Price Responsiveness of Marketed Surplus of Wheat in Pakistan

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The crucial role of the marketed surplus of foodgrains in the process of development has been generally recognized. A knowledge of the determinants of the marketed quantities of food is essential for designing price and tax policies for the agricultural sector. This knowledge is required for estimating the food availability for the urban sector and for forecasting the required level of foodgrains imports in any one year.

In the case of crops which are wholly or almost wholly marketed the elasticities of output and market supply can be regarded as approximately equal. But in the case of crops a substantial part of whose output is retained by peasants for self consumption, the responsiveness of the marketed surplus must be measured separately from the responsiveness of output. Food crops in Pakistan constitute a major part of farm production and almost sixty per cent of grain output is consumed by farm families themselves.

In this paper, some estimates of the price elasticity of market supply for the major food crop in Pakistan are generated. Implications for foodgrains price policy are then drawn.

BRIEF REVIEW OF THE PREVIOUS LITERATURE

The response of the market supply to the price change of a food crop essentially relates to the elasticity of the offer curve of the subsistence farmers. Such a formulation clearly indicates that positive, negative or zero price elasticities of the market supply are all normal and consistent with efficient and maximizing behaviour of the peasants. The offer curve may have segments that are vertical, backward bending or forward sloping, implying respectively zero, negative and positive price elasticity of the market supply within the domains of those segments.

The early debate regarding the sign of the price elasticity of foodgrains did not discuss the issue in this framework and arguments were presented, based mainly on *a priori* reasoning, about inevitability of a positive or a negative elasticity of market supply.

Negative Price Elasticity of Marketed Surplus

Two main reasons are given for the hypothesis of the inverse relationship between the price and the marketed surplus of foodgrains. Some economists have argued that subsistence farmers may have fixed monetary obligations and, therefore, only sell as much of their production as is necessary to obtain the desired money income [10,15]. These fixed cash needs consist of debt obligations, rent, land tax and a Ricardian-type bundle of non-agricultural subsistence goods. Whatever production that need not be sold to obtain the desired cash receipts has a very high utility at the margin for peasants self-consumption. The peasant, thus, maximizes production, sells whatever is needed to obtain the desired cash income and consumes the rest of the produce. The marketed surplus, in this case, varies inversely with the market price of the subsistence crop.

An alternative formulation behind the inverse relation between the marketed surplus of a subsistence crop and the market price does not concern itself with a fixed demand for monetary income but merely argues that an increased price for a subsistence crop may increase the producer's real income sufficiently so that the income effect on his demand for consumption of that crop outweighs the substitution effect on consumption and price effect on production [14]. The marketed surplus, thus, varies inversely with the price of the subsistence crop.

The assumptions underlying the *fixed-cash-need hypothesis* are questionable. The reasoning implies that both the income elasticity of demand for commodities other than food and the substitution effect are zero for the peasants. Neither of these two assumptions can be expected to be valid on *a priori* grounds. Basically, it is an empirical question All existing estimates concerning the values of the income elasticity of demand for non-food items in the rural area in Pakistan are non-zero [6].

The strict interpretation of the fixed cash-requirement hypothesis implies negative unitary elasticity of market supply. Noshirvani [18] has shown that if the assumption behind the hypothesis is correct, harvest conditions and the food prices should be uncorrelated. This is clearly contrary to observed facts regarding the negative correlation between harvest conditions and food prices. Noshirvani [18] also points out that, given negative unitary elasticity of market supply, the urban elasticity of food demand must exceed unity if the urban food market is expected to be dynamically stable. This again is contrary to observed facts.

The negative unitary elasticity of the marketed surplus of foodgrains for the agricultural sector as a whole can be expected not to be valid. However, if the basic premise behind the need-for-cash is interpreted such that cash needs are fixed relatively and not absolutely, one can get the negative elasticity of the marketed surplus and not violate the empirical facts as argued by Noshir-

vani [18]. Refutation of the hypothesis can then only be done after a thorough empirical study of the magnitude and the sign of the price elasticity of the foodgrain offer curve in any peasant economy.

In the early debate on the sign of the elasticity of the offer curve, some economists disputed the validity of the assumptions underlying the hypothesis of negative elasticity on *a priori* reasoning. Dandekar [7] refutes the hypothesis of negative elasticity by differentiating between three-sized holdings and arguing that the large farmers who are the main suppliers of the marketed surplus of foodgrains are expected to show positive elasticity of supply. According to Dandekar, the question of marketable surplus does not arise for small farmers as they are not buyers of foodgrains. The medium sized farms may be characterized by a negative price response, but their share in total supply of marketed surplus is insignificant.

Dandekar's arguments for the behaviour of each class of farmers is unconvincing. Small farmers are presumed incapable of generating any marketable surplus. The reasoning is implicitly based on the assumption that small farms could not shift acreage between food and cash crops and/or the substitution effect on consumption of foodgrains is not very large. If either of these assumptions is invalid, the marketable surplus of food crops can arise in case of small farmers after a significant price rise of the food crops.

The discussion by Dandekar for the medium-sized farms is also incomplete. The negative elasticity is explained in terms of an income effect only. It is implicitly assumed that either the substitution effect is zero on the income effect dominates the substitution effect. If this assumption does not hold, the elasticity in the case of medium farmers may be positive.

Large farmers are assumed to have a positive elasticity due to a "well behaved" negative consumption effect arising from a rise in food prices. The implied assumption is that either the income effect is zero and/or the substitution effect dominates the income effect.

Positive Price Elasticity of Market Supply

The focal point in the early debate on the price responsiveness of market supply was the formulation of the hypothesis of negative relationship between price and market supply and its refutation in given empirical situations. Khusro [11] was the first economist who argued on *a priori* grounds that farmers would sell more grains if the grain price is increased. Bhagwati and Chakravarty [3] have shown that Khusro's results are a consequence of his method of analysis which implicity puts restrictions on the shape of the offer curve. If the restrictive assumptions are removed, the possibility of a negative elasticity of marketed surplus would arise in the model by Khusro [11].

The controversy over the price response of the marketed surplus cannot be resolved on general principles. There is a need for an empirical study of the price responsiveness of food crops to test the different hypotheses. There is also a need for a modification of the customary theory of consumer demand when the consumer of the subsistence crops is at once both a consumer and a producer.

SELLER-CONSUMER PRICE RESPONSE:
A THEORETICAL FRAMEWORK

The ordinary theory of demand assumes that the consumer is the buyer of a commodity with given money income earned independently of the price of that commodity. The level of money income has no direct relation to changes in the price of the commodity demanded. The level of the real income does vary as a result of price changes. The case of subsistence farmers necessarily violates the assumption. It is, therefore, essential to take into account the effect of price changes upon money income. This necessary modification has been attempted by some economists [5,13,16,17]. As would be noted shortly, some differences in results arise due to different assumptions by different economists.

Given the following demand function for the subsistence crop,

$$q_1 = f \left(\frac{P_1}{I_1} , \frac{Y}{I_2} \right) \tag{1}$$

$$y = g (P_1) \tag{2}$$

where q_1 denotes the quantity demanded, P_1 the price for the subsistence crop, y the money income, I_1 the price index excluding P_1 and I_1 the Laspeyres price index. The total effect of the price change can be decomposed as

$$\frac{\delta q_1}{\delta p_1} = \frac{\delta q_1}{\delta p_1} - \frac{q_0 \delta q_1}{\delta y} + \frac{\delta y}{\delta p_1} \frac{\delta q_1}{\delta y} \tag{3}$$

The first two terms on the right-hand side represent the substitution effect and the income effect and the third term represents the direct money effects due to a change in the sale price of the subsistence crop. The total effect of a price change on consumption depends not only on the sign but also on the relative magnitude of each term on the right-hand side of equation (3).

Figure 1 illustrates the case of seller-consumer and depicts the substitution effect, income effect and direct money effect. The effects of price change on production are ignored in the analysis. The farmer is assumed to have Oq^* quantity of grain at his disposal which he allocates between self-consumption and sale. All other goods are lumped together and shown on the vertical axis OM. Given the preference pattern between grain consumption and other goods, the farmer will consume oq_1 units of grain at price P_1 and obtain OM_1 units of other goods by selling $q1 \, q^*$ units of grain. At the higher grain price P_2, the farmer will consume oq_2 units of grain (the above diagram shows a decrease in consumption, but it could be an increase) and will sell $q_2 \, q^*$ in exchange for OM_2 of all other goods. The movement from q_1 to q_2 is attributable to the dual role of the consumer/seller. If the farmer is treated as only a consumer of grain with OM_0 money income, he would consume oq_4 of grain at P_2 prices. The movement from q_1 to q_4 can be decomposed into the substitution effect (i.e., q_1 to q_3) and the real income effect (i.e. q_3 to q_4). The movement from q_4 to q_2 is due to the increase in money income in the role of farmer as seller of the grain.
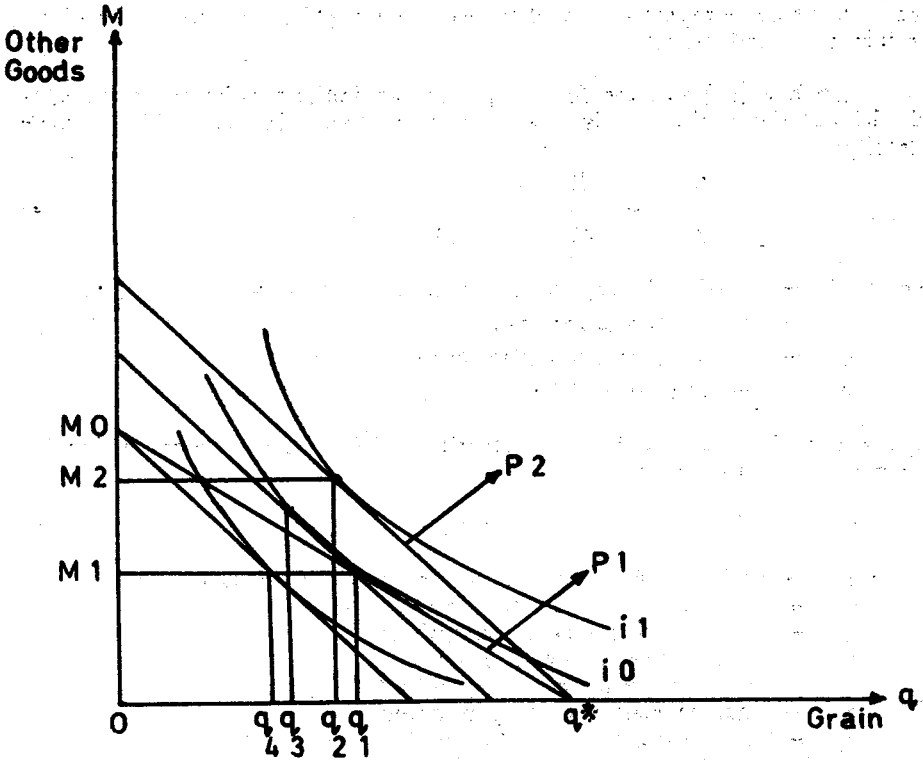
FIGURE 1

Effect Of Price Changes On The
Consumption Of The Seller-Consumer

Price Elasticity of Marketed Surplus

One common feature of the empirical studies concerning the price response of market supply of foodgrains is a notion that the absence of time series data on the marketed surplus and a small variance in food prices in any one year preclude direct estimation of the price elasticity. Various methods of indirect estimation of the price elasticity of market supply have been suggested in the literature. The common feature of all these attempts is to estimate the approximate range within which the elasticity of the market supply of a subsistence crop may be expected to lie if the parameters which determine it lie within certain estimated ranges.

Krishna [13] was the first to present an indirect estimate of the price elasticity of the market supply of a subsistence crop. He starts with a simple identity:

$$\frac{dM}{dP} = \frac{dQ}{dP} - \frac{dC}{dP} \qquad (4)$$

where M = marketed surplus of the subsistence crop
      Q = production of the crop
      C = own-consumption of the crop
      P = relative price of the crop

By some manipulation of the above identity, Krishna derives an expression for the price elasticity as:

$$e = rb_1 - (r-1)(g+mhk) \qquad (5)$$

where e = price elasticity of market supply of the substence crop
      r = inverse of the sale ratio i.e. M/Q
      g = price elasticity of consumption
      m = ratio between M and Q (i.e. 1/r)
      k = ratio of the value of crop output to net income
      h = income elasticity of crop output
      b_1 = price elasticity of output of the crop

Krishna's model has been critically examined by Noshirvani [17] and Behrman [5]. Noshirvani points out basic flaw in Krishna's decomposition of the consumption effect in that it omits the income effect which follows from the change in the value of the ini tial consumption as price of the product changes. He corrects Krishna's estimate of the price elasticity as follows:

$$e = rb_1 - (r-1)(g+hk+hkb_1) \qquad (6)$$

where all the variables are as defined above.

Behrman [5] extends Krishna's model to take into account other crops as sources of income for the peasant. The expression for the price elasticity is:

$$e = rb_1 - (r-1)(g+hk+hkb_1) - (r-1)hb_2(1-k) \qquad (7)$$

where b_2 is the price elasticity of production of crops other than the subsistence crop and all other parameters are as defined earlier in the discussion.

Krishna [12] does not dispute the mathematical manipulation of his model by Noshirvani and Behrman. He has argued that the measure of income most relevant for consumption decision by the peasant is not known. He maintains that unless the relevant concept of income is known, no suitable criterion exists to choose from amongst the three different models described above.

Krishna has suggested another method of estimating the price elasticity of market supply. This elasticity is a product of the price elasticity of output (i.e., b_1) and the output elasticity of the market supply (i.e., EMQ). Direct estimates of these elasticities are generally available in the developing countries and an approximate value of price elasticity of market supply can be estimated without first resolving the issue of the proper definition of income. The values of b_1 and EMQ have been empirically estimated in Pakistan as is shown in the following paragraphs.

Price Elasticity of Wheat in Pakistan: Indirect Estimates

The different models by Krishna [12,13], Noshirvani [17] and Behrman [5] can be employed to get estimates for the price elasticity of wheat in Pakistan. The values of the parameters on which price elasticity depends are taken from other empirical studies in Pakistan. A brief discussion is given about each of the study.

Data

The value of the price elasticity of production for wheat (b_1) is based on the study by Falcon [8]. The dependent variable, the acreage under irrigated wheat, is regressed on the relative price of wheat in the previous year. The price elasticity of acreage is generally a good approximation of the price elasticity of production.

The value of the elasticity of production of crops other than wheat is assumed to have the same range as that of the price elasticity of wheat. The sign of b_2 is negative because b_2 is defined with respect to $\dfrac{P_1}{P_2}$. It is a conservative assumption because some of the crops in competition with wheat are cash crops which generally show larger price response. The conservative assumption underestimates price elasticity of market supply for wheat.

The values of the price and income elasticity of demand for wheat are taken from a study by Bussink [6]. This study is based on the data from the *Quarterly Survery of Current Economic Conditions in Pakistan*, 1963/64. The price and income elasticities for the rural area in West Pakistan are assumed to hold for farmers. This approximation may be quite close as 90 per cent of the rural population is engaged in agriculture in Pakistan.

The estimated values of the proportion of wheat revenue in the total gross income of the cultivators are taken from the *Farm Management Research Studies* in four districts of West Pakistan [19]. The range of the values of k pertains to the different sub-groups of farmers in the selected villages in the four districts.

The value of the sale ratio (i.e., m) also pertain to the various sub-groups of farmers (i.e. owners, tenants and mixed) in the selected villages in six districts of West Pakistan. All disposals other than family consumption are classified as sales. The data are taken from a survey report on wheat marketing in Pakistan [20].

The range of the values of output elasticity of market supply are based on the estimates presented in an unpublished study by the present author [21].

Table I

Plausible Ranges of the Price Elasticity of the Marketed Surplus of Wheat in Pakistan

A

Parameter	Plausible Range	Values relevant for Min e	Max e
b_1	.1 to .2	.1	.2
g	—.09 to —.3	—.09	—.3
h	.11 to .36	.36	.11
k	.02 to .51	.51	.02
b_2	—.1 to —.2	—.1	—.2
m	.09 to .92		

B

Model		m = .09 r = 11.11	m = .55 r = 1.81	m = .92 r = 1.08
Krishna	Min e	1.854	.1899	.102
Model	Max e	4.141	.604	.240
Noshirvani	Min e	2.143	.090	.009
Model	Max e	5.229	.603	.240
Behrman	Min e	2.321	.103	.023
Model	Max e	5.437	.620	.242

Results

Table I shows the plausible range of various relevant parameters in the case of wheat in Pakistan. The range of the price elasticity of market supply

for wheat is calculated for three alternative values of the sale ratio and for each of the three models. In no case, the estimated elasticity of market supply is negative. This result for Pakistan wheat is different from that for Punjabi wheat in India. As pointed out by Noshirvani and Behrman, the minimum value for the price elasticity of market supply in India turns out to be negative for some combinations of the underlying parameters [5,17].

Table II presents the results for the price elasticity of market supply for wheat using the alternative estimation method suggested by Krishna [12]. The price elasticity of the marketed surplus for wheat is again positive for the likely values of parameters in Pakistan.

Table II

Plausible Ranges of the Price Elasticity of the Marketed Surplus of Wheat in Pakistan

Plausible Range of Parameters	Values of parameters relevant for		Plausible e limits of	
	Min e	Max e	Min e	Max e
$b_1 = .$ 1 to .2	.1	.2		
EMQ = 1.273 to 2.178	1.273	2.178	.13	.44

Sources: (1) The range of b_1, i.e., price elasticity of wheat, is taken from W.P Falcon [8].
(2) The range of EMQ, i.e., output elasticity of wheat market supply, is taken from Qureshi [21].

All the indirect methods of estimation yield estimates of the price response for market supply of wheat larger than zero and larger than the price response for wheat production.

Price Elasticity of Market Supply For Wheat: a Direct Estimate

Time series data on prices and total output are generally available. Data on marketable surplus are not available, however. Due to the lack of time series data and a belief that cross-section data on prices have a small variance, indirect estimates of the price elasticity are generally the only estimates about the price response of market sales. The belief that cross-section data on prices have small variance assumes perfect markets, low transport costs and a reasonably well-connected transport system. This is an empirical question, and must be considered in any particular situation.

The research on the marketing system and the regional price variations in Pakistan is limited but the general nature of the price variation among regions has been identified. Due to lack of transport facilities and transportation bottlenecks at certain times of the marketing seasons, price differences among different markets are large and have a tendency to persist [9]. The government policy in Pakistan has at times been an additional source of large price difference among different markets. The government quite often has banned the inter-district movement of commodities which results in price differences in different markets. An empirical study clearly indicates that the prices in different primary markets in Pakistan show a lower degree of correlation as compared with correlation among markets in each district [21]. Due to such imperfections in the marketing system in Pakistan, prices in different regions at the same time do show a high degree of variation.

The use of cross-section data permits a direct estimate of the price response for the agricultural sector and its various sub-groups. On *a priori* grounds, it can be argued that alternative forms of land tenure may have an influence on the overall level of the marketed surplus and its price elasticity. This may be due to different levels of efficiency and/or different extent of price response in production and consumption. Needless to say that such detailed estimates should be helpful for public policy.

The cross-section data permit one to extend the scope of the study. In some situations, estimates based on such data may be more reliable than the time-series data. The inverse correlation between market sales and grain price can easily arise if good weather or any other exogenous variable leads to high output, large marketed surplus and low grain prices. The possibility of such spurious correlation is quite real when a single variable is used to estimate the relationship. The use of cross-section data on sales, production and relative prices in a marketable surplus function can avoid some of the problems. The exogenous factors apply equally to all sample observations in one year.

Data

The data on the marketed surplus, production and relative prices was based on a random sample survey of cultivators in West Pakistan [1,2]. The sample survey relates to the years 1965/66 and 1966/67.

The measurement of the variables used in the analysis needs some discussion. The quantities of wheat produced and sold are in quantity terms. The quantity sold for cash is defined as the marketed surplus. The quantity of wheat bartered was not known and, thus, has been left out of the analysis.

The average prices of wheat, other crops and consumption goods were not shown in the survey as such. The information on the quantity sold and the sale values is available. Average unit values are computed and used as prices of the different commodities.

The relative price of wheat is computed by deflating the wheat price with a weighted average of the prices of competing consumption goods. The weights used are the relative amounts of expenditure on the different items. The bundle of consumption goods selected was limited by the availability of data. Com-

TABLE 3

Marketed Surplus Function—Regression Coefficients for a Cross-section Sample of Cultivators in West Pakistan

No.	Sample	Constant term	X_1	X_2 or X_2'	X_3	Degrees Freedom	$\bar{R}_i'$	Sample of to X_2	X_3 or X_3'
1.	Entire Sample	−269.058	.4198 (.0267)	165.1813 (118.5374)	−.00015 (.00075)	47	.88	1.344	.294
2.	Owners only	−598.7590	.4584 (.0617)	563.4185 (238.8976)	−.0002 (.0022)	14	.94	1.265	.709
3.	Tenants only	−24.0176	.3613 (.0451)	−114.0140 (174.1043)	−.00019 (.00073)	12	.83	1.416	−.306
4.	Mixed group	−197.6356	.3882 (.0770)	143.9983 (173.1312)	−.00110 (.00245)	13	.85	1.345	.314
5.	Entire Sample	−428.3701	.4080 (.0302)	18.7665 (18.1620)	.00007 (.00081)	47	.88	1.305	.685
6.	Owners only	−374.4866	.4533 (.0968)	15.5641 (54.7926)	−.00049 (.00326)	18	.90	1.251	.388
7.	Tenants only	−249.1218	.3440 (.0533)	9.8001 (28.3288)	−.0013 (.00077)	12	.81	1.350	.546
8.	Mixed group	−964.8335	.2658 (.0858)	57.5309 (24.3734)	.00258 (.00269)	13	.88	.922	2.509

Notes: X_1 = Production of wheat
X_2' = Relative price of wheat
X_3' = Absolute price of wheat

peting items of consumption goods were both food and non-food items. Items included in the bundle are rice, sugar, gram, oilseeds and cloth. The price of cloth was not available. The price of cotton was used as a proxy variable.

Results

The price response of the marketed surplus is measured net of other relevant determining factors of the marketed surplus. The level of production, relative price, incomes from other crops are hypothesized to influence the marketed surplus of wheat. The partial regression coefficient of the marketed surplus of wheat on the level of production is expected to be positive. As noted, there is a considerable controversy concerning likely value and sign of the price response coefficient.

Table III presents the estimated regression equations with separate equations for owners, tenants, mixed category and the entire sample. Several interesting results emerge.

First, the price response of the marketed surplus of wheat net of the effect on marketed surplus of the level of production and income from other crops is, as expected, positive for the entire sample, owners and the mixed category of farmers. The price response is negative for tenant but the coefficient is not significant. The coefficient is however, highly significant and positive for owners.

Second, the partial elasticity of the market supply with respect to the level of production is greater than unity and highly significant for all cases of tenures. The implication of this finding is important and clear. Any exogenous increase in output would be reflected in the marketable surplus more than proportionately.

Third, the price response of the marketed surplus is larger than the price response of total production for wheat. The price elasticity of the market supply varies between 0.3 and 0.7 while the estimates of the price elasticity of production for wheat in Pakistan range from zero to 0.2 [8]. This result is in agreement with the theoretical expectation as pointed out earlier.

Lastly, the relevant price for the marketing decision is the relative and not the absolute price of wheat. At least one study in India has arrived at a significant negative price response of the marketed surplus of foodgrains by using the absolute price of wheat [4]. Equations 5, 6, 7 and 8 in Table III present the marketed surplus function for wheat as a function of wheat production, absolute price of wheat and value of cash income from other crops. The coefficient of price response is positive and significant only for the mixed category of farmers. The price response for owners is insignificant. The results are clearly inconsistent with the theoretical expectation. The inconsistency arises from the improper definition of the price of wheat in the equations. This finding casts doubts on the validity of results in the Indian study.

POLICY IMPLICATIONS

The results of the study show that the higher relative price of wheat induces the farmer to reduce family consumption and increase farm sales. The

hypothesis of fixed-cash-requirement and the inverse relationship between price and market sales is not confirmed in Pakistan. All available evidence in Pakistan indicates a positive price response of market sales. The obvious policy implication is that any price-raising policy would increase the marketable surplus available for urban consumption. This increase in marketed surplus would be in addition to the increase in marketable surplus resulting from a higher level of production. A disaggregation of the farm sector by the type of tenures in Pakistan has shown that owners are relatively more price-responsive than tenants in their marketing decision. Any policy of land distribution among tenants would, *ceteris paribus*, increase the marketed surplus of wheat in Pakistan.

Apart from the weakness in the data used, the major limitation of the study relates to concentration on one food crop as contrasted with aggregate food availability. The positive price response of wheat marketed surplus may be due to the substitution of cheaper food items in consumption by the peasants. A further study is needed about the price responsiveness of aggregate food-grain supplies for the urban sector. It must however be noted that wheat is the predominant food crop in Pakistan. The results of this study, may, therefore be a useful "first approximation" estimate of the aggregate food supply for the urban areas.

Another limitation of the study stems from the exclusive reliance on the cross-section evidence regarding prices and market sales. Time series data on market sales are non-existing. There is an urgent need for collecting such data in Pakistan. Only after such data are available, a direct check on the reliability of the results of this study would be possible.

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