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STRUCTURAL CHANGES IN AN AGRICULTURAL ASSEMBLING
MARKET: A CASE STUDY OF ARECANUT (BETELNUT)
MARKET IN MANGALORE, KARNATAKA STATE†

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The need for an efficient marketing system for sustaining and accelerating agricultural production and thereby promoting economic growth in developing nations is now widely accepted. Marketing efficiency depends to a large extent on the structure and organization of the market. However, very little information is available on the structure, conduct, and performance of agricultural markets in these countries. Past studies have given a description of the marketing system in India both at micro and macro levels.¹ A few studies also have attempted to analyse the pricing efficiency to interpret the nature of competition in the marketing system.² The findings of these studies differ widely and are not conclusive on the nature of competition. More systematic studies on the structure of commodity markets in the developing countries need to be undertaken to help in policy making.

The present study examines the structure of arecanut marketing in Mangalore of Karnataka State. Mangalore is a major assembling market for arecanut in India and handles arecanut transactions worth over Rs. 200 million annually. This transaction is worth about one-sixth of total value of arecanut production in the country. The specific objectives of this study are: (i) to analyse the structural changes in the assembling market by using data on the size-distribution of firms and coefficients of inequality; (ii) to project the distribution of firms in different size categories by using Markov chain analysis; and (iii) to analyse the impact of changes in the market structure.

ASSUMPTION AND THEORETICAL BACKGROUND

Market structure, for practical purposes, can be interpreted to mean those characteristics of the organization of the market which seem to influence the nature of competition and pricing within the market. The characteristics most emphasized are: (a) degree of seller concentration, described by the size-distribution of sellers in the market; (b) degree of buyer concentration,

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1. L.V. Hirsch: Marketing in an Underdeveloped Economy: The North Indian Sugar Industry, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1961.

2. Ralph W. Cummings, Jr.: Pricing Efficiency in the Indian Wheat Market, Impex India, New Delhi, 1967; A. S. Kahlon: Impact of Changing Conditions on Grain Marketing Institutions and the Structure of Grain Markets in the Erstwhile Punjab, Punjab Agricultural University, Ludhiana, 1970; and Uma J. Lele: Working of Grain Markets in Some Selected States in India, 1955-56 to 1964-65, Occasional Paper No. 12, Cornell University, Ithaca, New York, December 1968.

described by the size-distribution of buyers in the market; and (c) condition of entry into the market.

In this study degrees of buyers and seller concentration are used as characteristics for determining the market structure. Measures of such concentration are defined in terms of market shares of buyers and sellers. Changes in shares over the years is thus assumed to provide the basis for studying the market structure changes. Also, changes in the number of buyers and sellers in the market over the years is assumed to reflect the conditions of entry into the market.

The term 'sellers' in this paper refers to the commission agents operating in the market. Included in this category also are two farmer co-operatives and a joint stock company. 'Buyers' are those who offer to buy arecanuts either on their own behalf or on behalf of others. A marketing and processing co-operative which enters the market both as a buyer and a seller is included on both the buying and selling sides of the market. The numbers of buyers and sellers when reported for a year, refer to the firms which made transactions in that year. The year is the time period from September 1 to August 31.

Most of the data were made available from Mangalore Market Reports³ for the period 1962-73. The data on market arrivals and prices of arecanuts were obtained from the records of Agricultural Produce Market Committee, Mangalore.⁴

MARKET ARRIVALS, SALES AND PRICES

The data on market arrivals, sales and prices of arecanuts in the Mangalore market for the period under study are presented in Table I.

TABLE I—MARKET ARRIVALS, SALES AND PRICES OF ARECANUTS IN MANGALORE*

	1965- 1966	1966- 1967	1967- 1968	1968- 1969	1969- 1970	1970- 1971	1971- 1972	1972- 1973
Market arrivals (thousand quintals)	168.7	163.2	272.4	193.2	237.0	228.0	341.2	335.4
Sales (thousand quintals)	155.1	173.9	265.7	185.6	244.1	222.3	337.7	342.0
Price† (Rs. per quintal)	587.4	552.1	564.1	678.8	657.3	640.2	507.7	390.8

Source: Agricultural Produce Market Committee, Mangalore.

* The year is from September 1 to August 31.

† Price reported is the annual average price of Mangalore Supari variety which is the major category of arecanuts sold in the market.

The market arrivals and sales have fluctuated, but on the average increased during the period from 1965-66 to 1972-73. The prices, on the other hand, declined dramatically during the same period. While the interrelationships among market arrivals, sales, prices and market structure changes are important, we recognize that several other variables (such as relative profitability of producing other crops in a region which competes for resources with arecanuts) also enter into these interdependencies. We present the in-

3. Access to these reports was provided by B. R. Kamath of Kanara Chamber of Commerce, Mangalore. This help is greatly appreciated by the authors.

4. The authors also appreciate the help from V. Subraya Bhat, President, Agricultural Produce Market Committee, Mangalore.

formation in Table I as a background reference to our study.

ANALYSIS OF THE TREND IN SIZE-DISTRIBUTION OF THE SELLERS

Table II presents the pattern of distribution of sellers among different size categories over a period of eight years, from 1965-66 to 1972-73. During this period small firms whose sales were less than 10,000 bags⁵ of arecanuts per year accounted for more than 50 per cent of the total number of sellers in the market. Their sales, however, in all these years were always below 33 per cent of the total sales. There were more firms in size categories falling between 10,000 and 40,000 bags of sale per year in 1971-72 and 1972-73 compared to 1965-66 and up to 1970-71. The share of the sales for the large firms with sales over 40,000 bags per year increased from 26.56 per cent in 1965-66 to 32.68 per cent in 1967-68, but thereafter, decreased and remained between 19 and 25 per cent which is less than in 1965-66. The total number of firms in the market increased from 34 to 47 over the period from 1965-66 to 1972-73.

Changes in the distribution of firms by size are also reflected in the coefficients of inequality presented in Table II. Following the procedure given by Krishnaswamy,⁶ these coefficients of inequality are estimated as follows:⁷

$$L = 1 - \sum_{i=1}^n (P_i - P_{i-1}) (Q_i + Q_{i-1})$$

where L = coefficient of inequality;

P_i = cumulative proposition of firms up to and including i th class; and

Q_i = cumulative proposition of transactions of firms up to and including i th class.

Lower the value of L, more equal is the distribution of firms by size.

The coefficient of inequality has steadily declined in value over the period 1965-66 to 1970-71. This implies a steady improvement in the size-distribution of shares towards a greater degree of competitiveness in the market structure. But the coefficient of inequality has increased during the period from 1970-71 to 1972-73. Just as the case for increased competition during the period from 1965-66 to 1970-71, the reasons for apparently increasing concentration of sellers are unclear from the data available to us. Also, Lele⁸ has emphasized that the presence of large number of firms would rule out the possibility of any collusive action on the part of traders. The total number of sellers in the market under study is considerably large to accommodate any such possibilities. In addition, the fact that two co-operative societies are the dominant

5. One bag = 65 kilograms = 143.3 lbs.

6. L. Krishnaswamy, "The Degree of Competitiveness in Agricultural Marketing", Supplement to the *International Journal of Agrarian Affairs*, 1975, pp. 49-62.

7. The coefficient of inequality or concentration coefficient (L) is also the well-known Gini ratio associated with the Lorenz Curves. Raju and Singh discuss a few other measures of concentration. See V. T. Raju and I. J. Singh, "Farm Income Distribution and Measures of Income Inequality", *Agricultural Situation in India*, Vol. XXIX, No. 9, December 1974, pp. 559-564. Certain problems associated with the use of Gini ratio are discussed by Richard A. Benson, "Gini Ratios: Some Considerations Affecting Their Interpretation", *American Journal of Agricultural Economics*, Vol. 52, No. 3, August 1970, pp. 444-447. But use of Gini ratios to compare size-distribution of firms over a time period does not pose serious problems.

8. Uma J. Lele: *Foodgrain Marketing in India: Private Performance and Public Policy*, Cornell University Press, Ithaca, New York, 1971.

TABLE II—SIZE-DISTRIBUTION OF AND COEFFICIENTS OF INEQUALITY FOR SELLERS

Size category range in bags of 65 kg. of arecanuts	1965-66		1966-67		1967-68		1968-69		1969-70		1970-71		1971-72		1972-73		
	Per cent of sellers	Per cent of sales	Per cent of sellers	Per cent of sales	Per cent of sellers	Per cent of sales	Per cent of sellers	Per cent of sales	Per cent of sellers	Per cent of sales	Per cent of sellers	Per cent of sales	Per cent of sellers	Per cent of sales	Per cent of sellers	Per cent of sales	
0-5,000	..	61.76	13.67	59.38	12.07	43.24	6.10	54.05	13.59	43.24	10.06	42.11	8.07	38.10	7.52	40.43	7.48
5,000-10,000	..	17.65	19.11	6.25	4.43	24.32	15.95	16.22	13.27	21.62	13.11	18.42	10.63	19.05	9.26	19.15	10.04
10,000-40,000	..	17.65	40.66	31.25	53.25	27.03	46.27	27.02	51.44	32.44	52.09	36.85	59.89	40.46	62.04	38.31	63.27
40,000-130,000	..	2.94	26.56	3.12	30.25	5.41	31.68	2.71	21.70	2.70	24.74	2.62	21.41	2.39	21.18	2.11	19.21
Total number of sellers		34		32		37		37		37		38		42		47	
Coefficients of inequality		0.66		0.62		0.59		0.55		0.55		0.46		0.55		0.62	

TABLE III—SIZE-DISTRIBUTION OF AND COEFFICIENTS OF INEQUALITY FOR BUYERS

Size category range in bags of 65 kg. of arecanuts	1965-66		1966-67		1967-68		1968-69		1969-70		1970-71		1971-72		1972-73		
	Per cent of buyers	Per cent of purchases	Per cent of buyers	Per cent of purchases	Per cent of buyers	Per cent of purchases	Per cent of buyers	Per cent of purchases	Per cent of buyers	Per cent of purchases	Per cent of buyers	Per cent of purchases	Per cent of buyers	Per cent of purchases	Per cent of buyers	Per cent of purchases	
0-5,000	..	82.35	20.16	76.12	16.62	74.32	15.60	79.07	20.46	81.57	22.71	74.77	19.34	70.91	15.82	80.47	28.88
5,000-10,000	..	2.94	4.51	8.96	12.65	10.81	14.43	9.30	16.95	7.90	13.82	12.15	17.55	11.82	14.97	8.28	14.47
10,000-40,000	..	14.71	75.33	14.92	70.73	12.16	46.98	11.63	62.59	9.64	53.26	12.15	52.68	17.27	69.21	11.25	56.65
40,000-50,000	2.71	22.99	..	..	0.89	10.21	0.93	10.43	..	..	..	..
Total number of buyers.		68		67		74		86		114		107		109		159	
Coefficients of inequality		0.66		0.66		0.67		0.66		0.65		0.64		0.64		0.56	

sellers in the market makes it more difficult for the rest of the firms to follow collusive tactics. It may, thus, be interpreted that the size-distribution of firms has been changing towards a more equal distribution during much of the period under study.

ANALYSIS OF THE TREND IN SIZE-DISTRIBUTION OF THE BUYERS

The number of arecanut buyers in different size categories as percentage of total number of buyers in the market and their relative shares in total transaction is presented in Table III. About 80 per cent of the total number of buyers in the market were in the size category of less than 10,000 bags of purchase per year in all the years. The share of purchase under this size category increased from 24.67 per cent in 1965-66 to 31.03 per cent in 1967-68 and 43.35 per cent in 1972-73. In size categories between 10,000 bags and 40,000 bags of arecanut purchases per year, the relative number of buyers was about 17 per cent. Their share of purchase dropped from 75.33 per cent in 1965-66 to 56.65 per cent in 1972-73. The total number of buyers in the market increased from 68 in 1965-66 to 159 in 1972-73. However, Table III shows that the overall concentration or inequality coefficient has declined from 0.66 to 0.65 during the same period of time. For the entire period of 1965-66 to 1972-73, the drop in the value of the coefficient of inequality has been from 0.66 to 0.56. On the buyer's side, the pattern of change in the size-distribution is, thus, found to be similar to that on seller's side *i.e.*, the size-distribution has tended towards more equality over the years. In other words, the market conditions have led the buying side towards a more competitive structure over these years.

PROJECTION OF SIZE-DISTRIBUTION OF SELLERS AND BUYERS IN THE MARKET FOR 1981-82

Changes in size-distribution of both sellers and buyers are used to project future distribution of these firms using first order Markov chains. Many studies have used Markov process in analysing problems of distribution of firms by size.⁹ Important assumptions underlying the use of Markov chain analysis in this study are:

1. The firm growth is stochastic, *i.e.*, change in the market share of a firm can be represented by a random variable; and
2. The conditions giving rise to structural changes in a time-period will continue to prevail for the course of time for which projections are made. In other words, the transition probabilities, or the probabilities of movements of firms among categories, are stable over the period into which projections are to be made.

Both these assumptions are tested for their statistical validity in the

9. Paul L. Farris and Daniel I. Padberg, "Measures of Market Structure Changes in the Florida Fresh Citrus Packing Industry", *Agricultural Economics Research*, Vol. XVI, No. 4, October 1964, pp. 93-118; Ronald D. Krenz: "Projection of Farm Numbers for North Dakota with Markov Chains", *Agricultural Economics Research*, Vol. XVI, No. 3, July 1964, pp. 77-83; and Daniel I. Padberg, "The Use of Markov Processes in Measuring Changes in Market Structure", *Journal of Farm Economics*, Vol. 44, No. 1, February 1962, pp. 189-199.

context of data set used. Following the studies of Farris and Padberg¹⁰ and Padberg,¹¹ chi-square tests were performed to test the validity of the above assumptions. The details of the above tests are not reported in this paper.

The results obtained from the chi-square tests lead us to accept the null hypothesis that firm growth is stochastic at 95 per cent level of confidence. The test for the assumption of stable transition probabilities is described later.

TRANSITION PROBABILITIES

Sellers and buyers of arecanut are grouped into four size categories separately in this study and are presented in Tables IV and V. Periods between 1966-67 and 1969-70 and between 1972-73 have been chosen as base periods for developing the transition probabilities. The base periods are chosen in this study with two considerations. (1) The base period should be long enough to include at least one business period which allows sufficient time for one turn-over of business; and (2) homogeneity with respect to market conditions over the base periods.

TABLE IV—PROJECTED NUMBER OF SELLERS

Sellers arranged in ascending order	Number of sellers in 1966-67	Projected number in 1981-82 based on P ₁	Number of sellers in 1969-70	Projected number in 1981-82 based on P ₂
Handling first				
67 per cent	7	23	9	17
Next 13 per cent	3	10	5	9
Next 15 per cent	9	15	12	21
Last 5 per cent	13	11	11	24

TABLE V—PROJECTED NUMBER OF BUYERS

Size category	Number of firms in 1966-67	Projected number in 1981-82 based on P ₃	Number of firms in 1969-70	Projected number in 1981-82 based on P ₄
Handling first				
50 per cent	5	25	7	61
Next 30 per cent	9	52	16	50
Next 15 per cent	15	64	27	50
Last 5 per cent	38	87	64	88

These base periods have been used in developing the transition probabilities. Movements of firms between categories during each of these periods are recorded. A fifth category is created to accommodate the firms leaving the market and also to include potential entrants into the market. Based on these firm movements transition probabilities are developed as follows:

$$P_{ijt}^A = \frac{m_{ijt}}{\sum_{i=1}^n m_{ijt}}$$

10. *op. cit.*

11. *op. cit.*

where \hat{P}_{ijt} = estimated probability that a firm in i th category moves into j th category in a given t th base period; and

m_{ijt} = number of firms in i th category in the beginning of base period t , moving into j th category by the end of t th base period.

Such probabilities are, thus, calculated for all categories for the buying sides and selling sides separately. Hence, matrix P formed by \hat{P}_{ijt} , for selling and buying sides for the two base periods are:

For sellers

for 1966-67 to 1969-70 period

$$P_1 = \begin{bmatrix} 0.8571 & 0.1429 & 0.0000 & 0.0000 & 0.0000 \\ 0.6667 & 0.3333 & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.2222 & 0.5556 & 0.2222 & 0.0000 \\ 0.0769 & 0.0000 & 0.1539 & 0.4615 & 0.3077 \\ 0.0000 & 0.0001 & 0.0005 & 0.0003 & 0.9991 \end{bmatrix}$$

for 1969-70 to 1972-73 period

$$P_2 = \begin{bmatrix} 0.8889 & 0.1111 & 0.0000 & 0.0000 & 0.0000 \\ 0.2000 & 0.8000 & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.4167 & 0.4167 & 0.1666 \\ 0.0000 & 0.0000 & 0.3636 & 0.4546 & 0.1818 \\ 0.0002 & 0.0001 & 0.0005 & 0.0006 & 0.9986 \end{bmatrix}$$

For buyers

for 1966-67 to 1969-70 period

$$P_3 = \begin{bmatrix} 0.8000 & 0.2000 & 0.0000 & 0.0000 & 0.0000 \\ 0.3333 & 0.5556 & 0.0000 & 0.1111 & 0.0000 \\ 0.0000 & 0.4000 & 0.5333 & 0.0667 & 0.0000 \\ 0.0000 & 0.0000 & 0.2632 & 0.3684 & 0.3684 \\ 0.0000 & 0.0004 & 0.0009 & 0.0048 & 0.9939 \end{bmatrix}$$

for 1969-70 to 1972-73

$$P_4 = \begin{bmatrix} 0.8571 & 0.0000 & 0.0000 & 0.0000 & 0.1429 \\ 0.4375 & 0.3125 & 0.0625 & 0.0625 & 0.1250 \\ 0.0000 & 0.4074 & 0.2963 & 0.1852 & 0.1111 \\ 0.0156 & 0.0625 & 0.1875 & 0.3594 & 0.3750 \\ 0.0001 & 0.0011 & 0.0017 & 0.0046 & 0.9925 \end{bmatrix}$$

Test for the Assumption of Stable Transition Probabilities

The transition probabilities developed from two base periods separately for the selling side and buying side are made use of in the statistical test following the procedure outlined in Padberg.¹²

The chi-square value obtained for the selling side is 12.44 and for the buying side it is 9.4 at 20 degrees of freedom. The table chi-square value for 20 degrees of freedom at 5 per cent level of significance is 31.254, which is greater than the calculated values. Therefore, the null hypothesis that the transition probabilities are stable is accepted with 95 per cent confidence for both selling and buying sides.

PROJECTION OF SIZE-DISTRIBUTION OF FIRMS FOR 1981-82

Since both the basic assumptions underlying the Markov chain process are found to be empirically valid, this technique is used to project the distribution of firms in different categories for the year 1981-82 as follows:

$$S_2 = S_1 \cdot P$$

where S_1 is a row vector, the elements of which are the number of firms in different categories in the first year of a base period; and

P is the transition probability matrix derived from the base period;

S_2 is a new vector representing the number of firms in different categories after the end of one base period (*i.e.*, in the third year in our case since the base period is of three years).

Finally, for 1981-82

$$S_4 = S_3 \cdot P = S_2 \cdot P^2 = S_1 \cdot P^3$$

where S_4 is the vector containing the projected number of firms in different categories for 1981-82.

Also, the matrix P may be used to obtain 'equilibrium distribution of firms'.¹³ This means that the size-distribution will not change with any more passage of time. Adelman¹⁴ explained that this equilibrium is achieved not because of the cessation of firm growth or decline but by the compensatory movements of firms.

In this study, the equilibrium size-distribution is not presented due to space limitations.

Projected Number of Sellers and Buyers

The number of sellers in each of the four categories projected for 1981-82 is presented in Table IV. The projections differ by their base periods for the last category. 1966-67 to 1969-70 base period projections suggest a decrease in the number of largest firms in 1981-82 to 11 from 13 in 1966-67. But the projections based on 1969-70 to 1972-73 base period indicate an increase in

12. *op. cit.*

13. Padberg, *op. cit.*

14. I. G. Adelman, "A Stochastic Analysis of the Size-Distribution of Firms", *Journal of American Statistical Association*, Vol. 53, No. 5, December 1958, pp. 893-904.

the number of firms for the last category. The decline in the number of sellers in 1972-73 in reality (Table I) only suggests that the increase in the number of sellers may not be as great as suggested by projections based on P_2 (1969-70 to 1972-73 base period) probabilities. Market arrivals increased by over 100 thousand quintals during the period from 1969-70 to 1972-73 compared to an increase of less than 75 thousand quintals during the period from 1966-67 to 1969-70 (Table I). During the period from 1966-67 to 1969-70 the average arecanut price increased slightly by less than Rs. 100 per quintal, but during 1969-70 to 1972-73 the average price declined by more than Rs. 200 per quintal (Table I). Such differences between the base periods, though statistically not significant, could have caused the transition probabilities leading to divergent projections. But the overall trend is an increase in the number of sellers in 1981-82, suggesting a more competitive structure for the selling side in 1981-82.

For 1981-82, the number of buying firms in all the four categories is estimated to increase under both base periods. The differences in projections using two different base periods are again due to the differences in market conditions during 1966-67 to 1969-70 and 1969-70 to 1972-73. The increase in the number of firms is greater in the categories of largest and smallest firms than in other categories. A sharp increase in the total number of buying firms from 159 in 1972-73 to 249 in 1981-82 shows a shift towards a more competitive structure for buyers.

IMPACT OF MARKET STRUCTURE CHANGES ON ARECANUT PRICES

The market performance is dependent on the market structure, among many other variables. The price of the product is one of the variables reflecting market performance.

A simple analysis of the impact of changes in the market structure on arecanut prices in the market was made using regression analysis. Several regression models were tried and the model which performed reasonably well is reported below.

$$P_{tm}^{OLS} = 1171.1254 + 318.0234B_t - 1139.8014S_t \\ 421.00*** \quad 469.59 \quad 196.97*** \\ + 0.5692M^2 - 35.2717T \\ 0.15*** \quad 7.48***$$

$R^2 = 0.64$ $n = 96$ $MSE = 4608.04$
 $DW = 3.15$ First order autocorrelation coefficient = 0.5154

$$P_{tm}^{GLS} = -136.8191 + 1527.8325B_t - 365.6008S_t \\ 552.41 \quad 620.48** \quad 273.95 \\ + 0.3505M^2 - 12.8485T \\ 0.15** \quad 10.47$$

$R^2 = 0.37$ $n = 96$ $MSE = 2754.38$

where P_{tm} = average price of arecanuts (Mangalore supari variety) in the market in m th month ($n = 1, 2, \dots, 12$ with September = 1) in t th year ($t = 1, 2, \dots, 8$ with 1965-66 = 1);

B_t = coefficient of inequality for buyers in t th year;

S_t = coefficient of inequality for sellers in t th year;

n = number of observations; and

M and T = proxy variables for seasonal and trend effects;

Superscripts OLS and GLS indicate the method of estimation of the model. GLS is used to correct for first order autocorrelation of residuals.

Another variable whose effect on price was found to be statistically insignificant in the presence of variables retained in the model was the quantity of market disposals of arecanuts. The proxy variables M^2 and T perhaps adequately represent the effect of market disposals on price. The quadratic effect of M rather than its linear effect was found to have significant effect on price. Correcting for autocorrelation in residuals, of order higher than one, did not significantly change the results.

In both the regression models estimated above, changes in buyers and seller concentrations have opposite effects on the price of arecanuts. While increase (decrease) in buyer concentration increases (decreases) the market prices, increase (decrease) in seller concentration decreases (increases) the market price of arecanuts. Although these results are very preliminary and superficial the hypotheses for explaining the results may be formulated as follows:

(a) As increasingly only a few buyers control large proportions of market transactions, the price competition among buyers will result in higher prices in the market for arecanut.

(b) As increasingly fewer sellers control large proportions of market transactions, the sellers (or the commission agents whose income is a percentage of the price) attempt to sell a large amount of the commodity by selling at a relatively lower price.

Several factors may contradict the possibility of the above hypotheses. For example, the marketing co-operative which acts as a seller may not engage in the kind of competition which other firms attempt. More information about the 'market conduct' can verify the validity of the above hypothesis. However, it appears from our results that changes in market structure have significant impact on price of arecanut.

CONCLUSIONS

Analysis of seller and buyer concentration, and size-distribution in an agricultural market in India suggests an increasing degree of competitiveness in the market structure. Markov chain analysis also projects a distribution of firms characterized by more equal distribution of share of market transactions. The analysis presented here, however, reveals only some of the information relevant in describing the conditions in a market. Consideration of information on market conduct and performance along with the information on the market structure presented in this paper may yield useful implications for those concerned with agricultural marketing in the developing nations.