can play a great role in mobilizing marketable surplus since the price response of marketable surplus is positive. We should hasten to add that although a positive price policy is a useful instrument for mobilizing marketable surplus, its effectiveness declines in time for an agricultural sector where population pressure is growing (i.e.,

\[ \frac{P}{P} > (1 + \frac{A}{A}) \frac{\hat{Y}_F}{Y_F} \]

In the short-run, the usefulness of price policies can hardly be emphasized due to the factor that any direct interference to mobilize marketable surplus will not only cause disincentives for farmers but also will be extremely costly and cumbersome to be enforced.

However, due to the increasing limitations on the price policies, it is essential that other policies should be adopted to reduce the population pressure in the farm sector. This will involve raising the area under crops as well as raising crop yields to such an extent that \( \frac{P}{P} > (1 + \frac{A}{A}) \frac{\hat{Y}_F}{Y_F} \). In countries like India and Pakistan, considerable attention has been given to increase the cultivable land resources. We think that concerted efforts should be made to raise crop yields on a continuing basis. This will be the only sure way to increase the agricultural marketable surplus and ease its response to price.
REFERENCES


