

Marketable Surplus Function: A Study of the Behaviour of West Pakistan Farmers

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SECTION I: INTRODUCTION

I.1 Introduction

Food shortages have become a harassing problem for Pakistan. Though foodgrains, received under the provision of United States Public Law 480, have reduced the immediacy of the problem considerably, it is necessary that this breathing space provided by aid be used to understand the nature and magnitude of the problem and to attempt solutions of it. One aspect of the problem is, of course, the general inadequacy of the total production to meet the overall food requirements. The general concern about increasing the volume of total production, and the whole range of policies directed towards this, spotlight one facet of the problem. The other aspect is the release from subsistence consumption of increasing amounts of food output for the market as more and more people are transferred to the urban centres and made dependent on the market. Success in solving the first aspect of the problem may not necessarily lead to any relaxation of the second.

To understand the nature of forces that govern the marketing decisions of farmers in Pakistan is, therefore, a separate and important objective. The experience of western countries with universal market oriented farm production cannot be of much help in Pakistan where most farmers produce primarily for the self-sufficiency of their own consumption. Changes in output and price may derive altogether different reaction from farmers in Pakistan. Policies undertaken in the field of food planning, such as price controls, cordon on the movements of foodgrains, and changes in the land tenure system have important repercussions on the marketing of food. Policy measures adopted in total ignorance of these possible effects may be positively harmful. Yet there is complete absence of any theoretical analysis or empirical study of the problem in Pakistan.

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I.2 Empirical Studies in This Field

Not much empirical research has been done about the determinants of the marketable surplus of food. Two such studies have been made in India recently by Dharm Narain¹ and by Ezekiel and Mathur².

The former is a study of aggregate marketable surplus and its response to the size of holding. It shows a mixed character of the marketable surplus in terms of its response to the farmers' income and price. While a part of marketable surplus will show an expected (direct) relation to price changes, the other part is likely to show an inverse relation to price change. This is because only half of the aggregate marketable surplus is truly a commercial surplus. The other half may be called a distress surplus which is necessitated by the cash obligation of the farmer. Higher prices reduce this distress surplus and lower prices increase it.

The basic argument of the Ezekiel-Mathur thesis is that the farmers in an underdeveloped economy market only that part of output necessary to earn them the cash that they require. This argument is discussed more fully in Section III below.

I.3 Objective of the Present Study

In view of the situation mentioned above, it is desirable that any existing (relevant) data be analysed to shed some light on the various aspects of the problem. The Central Statistical Office's National Sample Survey of Family Expenditure Schedules is a source of such data. The following information on the farmers of West Pakistan is available from the Survey for 1959: the composition and size of the family, area cultivated and yield received for each crop, tenanted and owned proportion of total cultivated area, disposal of each crop, total cultivated area, total family expenditure on each of the food and non-food items, total income, extent of barter transaction, and the proportion of each crop.

On the basis of these data, we examine the patterns of behaviour of West Pakistan farmers with respect to the marketing of food. As the data are cross-sectional, the study will reveal the extent to which differences in marketing behaviour among farmers can be explained in terms of important variables distinguishing them at a given point of time. It is, however, thought that this study will also provide an indirect indication of the behavioural

¹. D., Narain *Distribution of the Marketed Surplus of Agricultural Produce by Size-Level of Holding in India, 1950-51*, (Delhi: Institute of Economic Growth, 1961).

². P. N. Mathur, and H. Ezekiel, "Marketable Surplus of Food and Price Fluctuations in a Developing Economy," *Kyklos*, Fasc. 3, 1961, pp. 396-406.

pattern of individual farmers over time with respect to the same set of variables. The actual hypotheses tested and the relationships estimated are discussed in Section III. In Section II, we discuss the sample and the data.

SECTION II: THE SAMPLE AND THE DATA

II.1 The Sample

The data that form the basis of this study are derived from a sub-sample of survey schedules completed for the National Sample Survey of Family Expenditure conducted by the Central Statistical Office (C.S.O.) in 1959. The sub-sample yielded eighty-seven households as the representative of all the cultivating households of West Pakistan³. The accuracy and reliability of the data remains more or less as insured by the C.S.O. survey procedures. The accuracy has been improved upon to some extent by checking for internal consistency and obvious mistakes.

II.2 Definitions

Although most of the terms used appear to explain themselves, it is still useful to state clearly at the outset what they mean so that the possible danger of ambiguity is minimized.

The terms 'marketable surplus' and 'marketed quantity' are used interchangeably to refer to the amount of food sold for cash. It excludes both the amount that is paid to the landlord and the labourers and the part that ultimately flows back to the market from those sources. Thus, the sum of the marketable surpluses of the individual cultivators is to be distinguished from the actual aggregate surplus that finally enters the market. Since some of the cultivators later buy back a part of what they marketed soon after the harvest, the marketed quantity is the *net* amount sold for cash. It is obtained by subtracting the value of the quantity bought back by the farmer from the value of the quantity sold for cash. This, however, is not done for the farmers who do not sell any of the foodcrops for cash; in all such cases, the marketed quantity is taken to be zero.

It is difficult to draw a borderline between food and cash crops. One cannot find a practical criterion which is easily defensible on *a priori* grounds. Justifications can be found for including tobacco and sugarcane either as food or as cash crops. Ideally, these should have been treated as food crops in case of those farmers who produce them primarily for own consumption, and as cash crops in case of those who produce them primarily to sell for

³. A more detailed account of the original C.S.O. sample and method of obtaining the sub-sample is given in the Appendix.

cash. It is readily recognized that it is hard to apply this criterion. We define food as *grains, pulses and vegetables*. The rest of the agricultural crops is classified as cash crops. This is arbitrary to a great extent, but still is a useful rule of thumb.

Barter is defined to cover only a small part of the total non-monetary transactions. The quantity bartered for production purposes (e.g., the wages paid in kind) is not included. Only the value of the quantity bartered for consumption purposes (i.e., the quantity bartered to obtain goods and services for the cultivators' own consumption) is included.

Rent is paid in cash, in kind or in both. In this study, rent is defined to include the total payment to the landlord—in kind and in cash.

Total income is defined to include the total amount received by all members of the family during the whole year in cash or in kind. Income from fixed salary, wages, rent and the balance sheet items, such as the income from the sales of ornaments, are included in it. "Other income" refers to the non-agricultural income of the farmers (e.g., income from fixed salary).

II.3 The Method of Obtaining the Measurement of the Variables

Information about the actual physical quantities of marketable surplus of food, cash crop, barter and rent can be obtained from the sample survey. In order to express these variables in terms of their value in rupees, some price has to be used. In this study, the *harvest prices* of the *district centres* are used. These prices are published for each district⁴. The farmers of Sind districts are excluded from this study because no harvest price for these districts are available from the same source. In a few cases, harvest prices being non-available, certain adjustments are made⁵.

The variables used in this study are, in most cases, measured per "adult unit". For this purpose, the total value of each variable is divided by the number of standard adult units in the household. The method of transforming a family into adult units is the same as the one used by Coale and Hoover in estimating food requirements for India⁶.

⁴. Government of West Pakistan (Directorate of Land Records), *Report on the Season and Crops of Northern Zone, West Pakistan (1958-59)*. (Lahore: The Superintendent, Government Printing Press, West Pakistan, 1961).

⁵. For details, see, Appendix.

⁶. See, Appendix.

II.4 Notation

The following notations are used throughout the text:

- 1) M = Marketed quantity of food per standard adult unit
- 2) X = Output of food per standard adult unit
- 3) X_c = Output of cash crops per standard adult unit
- 4) X_o = "Other income" per standard adult unit
- 5) R = Total rent payment per standard adult unit
- 6) Y = Total income per standard adult unit
- 7) B = Barter of food per standard adult unit

where $X > \text{median}$
of X 's (122.75)

where $X < \text{median of } X\text{'s (122.75)}$

8) $X_1 =$	median (122.75)	X
9) $X_2 =$	$X - \text{median (122.75)}$	O

- 10) Q_1
 - 11) Q_2
 - 12) Q_3
 - 13) Q_4
- } = X 's as defined below:

	$0 \leq X \leq 81.07$	$81.07 \leq X \leq 122.75$	$122.75 \leq X \leq 192.81$	$192.81 \leq X$
$Q_1 =$	X	81.07	81.07	81.07
$Q_2 =$	0	$X - 81.07$	$122.75 - 81.07$	$122.75 - 81.07$
$Q_3 =$	0	0	$X - 122.75$	$192.81 - 122.75$
$Q_4 =$	0	0	0	$X - 192.81$

Median = 122.75, 1st Quartile = 81.07, 2nd Quartile = Median = 122.75,
3rd Quartile = 192.81

The notations 8 through 13 perhaps need a little clarification. The variables X_1 and Q_1 are values of food output at various ranges. The variables assume values as specified in the tables in different ranges of the value of food output. For example, the meanings of X_1 and X_2 (notations 8 and 9) are as follows: when food output is between zero and 122.75 (median) X_1 takes the value of the actual observation while X_2 takes the value of zero. Similarly, when food output falls within the range of 122.75 and infinity X_1 takes the value of the median while X_2 takes the value of the actual observation less the median. Notations 10 through 13 indicate further breakdown of food output showing the values Q_1 takes as the value of food output falls in different quartiles. The reason this classification is made is stated in Sub-Section III.4 below. The values of X_i and Q_i are so "complicated" (i.e., different for each range) simply to allow marketable surplus as functions of X_i 's and Q_i 's to become a *continuous* function of food output (X).

Note: The number of observations below median are 45, and those above median are 42. The quartiles also split the series into four parts which are somewhat unequal. ($Q_1 = 22$; $Q_2 = 22$; $Q_3 = 21$; $Q_4 = 21$). These discrepancies arise from the fact that all the 3 observations, dropped out of the original sample of 90, have above-median output, while the old median has been retained to avoid a lot of unnecessary recalculations. $Q_1 + Q_2 + Q_3 + Q_4$ is one less than 87 because the twenty-third observation is the first quartile and, hence, not included in either Q_1 or Q_2 . Its value is automatically considered.

SECTION III: THE MARKETABLE SURPLUS FUNCTION

III.1 Theoretical Hypotheses

An enquiry into the factors which determine the marketable surplus of food for the individual farmers of West Pakistan may be attempted on the basis of the data obtained from the C.S.O. National Sample Survey of Family Expenditure Schedules. A number of theoretical hypotheses may be advanced about the determinants of marketable surplus. The purpose of this section is to examine statistically a few such hypotheses advanced to explain variations in the marketable surplus of the individual farmers.

One important way to look at the marketable surplus of foodcrops is to consider it as the surplus of production over minimum consumption requirements which the producers sell in the market. The money income thus obtained, is utilized for consumption and investment purposes while the balance is held in the form of monetary saving. According to this hypothesis, the principal determinant of the marketable surplus is the output of

food. As output of food increases the consumption of food will probably rise but the incremental consumption ratio is likely to be less than one⁷. Thus, the marketable surplus is likely to increase as a result of an increase in the output of foodcrops.

An alternative hypothesis states that the cultivators in an underdeveloped economy sell that amount of their output which is sufficient to satisfy their cash requirement while they retain the rest for consumption and saving in kind. In a year of high food prices, the farmers have to sell less to earn the required cash than in a year of low food prices. The hypothesis, therefore, suggests that the marketed quantity varies inversely with the food prices⁸.

The first of the two hypotheses stated above can be tested on the basis of the information derived from the sample; we have information about marketed quantity and food output for each farmer in the sample. A rigorous test of the second hypothesis would require time series data on food prices and marketable surpluses over a reasonably long period of time. Since we have only cross-section data we can at best examine this hypothesis incompletely and partially.

The second hypothesis suggests that the marketed quantity is determined by the demand for cash. The greater the availability of cash from alternate sources the smaller would be the amount of food that has to be surrendered to acquire additional cash. Thus, the marketed quantity should vary inversely with the availability of cash from alternate sources. A farmer, having a high amount of cash crop and cash income from other sources, would market less than a farmer with small cash crop and cash income. Since we have data on 'cash crops' and 'other incomes' we are in a position to test this hypothesis. It should, however, be stressed that this is by no means a conclusive test of the hypothesis which says that the marketed quantity is determined by cash requirements. We are implicitly assuming that cash requirements of the farmers are fixed and not trying to specify the factors which cause variations in the individual farmer's cash requirements.

⁷. In fact, the marginal consumption ratio $\frac{dC}{dX}$ should depend on the level of output of the farmers. This will be high for the farmers with low per caput output and fairly low for the farmers with high per caput output. At very high levels of per caput output, this is likely to approach zero.

⁸. This hypothesis is put forward by P.N. Mathur and H. Ezekiel in a recent article. They mention the result of an empirical study in two districts of Maharashtra (India) in 1955/56 and 1956/57 where it was found that marketed quantity of food decreased by 7.5 per cent while price increased by 33 per cent between the two years. This happened in spite of 38 per cent increase in food production. See, *Kyklos*, 1961, Fasc. 3, pp. 396-406.

The following variables are studied as independent variables or "determinants" of per caput marketable surplus (M):

- 1) Per caput foodcrops production (X)
- 2) Per caput rent (R)
- 3) Per caput cash-crop production (X_c)
- 4) Per caput "other income" (X_0)

An attempt is made below to find out how the 'dependent variable' (i.e., per caput marketable surplus) is related to each of these four independent variables. The first hypothesis suggests that the marketable surplus should vary positively with foodcrop production and negatively with rent. The second hypothesis implies that the marketable surplus should vary inversely with the value of cash crops and "other incomes".

Toward the end of this section an attempt is made to see whether certain other factors (e.g., per acre yield, the composition of output, acreage, family size and the bartered quantity) influence the marketed quantity.

III.2 The Marketers and the Non-Marketers

Of the 87 farmers in the sub-sample, 36 (or nearly 41 per cent) market a part of their foodcrops output while the rest do not market any food. It may be useful to discuss the differences in the basic characteristics of the marketers and the non-marketers.

Both food- and cash-crop output (per caput) of the marketers are higher than those of the non-marketers. Per caput rent is higher for the marketers than for the others but rent per unit of output (i.e., $\frac{R}{X+X_c}$, which seems to be the more relevant magnitude) is considerably higher for the non-marketers than for the marketers.

The two types of farmer households do not differ significantly with respect to family size. Average size of the farm and productivity per acre are, however, much higher for those who market than for those who do not market.

TABLE 1

ANNUAL AVERAGES OF CERTAIN MAGNITUDES FOR MARKETERS
AND NON-MARKETERS

		Marketers (1)	Non- Marketers (2)	All Farmers (3)
Per caput food output (Rs.)	..	195.40	125.64	154.51
Per caput cash crop (Rs.)	..	84.35	43.32	60.30
Rent per caput (Rs.)	..	58.57	50.51	53.84
Rent per unit of output	..	0.20	0.30	0.25
Family size (adult units)	..	5.07	5.10	5.09
Farm size (acres)	..	13.14	9.61	11.07
Productivity per acre (Rs.)	..	107.88	89.73	98.73

III.3 Marketable Surplus Function for the Farmers
Who Market a Part of their Output

The marketable surplus function is estimated at two different levels: one for the marketers only, and the other for all the farmers in the sample⁹. In this sub-section, we estimate the marketable surplus function for the 36 farmers who actually market a part of their foodcrop production.

In order to test the hypothesis that the marketable surplus is determined by output and rent, we formulate a function of the following type:

$$M = a + bX + cR \dots\dots\dots (1)$$

To examine the hypothesis that the availability of cash from other sources influence the marketed quantity, we formulate two more equations:

$$M = a + bX + cR + dX_c \dots\dots\dots (2)$$

⁹. Sample henceforward means our sub-sample unless otherwise stated.

TABLE 2
LIST OF ESTIMATED EQUATIONS

Serial No.	Equation	No. of degrees of freedom	Coefficient of correlation	Coefficient of determination	Standard error of estimate
For the Marketers Only					
(1)	$M = -13.39^* + 0.3486^{**}X - 0.2058^{**}R$ (5.32) (0.0142) (0.0155)	33	.7628	.5818	30.58
(2)	$M = -12.14^* + 0.3462^{**}X - 0.1947^{**}R - 0.0170X_c$ (5.48) (0.0144) (0.0157) (0.0197)	32	.7634	.5828	31.015
(3)	$M = -10.09 + 0.3434^{**}X - 0.2063^{**}R - 0.0354X_c$ (5.46) (0.0448) (0.0490) (0.0565)	32	.7662	.5870	30.86
For Marketers and Non-Marketers (Whole Sample)					
(4)	$M = -7.3581^* + 0.2149^{**}X_1 + 0.2806^{**}X_2 - 0.2205^{**}R$ (3.0150) (0.0910) (0.0284) (0.0360)	83	.6650	.4422	27.46
(5)	$M = -4.7343 + 0.1650Q_1 + 0.2002Q_2 + 0.3513^{**}Q_3 + 0.2651^{**}Q_4 - 0.2177^{**}R$ (3.0823) (0.1706) (0.2098) (0.1432) (0.0375) (0.0375)	81	.6668	.4446	27.74
For Marketers and Non-Marketers in Less Irrigated Districts					
(6)	$M = 2.2664 + 0.0245X_1 + 0.3771^{**}X_2 - 0.2457^{**}R$ (4.0948) (0.1158) (0.0480) (0.0648)	35	.8226	.6767	24.22
For Marketers and Non-Marketers in More Irrigated Districts					
(7)	$M = -15.5610^{**} + 0.3541^{**}X_1 + 0.1848^{**}X_2 - 0.1646^{**}R$ (4.2855) (0.1308) (0.0346) (0.0575)	44	.5189	.2693	28.43

Figures in the parenthesis indicate the standard errors of the coefficients below which they appear.

*Significant at 5-per-cent level of confidence.

**Significant at 1-per-cent level of confidence.

$$M = a + bX + cR + eX_0 \dots\dots\dots (3)$$

The least-squares fit of equation (1) is as follows:

$$M = -13.39 + 0.3486 X - 0.2058 R \dots\dots\dots (1')$$

(5.32) (0.0142) (0.0155)

The signs of the regression coefficients are consistent with the hypothesis. Both the regression coefficients and the constant term are significantly different from zero at 1-per-cent level of confidence. Nearly 60 per cent of the variation in the marketable surplus is explained. The output elasticity of marketable surplus is + 1.60 at the mean¹⁰.

Diagram 1 represents the fitted equation (1'). The estimated function is plotted against output of food, holding rent:

- a) equal to zero in drawing the marketable surplus function M_1
- b) equal to some "average rent" (Rs. 50 per caput) in drawing the marketable surplus function M_2

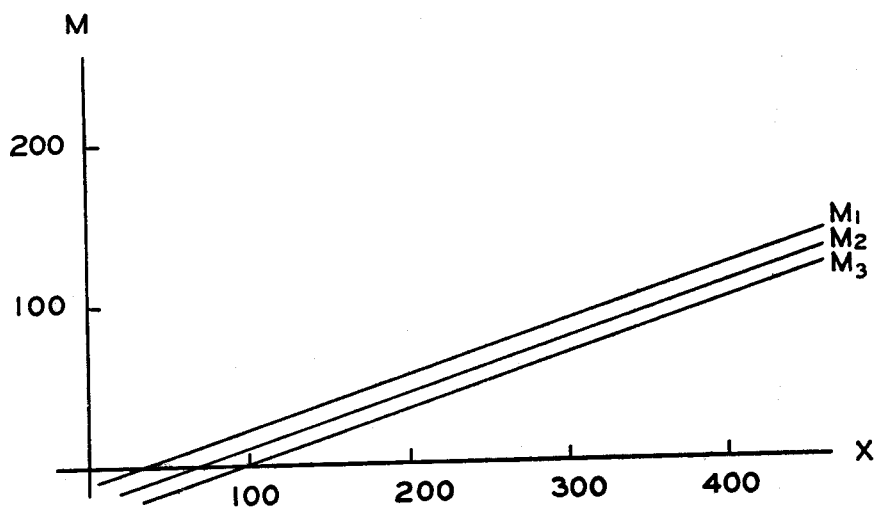


DIAGRAM 1

¹⁰. Elasticity at the mean is: $\frac{\bar{X}}{\bar{M}} \cdot \frac{dM}{dX}$ where \bar{X} = mean food output, \bar{M} = mean marketable surplus, and $\frac{dM}{dX}$ = incremental marketing ratio (first derivative of 'M' with respect to 'X').

- c) at a high level (Rs. 100 per caput) in showing the marketable surplus function M_3 .

The interpretation of the equation (1') is as follows: For the West Pakistan farmers, a change of one unit in the output of food appears, on the average, to have been directly associated with a change of 0.3486 unit in the marketable surplus of food while a change of one unit in rent appears, on the average, to have been inversely associated with a change of 0.2058 unit in the marketed quantity.

The least-squares fits of the equations (2) and (3) are:

$$M = -12.14 + 0.3462 X - 0.1947 R - 0.0170 X_c \dots\dots\dots(2')$$

(5.48) (0.0144) (0.0157) (0.0197)

$$M = -10.09 + 0.3434 X - 0.2063 R - 0.0354 X_o \dots\dots\dots(3')$$

(5.46) (0.0448) (0.0490) (0.0565)

The signs of the coefficient of cash crop in equation (2') and that of "other income" in equation (3') are consistent with the hypothesis that marketed quantity varies inversely with the availability of cash from other sources. None of these coefficients is, however, significantly different from zero at five-per-cent level of confidence. Moreover, the inclusion of these variables does not significantly increase the explained portion of the variation in the marketable surplus. This, however, cannot be taken as a conclusive evidence against the hypothesis that variations in the alternate sources of cash influence the marketed quantity for reasons mentioned above. The relation between the marketed quantity of food and the availability of cash crop is examined more elaborately toward the end of this section.

III.4 Marketable Surplus Function for the Entire Sample

Of the 87 cultivator households in the sample, 51 do not market any foodcrop. The next stage of the enquiry is to estimate the marketable surplus function for the entire sample of 87 cultivator households. Marketed quantity of food is again expressed as a function of food output and rent, the former variable being split into two parts¹¹.

¹¹. It may be useful to remind the reader the definitions of the two parts:

	$X < \text{median of } X\text{'s}$	$X > \text{median of } X\text{'s}$
$X_1 =$	X	median
$X_2 =$	0	$X - \text{median}$

$$M = a + bX_1 + cX_2 + dR \dots \dots \dots (4)$$

The underlying hypothesis is that the "above-median output" (X_2) should influence the marketed quantity differently from the "below-median output" (X_1). Unit change in the "above-median output" should induce a greater increase in the marketed quantity than a unit change in the "below-median output"¹². This is because the incremental marketing ratio is likely to increase as output increases¹³.

The least-squares fit of the estimated equation gives following:

$$M = -7.3581 + 0.2149X_1 + 0.2806X_2 - 0.2205R \dots \dots \dots (4')$$

(3.0150) (0.0910) (0.0284) (0.0360)

The regression coefficients are consistent with the hypothesis—larger for the "above-median output" than for the "below-median output". All the regression coefficients are significant at 5 per cent level. More than 44 per cent of the variation in the marketed quantity is explained. The coefficient of X_2 is, however, *not* significantly different from that of X_1 ; t -value in this case is less than one.

Diagram 2 represents equation (4'). The estimated marketable surplus

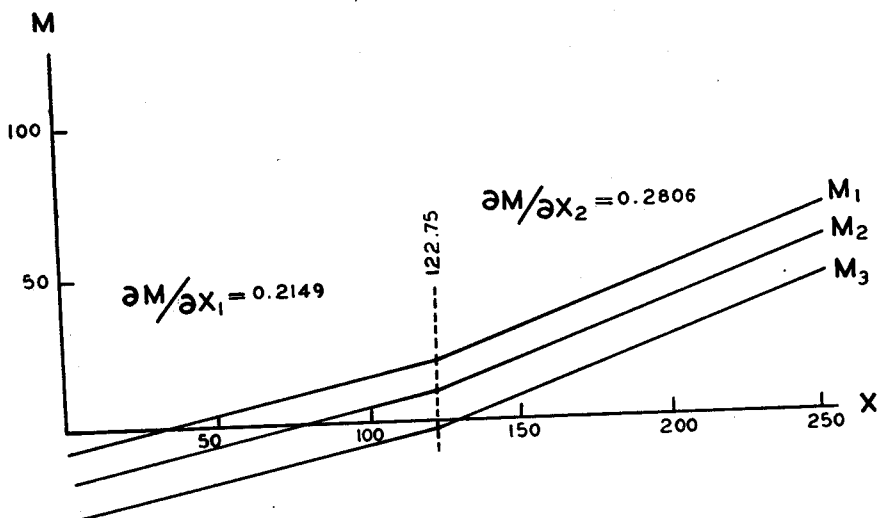


DIAGRAM 2

¹². This means that the estimated regression line of the marketed quantity on the output of food has a kink at the level of median food output.

¹³. Argument for this is the same as that for the saving function; as income rises not only saving but also the incremental saving ratio tend to increase.

function is plotted against the output of food. M_1 represents the marketable surplus function given zero rent while M_2 and M_3 represent the same with "average rent" (Rs. 50 per caput) and "high rent" (Rs. 100 per caput) respectively. The curve shows a kink at the level of median output of food (Rs. 122.75). Equation (4') shows that the marketed quantity of food is influenced by below-median output differently from above-median output. A change of one unit in the food output of a farmer *where food output is less than Rs. 122.75* appears to have been associated with a change of 0.2149 unit in the marketable surplus in the same direction. A change of one unit in the food output of a farmer *whose food output is more than Rs. 122.75* appears to have been associated with a greater change in the marketable surplus—0.2806 unit also in the same direction.

The distribution of the residuals of equation (4'), however, fails to satisfy one of the basic assumptions of the least-squares technique. One assumption of this technique requires that the variance of the residuals should be the same for all observations. This is called the assumption of homoskedasticity. The variances of the residuals of equation (4') do not satisfy this condition; they are highly correlated with one of the independent variables—per caput food output.

The existence of heteroskedasticity—as the inconstancy of the variance of residuals is named—does not, however, affect the unbiased property of the coefficients estimated by the least-squares technique. Heteroskedasticity only implies that the estimates given by the fitted equation (i.e., equation (4') above) "will not be of minimum variance, that is, they are inefficient"¹⁴.

To push the hypothesis underlying equation (4') further (i.e., to see how the incremental marketing ratio varies with the levels of food output) the output of food is split into four quartiles and the following hypothesis is formulated¹⁵:

$$M = a + bQ_1 + cQ_2 + dQ_3 + eQ_4 + gR \dots\dots\dots (5)$$

¹⁴. S.J. Prais, and H.S. Houthakker, *The Analysis of Family Budgets*. (Cambridge: Cambridge University Press, 1955), pp. 55-57. For a proof of the above statements about heteroskedasticity, cf. *Ibid*.

¹⁵. It is useful to repeat the definition of the Q_s :

	$0 \leq X \leq 81.07$	$81.07 \leq X \leq 122.75$	$122.75 \leq X \leq 192.81$	$192.81 \leq X$
$Q_1 =$	X	81.07	81.07	81.07
$Q_2 =$	0	$X - 81.07$	$122.75 - 81.07$	$122.75 - 81.07$
$Q_3 =$	0	0	$X - 122.75$	$192.81 - 122.75$
$Q_4 =$	0	0	0	$X - 192.81$

where 81.07 = first quartile, 122.75 = second quartile (median) and 192.81 = third quartile.

The expectation about the coefficients is $b < c < d < e$, so that incremental marketing ratio increases as output of food varies from one quartile to a higher quartile. The least-squares fit of the equation is as follows:

$$M = -4.7343 + 0.1650Q_1 + 0.2002Q_2 + 0.3513Q_3 \\ (3.0823) \quad (0.1706) \quad (0.2098) \quad (0.1432) \\ + 0.2651Q_4 - 0.2177R \dots\dots\dots(5') \\ (0.0375) \quad (0.0375)$$

A comparison of the equations (4') and (5') reveals the following things:

- a) Equation (5') does not significantly improve the explained variation in the marketed quantity over the equation (4'). While the coefficient of determination is 0.4446 for equation (5'), it is 0.4422 for equation (4').
- b) The coefficients of Q_1 and Q_2 are not significantly different from zero¹⁶.
- c) While the coefficients of equation (4') are consistent with the hypothesis the coefficients of equation (5') are not. It is, indeed, difficult to find a theoretical explanation of the decline in the incremental marketing ratio at very high levels of food output as is revealed by equation (5'). An explanation is attempted later in this section. Here, it may be mentioned that the coefficient of Q_4 is not significantly different from the coefficient of Q_3 ¹⁷.

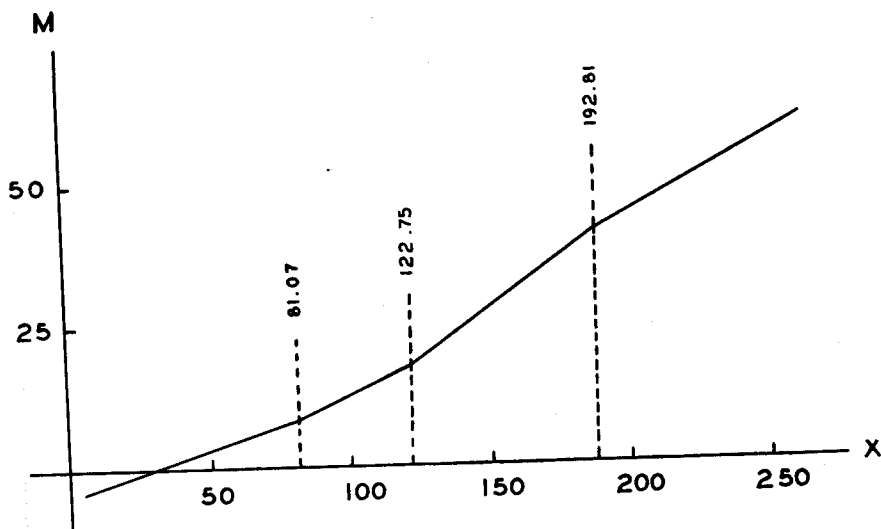


DIAGRAM 3

¹⁶. t -value in each of these cases is less than one.

¹⁷. t -value, in this case, is less than one. In fact, the coefficient of no 'Q' is significantly different from that of any other 'Q'; t -value, in no case, is more than about 1.5.

Diagram 3 represents the equation (5') with zero rent. As food output increases from first to second to third quartiles, the slope of the curve increases; but, finally, the slope declines as output reaches fourth quartile. The curve has kinks at three levels of food output—81.07, 122.75 and 192.81.

III.5 The Influence of Certain Other Variables on the Marketable Surplus

The influence on the marketed quantity of food of a number of other variables is examined from an analysis of the relation between each of these variables and the residuals of equation (4'). The following variables are considered:

- a) Per caput cash crop. The possible effect of variation in cash crop output on the marketable surplus has been indicated above.
- b) Ratio of wheat output to total food output. Marketing should be influenced by the composition of food output in relation to consumption habits. A farmer, who produces plenty of rice but predominantly consumes wheat, will market most of his rice output. But he will probably buy wheat for consumption. The implicit assumption is, however, made that the farmer's propensity to consume his own product is higher than that for the food bought from others.
- c) Per acre yield. The higher the per acre yield, the smaller the unit cost is likely to be and the greater the surplus of the farmer, so that the farmer is able to market a higher proportion of his output.
- d) Per caput quantity of barter. The quantity bartered may influence the marketed quantity of foodcrops in two possible ways: 1) As bartered quantity increases, there is less foodcrops left for disposal in other directions including marketing. 2) Secondly, the higher the quantity bartered, the smaller is the demand for cash.
- e) Per caput "other income" of the household. The direction in which variations in this may cause variations in the marketed quantity has already been indicated.

None of the above variables, however, appears to add to the explained variation in the marketed quantity of food.

III.6 Marketable Surplus Function for More Irrigated and Less Irrigated Districts

The distribution of the residuals of equation (4') for the observations in the more irrigated districts appears to be different from that of the less

irrigated districts. It is, therefore, believed that it is not proper to use the same equation to explain the behaviour of marketable surplus in the two different types of districts. A separate function may be fitted for each type of districts.

The following are the more irrigated districts¹⁸: Sialkot, Shahpur, Montgomery, Lahore, Jhang, Sheikhupura, Lyallpur and Multan. The other fourteen are the less irrigated districts. The two types of districts do not differ significantly with respect to per caput food output. They, however, differ quite significantly with respect to cash-crop production. Per caput cash crop in the more irrigated area (Rs. 83.66) is about twice as high as that in the less irrigated area (Rs. 43.54). Only 33 per cent of the farmers in the less irrigated area produce cash crops while 88 per cent of them in more irrigated area are partly engaged in cash-crop production. Other differences between the two groups are shown in Table 3 below.

TABLE 3

**ANNUAL AVERAGES OF CERTAIN MAGNITUDES FOR MORE
IRRIGATED AND LESS IRRIGATED DISTRICTS**

		Farmers in more irrigated area	Farmers in less irrigated area	All farmers
Per caput food output (Rs.)	..	156.28	152.33	154.51
Per caput cash crop (Rs.)	..	83.66	43.54	60.30
Rent per caput (Rs.)	..	73.13	31.33	53.84
Rent per unit of output	..	0.30	0.16	0.25
Average family size (adult units)		4.73	5.38	5.09
Average farm size (acres)	..	9.71	12.79	11.07
Productivity per acre (Rs.)	..	116.88	82.37	98.73

¹⁸. The classification is made on the basis of the findings of an unpublished work done in the Institute's Fiscal and Monetary Section.

A function of the type of equation (4) is fitted to explain the marketed quantity for each of the two areas. The estimated regression equation for the less irrigated area is:

$$M = 2.2664 + 0.0245X_1 + 0.3771X_2 - 0.2457R \dots \dots \dots (6')$$

(4.0948) (0.1158) (0.0480) (0.0648)

The signs and the relative magnitudes of the coefficients are in conformity with expectations. The constant term and the coefficient of below-median food output (X_1) are not significantly different from zero¹⁹. The other two coefficients are, however, significant at the one-per-cent level. The independent variables together explain 68 per cent of the variation in the marketed quantity. The coefficient of X_2 is significantly higher than that of X_1 at one-per-cent level of confidence.

The least-squares estimate of the equation for the more irrigated area, however, gives a completely different fit:

$$M = -15.5610 + 0.3541X_1 + 0.1848X_2 - 0.1646R \dots \dots \dots (7')$$

(4.2855) (0.1308) (0.0346) (0.0575)

All the coefficients are significantly different from zero at one-per-cent level of confidence. But the coefficient of above-median output, contrary to expectation, is smaller than the coefficient of below-median output. The difference between the two coefficients is significant at one-per-cent level. Only 27 per cent of the variation in the marketed quantity is explained.

It is indeed difficult to find an explanation of the decline in the incremental marketing ratio at high level of food output. One possible explanation is found by analysing one special characteristic of the farmers in more irrigated area: unlike the farmers in the less irrigated area, these farmers usually have high per capita cash-crop production. For these farmers there exists a definite relation between food output and cash-crop output. High food output is usually associated with high cash crop; the coefficient of correlation between the two is +0.68.

Since cash crop is high at high levels of food output, unsatisfied cash requirement of the farmers is low; most of the required cash is obtained by selling the cash crop. Thus, the farmers can satisfy their cash requirement by marketing a small part of their food output. This explanation, incidentally, renders support to the Ezekiel-Mathur hypothesis mentioned above.

¹⁹. In each case, *t*-value is less than one.

III.7 Conclusions

The main findings of the study are mentioned at each stage of the analysis. It is still considered useful to state the broad conclusions in a summary form.

- a) For the 36 farmers who market a part of their food output nearly 60 per cent of the variation in the marketed quantity is explained by their food output and rent payment. Marketed quantity is an increasing function of food output and a decreasing function of rent payment. The output elasticity of marketable surplus at the mean is $+1.60$.
- b) Nearly 44 per cent of the variation in the marketable surplus of *all* farmers in the sample is explained by food output and rent. Incremental marketing ratio is found to increase as output of food increases (except at very high level of food output).
- c) While 68 per cent of the variation in the marketed quantity is explained for the farmers in the less irrigated area, only 27 per cent is explained for those in the more irrigated area. We were not able to find out why the fit is so much worse for the latter.
- d) It is not possible to test rigorously the hypothesis which states that the marketed quantity is determined by cash requirement of the farmer. The indirect evidences were both in favour and against this hypothesis. While alternate cash sources do not seem to influence the marketable surplus significantly either for the marketers or for the entire sample, the unexpected behaviour of marketable surplus at high levels of output (especially in case of the more irrigated area) makes us suspect the operation of some such influence on the marketing decisions of the farmers.

Appendix

On The Sample

This appendix is intended to describe the procedures followed in drawing up the sample for the Family Expenditure Survey of the Central Statistical Office (C.S.O.) and to explain the method of obtaining the present sub-sample from the former.

The C.S.O. Family Expenditure Survey of 1959 was conducted to gather information on the income and expenditure pattern of the rural population of Pakistan "to know what they earn, how they spend their income, their family size, their expenditure on food, clothing, rent and other miscellaneous items"¹. A *multistage, proportionate, stratified, random sample* of rural households in each of the former provinces of West Pakistan was drawn. The method used is briefly stated in the following paragraphs.

The sample survey involves the following stages: *First*, the entire area is divided into topographically homogeneous and geographically contiguous regions. *Second*, *tehsils* within each region are grouped to form a stratum on the basis of population density. *Third*, one *tehsil* is selected from each stratum with probability proportional to the population size. *Fourth*, villages are selected from each *tehsil* with probability proportional to their population size. *Fifth*, eight households are selected at random from each village from a complete list of households prepared for each of the selected villages.

The technique obtains complete randomness in the selection of each household, while the geographical stratification ensures proportional representation of each area by preventing the possibility of chance concentration.

Our sub-sample is taken out of the above-mentioned sample frame. It maintains the same principles of randomness and proportional geographical representation, but reduces the size of the sample for the convenience of the type of analysis involved. In the sub-sample, one village is selected from each stratum with probability of selecting a village equal to the following:

$$\frac{\text{number of households in the } i\text{-th village}}{\text{total number of households in all the villages of the } j\text{-th stratum}}$$

Four households are then selected at random from among the sample households of each sub-sample village. The size of the sub-sample, thus obtained, is 224 (4 households taken from each of the 56 villages). The number used in this study, however, is 87. The remaining 137 are dropped out due to the following reasons:

- a) The C.S.O. Family Expenditure Survey Schedules for sixteen sub-sample households happened to be among those which are either found blank or not traceable.

¹. C.S.O., *Instruction To Enumerators, Family Expenditure Schedule (Second Round)*, 1959. (unpublished), p. 1.

- b) Eighty households are excluded because they are non-cultivators.
- c) Thirty-eight cultivating households of the former province of Sind could not be included because the harvest prices required for the valuation of farm outputs are not available for those districts².
- d) The remaining ninety schedules are then checked for internal inconsistency and other errors. Three schedules are excluded in the process because of serious discrepancies. Schedules having minor inconsistencies which can be explained and adjusted are, however, retained.

The final sub-sample satisfies the test of being a random sample. Each household is chosen with equal probability. The factors responsible for the elimination of any of the households are due purely to chance. All the cultivating rural households of West Pakistan, therefore, have equal chance of being included in the sub-sample. This, however, involves the assumption that the ratio of cultivating households to total households is the same for each stratum, *tehsil* and village.

To check how the distribution of the actual numbers of households in our sample compare to those expected on the basis of the non-metropolitan population of each of the sample districts we have used the chi-square test³. However, we have combined the expected number of households for each division because most of the expected numbers of households for districts are lower than five⁴. The number of households selected in the sample from each division is found to be more or less proportional to the size of its non-metropolitan population. The discrepancy between the actual numbers and the expected numbers is statistically not significant.

The exclusion of all the households of the former province of Sind is also due to chance non-availability of harvest prices for that area. This could happen in the case of other districts as well. Even if the districts of Sind have important regional differences, the sub-sample can still be regarded as representative of West Pakistan excluding Sind.

Adjustments Made in the Data

a) Harvest prices for *moong*, *masur*, *mash* and mustard are not available. So these have been estimated by deflating their wholesale prices twenty per cent.

². See, Sub-Section II.3 of this paper.

³. The size of the non-metropolitan population of each district as percentage of the total non-metropolitan population of all the sample districts is given at the end of this Appendix.

⁴. Use of chi-square test is ruled out if the expected frequencies of observations are less than five.

The wholesale prices are taken in each case from the Institute's *A Measure of Inflation in Pakistan: 1951-60*.⁵

b) Mustard price has been used for rye as well. Harvest price of chillies is assumed to be Rs. 2.00 per seer.

c) Harvest prices of the adjacent district have been used in some cases where local harvest prices are not available:

Cotton price of Multan is taken for Muzaffargarh; Shahpur prices for rice, tobacco and maize are used for Mianwali; Lahore prices for *jowar* and cotton are used for Sialkot.

d) The following method has been used for transforming a family into adult units:

Male 10 years and above	=	1.0 adult unit
Female 10 years and above	=	0.9 adult unit
Both male and female below 10 years	=	0.5 adult unit

See: A.J. Coale and E.M. Hoover, *Population Growth and Economic Development in Low-Income Countries*. (Princeton, New Jersey: Princeton University Press, 1958). p. 88, footnote.

e) Conversion ratios used for local area measurements are:

1 <i>Qila</i>	=	1 Acre
2 <i>Jareeb</i>	=	"
8 <i>Kanal</i>	=	"
240 <i>Marla</i>	=	"

A Summary of the Questionnaire Used in C.S.O. Family Expenditure Survey

Blocks I, II & III: Identification of the interviewee, the enumerator and the administrative process.

Block IV: Family composition on the date of enquiry.

Blocks V & VI: Births and deaths (last year) respectively.

⁵. Fiscal and Monetary Section, Institute of Development Economics, *A Measure Of Inflation in Pakistan, 1951-60*. (Karachi: The Institute of Development Economics, 1961).

Block VII (a): Area cultivated to each crop; tenanted and owned proportion of area in each; quantity produced; yield per acre.

Block VII (b): Details of the total uses of each crop: quantity paid in kind for harvesting etc.; quantity paid to landlord; quantity sold for cash; quantity bartered; quantity used for seed and fodder; quantity purchased; quantity received as wages, rent or share of crop; quantity consumed.

Blocks VIII to XI: Consumption of food; apparel, textile and footwear; housing and household accessories; miscellaneous, such as personal care, medical expenses, servants' salary, etc.

Block XII: Saving and insurance.

Block XIII: Receipts: income classified according to source.

A District-Wise Breakdown of Sub-Sample Households

Our code		Division	District	Total no. of families	Percentage of non-metropolitan population of the sample districts
From	To				
1.1	1.4	'Pindi	Attock	4	2.88
2.1	2.4	Peshawar	Hazara	4	5.48
3.1	—	Peshawar	Peshawar	1	3.48
4.1	4.3	Peshawar	Mardan	3	2.96
5.1	5.3	D. I. Khan	Bannu	3	1.62
6.1	6.3	D. I. Khan	D. I. Khan	3	1.31
7.1	7.3	'Pindi	Gujrat	3	4.84
8.1	8.3	Lahore	Gujranwala	3	3.96
9.1	9.5	Lahore	Sialkot	5	5.61
10.1	—	Sargodha	Sargodha (Shahpur)	1	4.95
11.1	11.5	Sargodha	Mianwali	5	2.53
12.1	12.11	Multan	Montgomery	11	7.93
13.1	13.8	Lahore	Lahore	8	4.25
14.1	14.8	Sargodha	Jhang	8	3.79
15.1	15.2	Lahore	Sheikhupura	2	3.95
16.1	16.9	Sargodha	Lyallpur	9	8.83
17.1	17.4	Multan	Multan	4	8.89
18.1	18.2	Bahawalpur	Rahim Yar Khan	2	3.77
19.1	—	Bahawalpur	Bahawalpur	1	9.27
20.1	20.6	Multan	D. G. Khan	6	2.84
21.1	—	Multan	Muzaffargarh	1	3.84
22.1	22.3	Bahawalpur	Bahawalnagar	3	3.00
TOTAL:				90	100.00