CHAPTER III

As regards the estimates of the price-elasticity of marketed (or marketable) surplus, we shall concentrate only on those studies which are based on Indian data. Perhaps the most painstaking study in the field is the one undertaken by R. Thamarajkshi. This is a sectoral study in the sense that the index of marketable surplus of the agricultural sector (M) is regressed on net barter terms of trade between the agricultural and the non-agricultural sectors of the Indian economy (P), the index of agricultural output (Q) and time, 't' during the period 1951-52 to 1965-66. The equations she has derived are

\[
\begin{align*}
(56) \quad M &= 60.9887 - 0.3568 P + 0.6802 Q + 1.1658 t \\
&\quad (0.2767) \quad (0.2178) \quad (0.6219) \\
(57) \quad \log M &= 1.5451 - 0.2621 \log P + 0.4428 \log Q + 0.1133 \log t \\
&\quad (0.2304) \quad (0.1852) \quad (0.0300)
\end{align*}
\]

(Figures in brackets indicate standard errors).

Agricultural sector, here, includes crop and animal husbandry. Net barter terms of trade has been calculated as a ratio of a composite index of prices of all agricultural products purchased by the non-agricultural sector for intermediate and final use (export price) to a composite index of prices of all non-agricultural products purchased by the agricultural sector for intermediate and final use (import
price); the intersectoral purchases of all the relevant commodities in the year 1960-61 (the base year) being used as weights in the construction of the composite indices.

In constructing $M$, first the value of the marketed surplus of the agricultural sector to the domestic non-agricultural sector for final use is estimated by taking into account the fact that the realised demand of the non-agricultural sector for agricultural products (net of imports) can be taken as the effective supply of the marketed surplus of the domestic agricultural sector, export from India, not being substantial. In constructing the marketable surplus of agricultural products to non-agricultural sector for intermediate use, it has been assumed that the entire production of such agricultural intermediate goods, even that part exported, is first bought by the non-agricultural sector. For lack of space it is not possible to give a detailed explanation of all the steps in the estimation procedure. But one may easily see that $M$ as constructed can be interpreted in two ways, (1) the marketed surplus of the agricultural sector to the domestic non-agricultural sector ($Ms$) and (2) the realised demand of the domestic non-agricultural sector for agricultural products not of imports ($M_a$).

It is quite conceivable that in a short period, agricultural output being pre-determined, $Ms$ will be a increasing function of $F$ and $M_g$, a decreasing function of $P$. An increase in $P$ will induce more expenditure on the marketing inputs
which will minimize the physical loss in output in the marketing stage. It may also lead to a reduction in the retained part of agricultural production either at the farm level or in the wholesale (or even at retail) level and that will also help to increase $M_s$ out of a given $Q$. On the other hand, at least some of the agricultural commodities that are taken into account are expected to have a moderately high price elasticity of demand. So $M_d$ function is also expected to have a negative slope. In the ex post sense, however, $M_s = M_d$. In a time series, both $t$ and $Q_t$ will vary but as we have noted in the last chapter, an increase in $Q_t$ is likely to shift $M_s$ function upwards, while $M_d$ function may be assumed to remain relatively stable. When we also take into account the effects of $t$, the resulting diagram may look like Fig (1).

Each $M_s$ curve and similarly each $M_d$ curve in Fig. 1 corresponds to a particular $t$ and corresponding $Q_t$ which is pre-determined at $t$. The scatter diagram of the equilibrium quantities marketed and the corresponding market equilibrium
price would look like Fig. 2.

\[ M_S = M_d \]

If we fit a regression line to the above scatter of points with \( M_S = M_d \) as the explained and \( P \) as the explanatory variable, the fitted regression line will have a negative slope. This might explain why Thamarajkshi has obtained a negative price elasticity, though the regression coefficients obtained by her are not significant even at ten percent significance level either in the linear or in the non-linear form.

Bardhan and Bardhan have also started by estimating the total consumption of cereals by the non-agricultural sector by two alternative methods and deducting from each of them the total government issue of cereals minus internal procurement (i.e., government distribution from imports) to derive two estimates for the amount marketed by the agricultural population. Dividing them by the official data for net output of cereals, they have constructed two alternative time-series for the explained variable \( Y \), the marketed proportion of cereal output from the agricultural sector for
the years 1952-53 to 1964-65, in their (long-linear) regression equations. Explanatory variables are \( X_1 \), the ratio of current wholesale price of cereals to the weighted average of current wholesale prices for four major manufactured consumables (cotton manufacture, edible oil, sugar and kerosene); \( X_2 \) the ratio of weighted average of past years' prices for four major commercial crops (oilseeds, raw cotton, raw jute and an average of raw sugar and sugar-cane) to the past year's price of cereals; and \( X_3 \) non-agricultural income per head of the agricultural population. The log-linear regression equations they have estimated are

\[
\text{(58) (a) } \log Y = 4.462 + 0.909 \log X_1 - 0.440 \log X_2 - 1.672 \log X_3 \\
(0.910) (0.230) (0.170) (0.390)
\]

\[
\text{(58) (b) } \log Y = 4.515 + 1.065 \log X_1 - 0.610 \log X_2 - 1.673 \log X_3 \\
(1.000) (0.260) (0.190) (0.440)
\]

A few other regressions were run but they either do not add any significant variable or the value of \( R^2 \) is reduced.

In the above, (a) and (b) represent two alternatives estimates.

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(1) There seems to be a printing mistake in the definition of \( X_1 \) on p. 258 of (43), which is correctly given on p. 260 of the same article and in the original version of the article.
of the explained variable $Y$. In both the equations, $\log X_1$ as well as $\log X_2$ were significant at one per cent level and $X_2$ only at five per cent level of significance.

Bardhan and Bardhan are quite aware of some of the limitations of their estimation procedure. Like Thakuraj, they also did not allow for trader's stock or the possibility that the marketed surplus may come out from past years' production and the current output may be retained at the farm level to meet subsequent years' cash requirements. In the original version of the article (12), there was a section on the cash-purchased proportion of cereals output where they also recognized that agricultural labourers and large fractions of small farms have partly to depend on market for their supply of cereals. They, however, do not take into account the fact that a substantial part of the agricultural population besides agricultural labourers and marginal farmers will also be a net buyers of cereals (either by paying in cash or in-kind) and this applies not only to those who are mainly engaged in the production of animal products and to industrial raw materials like cotton or jute but also those producers of food crops like sugar, potatoes, pulses etc. In fact as a justification of one of their alternative estimates, they have also pointed out that even the non-agricultural population of the rural sector will often be engaged in the producing some part of their cereals needs and that part of the non-agricultural demand for cereals will not be a part of the marketed surplus.
of the agricultural population.

The positive (relative) price elasticity of the marketed proportion of cereals output, however, suggest that the government's policy regarding the distribution out of imports of cereals in different time periods, has introduced a highly destabilising factor in the ration of residual demand for cereals on the part of the non-agricultural population to a given output of cereals overtime as a function of price. In comparison, the proportion of cereals output that is acquired by the government through internal procurement which is autonomously determined and is expected to vary directly with the output produced must have introduced a relatively high degree of stability in supply of the aggregate supply of cereals on the part of the agricultural population as a proportion of a given output of cereals over time as a function of price. It may be noted, in this connection, that the destabilising factor in the case of $M$ function in Thamrajkshi estimation procedure has, to a large extent, already been neutralised by dividing the marketed surplus of cereals by the quantity of cereals produced. All these, however, are more possibilities and cannot be ascertained without a more rigorous analysis.

The direct estimates of the price-elasticity of the marketable surplus function, are therefore, not conclusive regarding the sign of the elasticity, Thamrajkshi has found it negative, though not very significant, while Bardhan and
Bardhan have found it positive and quite significant.

Thamarajkshi have, however, computed the elasticity taking all agricultural products into account. Bardhan and Bardhan have concentrated on cereals only. Besides, Bardhan and Bardhan have measured the (relative) price elasticity of the marketed proportion of cereals output. Both Thamarajkshi and Bardhan and Bardhan have adopted the 'sectoral approach' to estimate marketed surplus from time-series data from non-agricultural sector's demand for agricultural products or for cereals, as case may be. The results obtained by them could be given an alternative explanation in terms of the relative stability of the relevant supply and demand curves.

Let us now turn to the indirect estimates of the price-elasticity of marketable surplus function.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>b</th>
<th>g</th>
<th>h</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>.1</td>
<td>.2</td>
<td>.5</td>
<td>.1</td>
</tr>
</tbody>
</table>

The above table giving the range of relevant parameters has been used for the calculation of the price-elasticity of marketable surplus for wheat by Raj Krishna and Harshirvani. Behrman has also used the above tabulated ranges of parameters.
for g, h and k; and the range for 'b' for his b_1. His b_2 is also assumed to have the same range as b in terms of absolute magnitude, but with a negative sign i.e., $b_2 < -0.1$ since the relevant elasticity in the case of b_2 is defined with respect to $p_1/p_2$ and not $p_2/p_1$. Bardhan also in trying to calculate the price elasticity of marketed surplus of foodgrains has used the above tabulated ranges for her parameters except for k which she has assumed would vary between 0.45 to 0.55. (By her definitions, f = -g and b_2 = -c, hence both of them are throughout positive, i.e., 0.2 g 0.4 and 0.2 b_2 0.2.

As a justification for using the above ranges for the parameter, Raj Krishna has referred to the following studies:

1. His own study regarding the elasticity of average of wheat with respect to the relative price of wheat - relative to an index of ten alternative crops, grown in Punjab. The short term elasticity in that study was found to be 0.1 and the long-run elasticity (in the Nerlovian sense) was found to be 0.2.

2. "A.K. Chakraborty's" study of the price-elasticity of demand for wheat, where logarithm of per capita wheat consumption during 1924-25 to 1941-42 was regressed on the logarithm of the price of wheat deflated by the wholesale price index of all commodities and logarithm of per capita income.

3. The estimate as given in "B.K. Barpujari and K. Chandra's" paper regarding the price elasticity of per capita
physical consumption of cereals with respect to (1) the wholesale price of cereals deflated by all India cost of living index and (2) per capita disposable income deflated by the same index, using all India data for 1950-1 to 1957-8.

(4) Cross-section studies of "A.K. Biswas and D.K. Bose" using National Sample Survey data during 1952-56 regarding the elasticity of per capita consumption of cereals with respect to total consumer expenditure per capita in rural areas.

It may be noted that in Raj Krishna's formula for the full multiplier effect of $P$ on $H$ is not taken into account. On the other hand in a comparative static model, the long term price elasticity of acreage would be more relevant. Any way, the effects of yield variation is not taken into account in calculating the effect of $P$ on $Q$. A part of the yield variation would be autonomous, say, due to weather. But a part of may be induced by a price change, say, through the use of high-yielding inputs. Secondly in Chakraborty's study the concept of income seems to be absolute income and that too in the sense of imputed income. In "Barapujari and Chandra" study, the concept of income used is real (or relative) income and the same as the Nowshirvani's concept of income. In "Biswa and Basu" study, the concept of income is replaced by total consumer expenditure in value terms and hence it does not correspond to a concept of real income. Both "Barpunjari-
Chandra" and "Biswas - Bose studies deal with cereals. Lastly while Raj Krishna's study of acreage response deals only with Punjab, the other studies deal either with the whole of India or the rural part of India only.

All the above limitations should be borne in mind when we evaluate the actual estimates of the ranges of the price-elasticity of marketable surplus that have been calculated by Raj Krishna, Nowshirvani and Behrman using the ranges of values of the relevant parameters in Table 1 and their derived formulae.

<table>
<thead>
<tr>
<th></th>
<th>m = .1</th>
<th>m = .5</th>
<th>m = .9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raj Krishna</td>
<td>2.30 to 5.56</td>
<td>0.12 to 0.78</td>
<td>0.08 to 0.26</td>
</tr>
<tr>
<td>Nowshirvani</td>
<td>-2.74 to 5.56</td>
<td>-2.16 to 0.74</td>
<td>0.07 to 0.56</td>
</tr>
<tr>
<td>Behrman</td>
<td>-2.56 to 6.03</td>
<td>-0.19 to 0.85</td>
<td>0.07 to 0.26</td>
</tr>
</tbody>
</table>

In the above table 'm' is the sale ratio, i.e., N/Q or the reciprocal of 'r' in our notation. The last row gives the estimated values according to Nowshirvani's formula as calculated by Sen. (4). One consistent feature of this table is as the sale ratio increases towards .9, all the estimates yield a range of positive values. This is, of course, what we should expect since a high sale ratio would be true for a
highly commercialized farm and for him the parameter that would be most crucial would be the value of 'b' which is assumed to be positive. Krishnan has used his own estimates of price and income elasticities of demand for foodgrains on the part of the farm sector. In our notations, the values of g and h used by him are -0.3584 and 0.5216 respectively which are well within the range of these parameters in Table 1. From, he has used the Rural Credit Survey estimate of 35 per cent. The elasticity of marketable surplus was found by him to be -0.3030 (18).

As a justification of the range of the parameters, Bardhan has also referred to Krishnan's estimate of expenditure elasticities of the demand for foodgrains in the rural sector of India and Khatkhate and Deshpande's estimate of income elasticity of expenditure to convert the above expenditure elasticity into income elasticity to justify the range of values for 'g'. So far as the range for 'h' is concerned, she has cited Barmujari - Chandra estimate as well as Krishnan's estimate. In justification of the choice of limits for the price elasticity of production of foodgrains and its production alternative, she has followed Behrman's example though both Raj Krishna and Behrman estimated the price elasticity of wheat.

The estimates of the price elasticity of marketable surplus on the basis of her three commodity models are within the range of -0.47 to 1.37.
To conclude, almost all the indirect estimates are ambiguous regarding the sign of the price elasticity of marketable surplus. Raj Krishna, of course, has obtained a positive value because he has a different concept of income. On the other hand, Krishna has obtained a negative value because he has only considered the short-term price elasticity, ignoring the long-run effects of price on output.

Bardhan has also run quite a few regressions using village-level cross-section data. Actually, it is a mixture of cross-section and time-series data, because the reference periods are not the same for all the 27 villages and four of the villages are surveyed twice. Anyway, her study also is concerned with the short-run price elasticity, since the long-run impact of prices on production could not be captured by such one-point (or two-point) observations. The linear regression estimate she obtained for 31 observation points (i.e., by treating the resurveyed village as a new observation) is

\[ Y = 24.913 + 1.293 \, X_1 - 1.351 \, X_2 + 0.68 \, X_3 \\
- 4.683 \, X_4 + 9.549 \, X_5 - 0.097 \, X_6 \]

Where:

- \( Y \) is the total amount of foodgrains sold by villagers as percentage of production of foodgrains; (s in our notation)
- \( X_1, X_3, X_4 \), the foodgrains production, the value of production of commercial crops other than foodgrains, and value
of production of milk and milk products, respectively, per adult unit of the cultivating population in a village, $X_2$, the average price of foodgrains for the cultivations in a village, derived by dividing the total value of foodgrains production by its total volume in the village, $X_5$, a crude index of concentration of cultivated acreage in a village, calculated from classifying cultivated area in three size-groups and $X_6$, net disposals of foodgrains by the cultivators as a group to the pure rent receivers and the agricultural labourers in the form of rent and wage payments in kind, derived by subtracting recipes of foodgrains in kind of the cultivators from their disposals of foodgrains in kind. Only the regression co-efficients of $X_1$ and $X_2$ are significant at one to five per cent significance levels. The mean elasticities calculated are found to be 0.788 for $X_1$ (i.e., output) and -0.575 for $X_2$ (i.e., price).

The other regressions ran by her by excluding one of the each double-point surveys also does not change the signs of either price or output elasticities or their magnitudes or significance levels in a significant manner. Similarly the replacing of $X_2$ by the average price of foodgrains received by the cultivators for the quantity sold does not change much the signs or the magnitudes or the significance levels of the above elasticities. A few implications of the results obtained by her may be noted:
(1) Since the regression co-efficient of the marketed proportion of production on production itself is highly significant, it suggests that the volume of marketed surplus of a village is a quadratic function of the average level of production of the village with a positive second derivative.

(2) Since output and prices are found to be un-correlated for the cross-section of 31 observations points, the negative sign of the price elasticity of the marketed proportion of production can be taken as a fair indicator of the negative price elasticity of 'marketed' surplus. The price elasticity of the marketed proportion was found to be -.6 (or -.7 when the alternative way of calculating average price was adopted).

(3) Both the output elasticity and the price-elasticity are not of effects of changes in cultivator's income from other sources than foodgrains production as well as resource-transfer effects as between foodgrains and their competitive crops (i.e., production alternatives). However, the regression co-efficients of \( X_3 \) is neither of the correct sign, nor is it significant.

Bardhan also ran a few regressions for 'better-off' cultivators of the villages by grouping together only the cultivators with operational holdings of 10 cares and above or other criteria. In the case of these richer sub-samples, once again, the marketed proportions of production were found to be positively related in a significant way to production
level at one to five per cent level, but the price elasticity of marketed surplus, though still negative, were no longer significant at that level.

In a cross-section sample, as Bardhan has pointed out, price and output could be taken to be independent of each other, since price changes in one year cannot affect production before the next year or the next sowing season. She has also calculated the co-efficient of correlation between average grain price in a village and the production of grains in the same village and has found it to be statistically insignificant. (For the 31 observation points, the co-efficient of correlation turns out to be -0.04 only). What she has not taken into account is the possibility that the price of grain may not be uncorrelated with the error term in the regression co-efficient. For instance, some of the relevant variables like the distance from the nearest urban centre, that are not considered as explanatory variables for marketable surplus in a regression equation, and hence presumably subsumed in the 'catch-all' error term, may be sufficiently related to the price of grain in a particular village. Even in that case, least square procedure would not given unbiased or even consistent estimates.

Haessel's objection to Bardhan's procedure is, however, based on the ground that in a village, which is reasonably self sufficient in foodgrains, the price will be affected by the quantity produced and marketed.
Using Bardhan's data Hassell has estimated in an indirect manner, the short-run price elasticity of marketing the output-elasticity of marketing and the price elasticity of demand for foodgrains on the part of the entire community and compares that the estimated value of price elasticity of home-demand on the part of producers of the commodity.

Hassell is not very explicit about the methods of estimation he has adopted. It appears that he has first of all regressed both $P$ and $Y$ separately on the following set of five variables:

1. Output ($S$ in his notation, $Q$ in our notation).
2. Output minus net disposals ($Q$ in his notation, $Q'$ in our notation).
3. Other income ($Y^o$ in both notations).
4. Ratio of income from milk and milk products to other income.
5. Index of concentration of land-holdings.

The first, and the fifth explanatory variables correspond to $X_1$ and $X_5$ in Bardhan's regression equations, while the fourth can be written as $X_4/(X_2 + X_4)$ in terms of Bardhan's explanatory variables.

In the first method, $C$ is then regression on $\hat{P}$ and $\hat{Y}$, the estimated values of the first stage regression equations. In the second method, he has used $\hat{P}$ as obtained in the first method to construct $\hat{Y}$ and $\hat{Y} = \hat{P}Q' + Y^o$. Regressing $\hat{P}$ on $Y^o$ and
the other five variables he gets $P$. In the final stage, $C$ is regressed on $P$ and $Y$. Whatever may be the method followed, the estimates of short-run price elasticity for the entire sample turns out to be 2.74 by the first method and 2.76 by the second method and in both cases they are positive, contrary to Bardhan's results. For the same samples the estimated value of $g$ and $h$ are -1.99 and 0.60 by the first method and -2.00 and 0.56 for the second method. He then regression $M$ also on the same set of five explanatory variables to calculate the output elasticity of marketing which he has found to be 1.97 for the entire sample. He then has used equation (34) to calculate $1/Y$ as -4.29, or -4.28, according as the values obtained by the first or the second method are plugged in equation (54). Any way they are much higher in absolute values than the corresponding estimated values of $g$ by the two methods. Haessel has interpreted $1/Y$ as the price elasticity of demand for the entire community.

Haessel have also attempted to estimate the above elasticities for the 'subsample' of the cultivators with operational holdings of more than or equal to 10 acres. All the estimated elasticities for the sub-sample are consistently higher in absolute values than those obtained for the entire subsample, as we should except. Haessel's estimates point out that even in a cross-section sample, as in the case with the time series data, an inverse relationship between price and marketing is not conclusive enough regarding a negative price-elasticity.
of marketable surplus. If we accept the proposition that quantity produced is the most dominant variable in determining marketed surplus, then the above-mentioned relationship between price and marketing may be just a reflection of an inverse relationship between price and output produced in a closed village. To be fair to Bardhan, it must be mentioned that she has examined the possibility of a relationship between output of a village and price of that village for the cross section of 31 cases and has found no such relationship. But, perhaps, a simple correlation co-efficient may not be sufficient to bring out the endogenous nature of the price variable.