Vol XLIII
No. 4

OCTOBER-
DECEMBER
1988

ISSN 0019-5014

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

Ind. Jn. of Agri. Econ.
Vol. 43, No.4, Oct.-Dec. 1988

A CHANGING PATTERN IN THE INTEGRATION OF GROUNDNUT MARKETS

The regulation of markets in India with one of the prime objects as stabilising price movements of agricultural products through perfect dissemination of price information of other (spatial and vertical) markets results in *(i)* free flow of price information and *(ii)* sustaining the uniform price movements across markets. Free flow of price information, being an indicator of marketing efficiency, ensures spatial and vertical market integration. Besides, with a perfect parity pricing, the intra-product (or intra-market) integration, *i.e.*, among the prices of pod, kernel, oil and cake, can also be viewed. The earlier literature on the subject showed that the groundnut price movements were highly correlated among the markets (see Parthasarathy, 1961; Jasdanwala, 1966; Cummings, Jr., 1967; Lele, 1967; Kahlon, 1970; Subbarao, 1978; Kulkarni, 1963). The prices of groundnut products exhibited more or less uniform pattern over time. The degree of price variation among groundnut markets, however, was found to be significant in some of the studies. Among the agricultural commodities, wheat, paddy and jowar markets seemed to be better integrated.

However, the groundnut market integration is observed not only in one product prices (say oil), but also with other product prices (say kernel or pod). Here, if it is so, one may expect the phenomenon of 'transitivity' effect on product prices, hence, leading to intra-market integration. More clearly, the correlation between oil prices, say in 'A' and 'B' markets and between oil and pod prices in 'B' market can bring out the correlation between 'oil' price in 'A' market and 'pod' price in 'B' market. Thus the market integration should be viewed through inter- and intra-markets simultaneously. Further, if 'A' and 'B' primary markets are predominant in oil and pod transactions respectively, one should analyse the price behaviour between 'A' and 'B' primary markets. These aspects need further investigation.

In this context, the paper has the following objectives : *(i)* to examine a significant evidence in groundnut marketing in terms of inter-market integration and intra-market integration, *i.e.*, integration between product prices in each market; *(ii)* to study whether inter-market integration is more evident with regard to the major product(s) in which the particular market is specialised. In other words, whether information flows between that market and other markets will be mainly confined to the product that is being specialised; and *(iii)* to find out whether the price signals (leading to inter-market integration) between primary markets will depend upon the interests/activities of the major participants of the system.

APPROACH

To examine the first objective, the three methods adopted are : the trends of monthly average product prices in the selected markets; the correlation coefficients between *(i)* the markets for each product and *(ii)* products for each market; and coefficient of variation (C.V.) for each product prices in the selected markets. The canonical correlation method is adopted for examining the other two objectives.

Canonical Correlation

This method attempts to find out the product identification in inter-market integration. One or more linear combinations of the product prices between primary markets describe the associations within the sets of prices between the markets. The technique of canonical correlation lies in finding two linear combinations, one of the variables in one set and the other of the variables in the other set that have maximal correlation (Pillai, 1960). The two linear combinations are so chosen that one is the best linear combination of the set of data for one variable for predicting that of the other set of data for the other variable. The canonical correlation analysis seeks to define the correlation (or set of correlations) between two vector random variables. Specifically, the model[1] is as follows :

$$Z = \sum_{i=1}^{4} \alpha_{it}^{1} x_{it}^{1}$$

$$W = \sum_{i=1}^{4} \beta_{it}^{2} x_{it}^{2}$$

determine the coefficients α_{it}^{1} and β_{it}^{2} so that the correlation between Z and W is maximised.

where X_{1t} = price of pod for t th period in Rs. per quintal;
X_{2t} = price of kernel for t th period in Rs. per quintal;
X_{3t} = price of oil for t th period in Rs. per quintal;
X_{4t} = price of oilcake for t th period in Rs. per quintal;
t = number of monthly observations, 1,2,......, 222. Out of which 1, 2,......, 108 refer to period before regulation and 109, 110,......., 222 post-regulation; Superfixes 1 and 2 are markets 1 and 2 ; and α and β are the coefficients of the variables.

One of the earlier studies by Waugh (1942) considers the problem of relation between meat consumption and meat prices. For that purpose, he had a sample of 20 (yearly) observations on X_1 = steer prices, X_2 = hog prices, X_3 = beef consumption and X_4 = pork consumption. The consumption data are per capita and the price data are 'deflated' by per capita income.

Data

The data relate to monthly prices of the groundnut pod, kernel, oil and cake of selected six markets of Rayalaseema region of Andhra Pradesh for the period 1963-81, collected from secondary source, *i.e.*, Directorate of Marketing, Hyderabad (India). The analysis is carried out separately for pre- and post-regulation period, *i.e.*, 1963-71 and 1972-81 respectively. The selected six markets are :

1. Regulated Markets (RM) — Kurnool and Adoni.
2. Partially Regulated Market with co-operative set-up (PRMC)—Anantapur.
3. Partially Regulated Market (PRM) — Nandyal.
4. Unregulated Markets (URM) — Cuddapah and Chittoor.

RESULTS

The findings are presented under three sections. The first section discusses the inter-market integration. The second section presents intra-market integration. The last section provides an integrated view of market integration.

Inter-Market Integration

The results on trend analysis do not contain any additional insights, but the parallel straight lines with positive slopes of prices in the markets show inter-market integration. The correlation analysis not only helps in confirming the proposition that there is inter-market association in product price movements, but also provides a measure of the extent of integration by the magnitude of correlation coefficients. The computed correlation coefficients[2] among monthly prices of primary markets for each year show that during the period, kernel and cake prices are not integrated in some years. Except in 1978 and 1980, the oil markets are highly integrated with the coefficient values more than 0.8. In pod markets, the inter-market integration is found to be in more than 50 per cent of the markets except for 1970 and 1974. It can be inferred that the extent of inter-market integration in terms of kernel and cake prices is lower than that of pod and oil prices. Since the transactions in most of the Rayalaseema markets are predominantly either in pod or in oil, the relatively low degree of inter-market integration in terms of kernal prices is possible.

The analysis of coefficient of variation[3] in monthly product prices shows a similar trend (*i.e.*, either increasing or decreasing) in all markets. In other words, any rise or fall in price variation in one market is well associated with similar fluctuations in price of all other markets in the region. Further, it can also be noticed that the price variability over time is narrowing down in respect of all product prices in all markets. This observation validates our proposition that the groundnut product prices are getting stabilised, *i.e.*, the role of seasonal factor on price deviations is contained/reduced.

The magnitudes of C.V.s for the different groundnut products also reveal that pod, kernal and oil markets are relatively more integrated than oilcake markets; and seasonal factor is less significant in all markets except for the year 1976. Further, it is also clear that barring the case of oilcake market, other product markets are (increasingly) attaining stability as indicated by the reduction in variability. The reduction in the C.V. may be due to the development of infrastructural facilities such as storage, transport, etc., and

TABLE I. PRICE CORRELATION MATRICES

Product	Anantapur (PRMC)				Adoni (RM)				Kurnool (RM)			
	Pod	Kernel	Oil	Cake	Pod	Kernel	Oil	Cake	Pod	Kernel	Oil	Cake
Pod	1.00	0.99	0.99	0.94	1.00	0.84	0.90	0.93	1.00	0.95	0.99	0.94
Kernel		1.00	0.99	0.93		1.00	0.79	0.70		1.00	0.94	0.91
Oil			1.00				1.00	0.84			1.00	0.91
Cake				1.00				1.00				1.00

Product	Nandyal (PRM)				Cuddapah (URM)				Chittoor (URM)			
	Pod	Kernel	Oil	Cake	Pod	Kernel	Oil	Cake	Pod	Kernel	Oil	Cake
Pod	1.00	0.98	0.96	0.87	1.00	0.99	0.94	0.93	1.00	0.96	0.92	0.82
Kernel		1.00	0.97	0.87		1.00	0.94	0.93		1.00	0.93	0.85
Oil			1.00	0.87			1.00	0.91			1.00	0.87
Cake				1.00				1.00				1.00

also their accessibility to the farm community and other participants in the market system. The C.V. in oil prices is fluctuating over time.

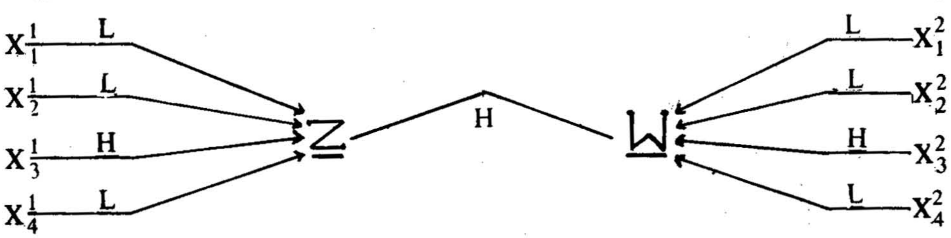
Intra-Market Integration

The respective rates of increase in the monthly prices per quintal of pod, kernel, oil and oilcake ('b' coefficients in trend lines) are in the proportion of 1.2: 1.6 :4.0: 0.6. The physical/technical conversion ratios among pod, kernel, oil and oilcake in Rayalaseema region (Patnaik, 1985) (100 kg. of pods = 72 kg. of kernels = 27.36 kg. of oil + 43.92 kg. of oilcake) are 1 : 0.72 : 0.27 : 0.44 respectively. The rate of increase in product prices when multiplied by the corresponding (technical) conversion ratios should yield same value for all the products and this is an indicator of the efficiency of the groundnut markets. When multiplied, price ratios of pod : kernel : oil + cake are of the order of 1 : 0.96 : 1.12. These ratios imply that pod and kernel markets are well integrated. This means that oil prices are higher than the equivalent pod/kernel prices. The differences in these ratios could be partly due to processing costs. If the differences in price ratios exist even after adjusting for processing costs, it indicates that it is more beneficial to operate in oil and cake markets, *i.e.*, the markets are less efficient (from the producer's point of view).

The correlation matrices among monthly product prices for the period 1963-81 of each market are presented in Table I. The table shows that the product prices within a market are highly integrated with the correlation coefficient values lying in the range of 0.8 – 1.0. In Adoni (regulated) market, the correlations between the prices of kernel and oil and kernel and cake are slightly lower, *i.e.*, the coefficient value is 0.79 and 0.70 respectively. Thus the extent of integration among products through correlation analysis is observed to be statistically significant. In support of this, the differences between minimum and maximum C.V.s of product prices across the markets over time and the closeness in C.V.s across products coupled with the high degree of correlations indicate intra-market integration and efficient conversion of final product price into raw product price.

Integrated View of Market Integration

The composition of canonical variates is shown in the following flow diagram.



L = Some very small value, *e.g.*, nearly zero.
H = Some very large value, *e.g.*, nearly one.

The canonical variates of various compositions are computed. In Tables II and III, those compositions of canonical variates that maximise the canonical

TABLE II. CANONICAL CORRELATIONS AND CANONICAL VARIATES (WEIGHTS)—MARKETWISE BEFORE REGULATION

Markets	Variable	Adoni		Chittoor		Nandyal	
		Left	Right	Left	Right	Left	Right
Anantapur	Pod variate	0.35	0.10	0.02	0.11	− 0.42	0.66*
	Kernel variate	0.13	0.05	0.30	0.08	0.41	0.22
	Oil variate	0.79*	0.86*	0.85*	0.99*	0.98*	0.23
	Cake variate	0.23	0.50	− 0.005	− 0.02	0.50	0.68*
	Canonical correlation	0.9896		0.9914		0.9640	
	Lambda value	0.0102		0.0125		0.0459	
	Chi-square value	472.21		453.39		318.89	
Adoni	Pod variate			0.12	0.08	0.15	0.55*
	Kernel variate			− 0.02	0.03	0.04	0.25
	Oil variate			0.86*	0.99*	0.77*	0.20
	Cake variate			0.25	0.12	0.77*	0.77*
	Canonical correlation			0.9852		0.9679	
	Lambda value			0.0184		0.0394	
	Chi-square value			413.40		334.82	
Chittoor	Pod variate					− 0.15	0.54*
	Kernel variate					− 0.12	0.24
	Oil variate					0.96*	0.39
	Cake variate					0.49	0.71*
	Canonical correlation					0.9684	
	Lambda value					0.0523	
	Chi-square value					305.48	
Nandyal	Pod variate						
	Kernel variate						
	Oil variate						
	Cake variate						
	Canonical correlation						
	Lambda value						
	Chi-square value						
Kurnool	Pod variate						
	Kernel variate						
	Oil variate						
	Cake variate						
	Canonical correlation						
	Lambda value						
	Chi-square value						
		Kurnool				Cuddapah	
Anantapur	Pod variate	0.33	0.23			0.21	− 0.16
	Kernel variate	0.24	0.22			0.17	0.24
	Oil variate	0.95*	0.88*			0.76*	0.95*
	Cake variate	0.18	0.36			0.04	0.15
	Canonical correlation	0.9934				0.9914	
	Lambda value	0.0060				0.0064	
	Chi-square value	529.03				522.44	

(Contd.)

TABLE II *(Concld.)*

Markets	Variable	Kurnool Left	Kurnool Right	Cuddapah Left	Cuddapah Right
Adoni	Pod variate	0.09	0.17	0.11	0.02
	Kernel variate	0.05	0.08	0.003	− 0.08
	Oil variate	0.94*	0.85*	0.69*	0.90*
	Cake variate	0.55*	0.50	0.46	0.43
	Canonical correlation	0.9933		0.9904	
	Lambda value	0.0030		0.0056	
	Chi-square value	600.54		537.02	
Chittoor	Pod variate	0.14	0.41	− 0.02	− 0.16
	Kernel variate	0.02	− 0.02	0.16	0.16
	Oil variate	0.95*	0.89*	0.96*	0.96*
	Cake variate	0.05	0.18	0.02	0.16
	Canonical correlation	0.9846		0.9885	
	Lambda value	0.0197		0.0149	
	Chi-square value	406.68		435.63	
Nandyal	Pod variate	0.53*	0.44	0.42	− 0.33
	Kernel variate	0.18	0.57	0.13	0.06
	Oil variate	0.17	−0.20	0.10	0.85*
	Cake variate	0.65*	0.66*	0.39	0.41
	Canonical correlation	0.9660		0.9609	
	Lambda value	0.0443		0.0509	
	Chi-square value	322.51		308.22	
Kurnool	Pod variate			0.19	− 0.08
	Kernel variate			0.31	0.26
	Oil variate			0.53*	0.88*
	Cake variate			0.41	0.38
	Canonical correlation			0.9900	
	Lambda value			0.0073	
	Chi-square value			509.12	

* Shows the variate values are more than 0.5.

correlation between the two sets are presented for markets before and after regulation periods respectively. The canonical correlations in all markets are nearly one. The Chi-square value in all cases are found to be statistically significant. Among the canonical variates in the left side set of Anantapur market (Table II), only X_3^1 variate (weight) has the largest value. And in the right side set relating to Adoni market, the largest value is found in X_3^2 variate. Thus X_3^1 and X_3^2 are significant variables in those two sets that maximise the canonical correlation coefficient value 0.99 between the price sets of Anantapur and Adoni markets. Further, Adoni and Anantapur markets are predominantly oil markets, thus the price information flow from one market to another is found to be in oil prices. Similar analysis is made for other markets (Levine, 1984).

TABLE III. CANONICAL CORRELATIONS AND CANONICAL VARIATES (WEIGHTS) — MARKETWISE AFTER REGULATION

Markets	Variable	Adoni		Chittoor		Nandyal	
		Left	Right	Left	Right	Left	Right
Anantapur	Pod variate	0.65*	0.96*	− 0.26	0.45	0.16	0.63*
	Kernel variate	0.14	0.16	0.54*	0.81*	0.58*	0.55*
	Oil variate	0.27	0.05	0.96*	0.003	0.97*	0.48
	Cake variate	0.31	0.25	0.29	0.37	− 0.11	0.26
	Canonical correlation	0.9760		0.9711		0.9721	
	Lambda value	0.0159		0.0340		0.0247	
	Chi-square value	453.56		370.35		405.44	
Adoni	Pod variate			0.97*	0.60*	0.92*	0.55*
	Kernel variate			0.35	0.69*	0.53*	0.71*
	Oil variate			0.15	− 0.04	0.06	0.29
	Cake variate			0.16	0.41	− 0.08	0.32
	Canonical correlation			0.9582		0.9515	
	Lambda value			0.0466		0.0579	
	Chi-square value			335.74		312.02	
Chittoor	Pod variate					0.81*	0.47
	Kernel variate					0.84*	0.80*
	Oil variate					− 0.08	0.26
	Cake variate					− 0.20	0.25
	Canonical correlation					0.9527	
	Lambda value					0.0461	
	Chi-square value					336.97	
Nandyal	Pod variate						
	Kernel variate						
	Oil variate						
	Cake variate						
	Canonical correlation						
	Lambda value						
	Chi-square value						
Kurnool	Pod variate						
	Kernel variate						
	Oil variate						
	Cake variate						
	Canonical correlation						
	Lambda value						
	Chi-square value						
		Kurnool				Cuddapah	
Anantapur	Pod variate	− 0.01	0.70*			− 0.46	− 0.20
	Kernel variate	0.09	0.07			0.80*	0.73*
	Oil variate	0.98*	0.69*			0.37	0.20
	Cake variate	0.05	− 0.18			0.61*	0.62*
	Canonical correlation	0.9908				0.9786	
	Lambda value	0.0017				0.0158	
	Chi-square value	697.78				154.29	

(Contd.)

TABLE III (*Concld.*)

Markets	Variable	Kurnool		Cuddapah	
		Left	Right	Left	Right
Adoni	Pod variate	0.90*	0.94*	0.72*	− 0.05
	Kernel variate	0.20	0.20	0.42	0.58*
	Oil variate	0.18	0.22	0.32	0.69*
	Cake variate	0.30	0.15	0.26	0.44
	Canonical correlation	0.9739		0.9691	
	Lambda value	0.0168		0.0226	
	Chi-square value	447.45		415.09	
Chittoor	Pod variate	0.46	0.64*	0.47	− 0.06
	Kernel variate	0.72*	0.28	0.63*	0.82*
	Oil variate	0.20	0.71*	0.08	0.46
	Cake variate	0.33	0.03	0.44	0.34
	Canonical correlation	0.9665		0.9601	
	Lambda value	0.0411		0.0551	
	Chi-square value	349.39		317.35	
Nandyal	Pod variate	0.55*	0.93*	0.37	− 0.19
	Kernel variate	0.08	0.07	0.21	0.94*
	Oil variate	0.31	0.27	0.25	0.23
	Cake variate	0.20	− 0.25	0.39	0.18
	Canonical correlation	0.9627		0.9451	
	Lambda value	0.0452		0.0840	
	Chi-square value	339.08		271.21	
Kurnool	Pod variate			0.45	0.11
	Kernel variate			0.32	0.71*
	Oil variate			0.41	0.39
	Cake variate			0.37	0.58
	Canonical correlation			0.9815	
	Lambda value			0.0051	
	Chi-square value			577.45	

* Shows the variate values are more than 0.5.

The selected markets have different product transactions. The major product transactions in the markets are :

Sr. No.	Market	Product
1.	Kurnool (RM)	Oil and pod
2.	Adoni (RM)	Oil, pod and cake
3.	Anantapur (PRMC)	Oil and pod
4.	Nandyal (PRM)	Pod
5.	Cuddapah (URM)	Kernel
6.	Chittoor (URM)	Kernel

It is observed from the field survey that the transactions take place in Chittoor and Cuddapah at market/production centres in the form of kernel. In the rest of the markets, the transactions are primarily in the form of pods. The farmers at Anantapur collect the pod price information from Adoni market which has emerged as an important market for pods after regulation. Anantapur market during the period of study and with a large number of processing units has emerged as an oil market.

The association between the product prices which have larger values (> 0.5) of canonical variates is given in Table IV. The analysis shows that the association/correlation between the prices of one/more products of primary markets is found to be significant, except between Nandyal and Cuddapah markets. During the period of study the canonical variates of Nandyal and Cuddapah markets explain that the oil price information flow from Cuddapah to Nandyal is significant. But Cuddapah market does not receive price information about any product from Nandyal market.

The analysis of two periods, before and after regulation, shows that the price flow before regulation among primary markets is in terms of oil prices, except in Nandyal which is mainly confined to cake prices during the period. After regulation, the markets seem to have emerged as pod markets and price information is found to be mainly in terms of producers' transaction prices, *i.e.*, either pod or kernel prices. Table V presents the changes in the nature of markets before and after regulation in terms of price flow.

Thus the inferences from the analysis are :

1. Prior to regulation, *i.e.*, during the sixties, most of the markets were oil markets and inter-market integration was achieved by flow of information in oil prices.
2. During the seventies, the selected markets turned out to be pod/pod and oil markets. Due to the establishment of decorticating units, Cuddapah, Chittoor and Nandyal have emerged as kernel markets, and dissemination of information on kernel prices has led to inter-market integration.

This phenomenon could be due to the following: The entry of groundnut producers in the primary markets on a large scale was not evident and the primary markets were dominated by oil brokers/traders and oil merchants. These participants would like to collect information on the prices received by their counterparts in other markets. Thus price flows were mainly related to oil during the sixties.

With the development of markets and government intervention in the form of regulation, the groundnut producers are participating in a significant way and their transactions are usually in pods (kernel in a few markets such as Chittoor). The prices paid to the farmers in the other primary markets are of interest to these major participants. Thus the market integration is achieved by transmission of price signals with regard to pods.

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The author is grateful to Prof. R. Radhakrishna, Director, Centre for Economic and Social Studies, Hyderabad, Dr. K. H. Rao, National Institute of Rural Development, Hyderabad and to the anonymous referees of this Journal for their valuable comments on the earlier draft.

TABLE IV. INTER-MARKET PRODUCT PRICE INTEGRATION IN THE SELECTED MARKETS OF RAYALASEEMA

Sr.No. Markets	1963-71 (Before regulation)					1972-81 (After regulation)				
	Kurnool (RM)	Anantapur (PRMC)	Nandyal (PRM)	Cuddapah (URM)	Chittoor (URM)	Kurnool (RM)	Anantapur (PRMC)	Nandyal (PRM)	Cuddapah (URM)	Chittoor (URM)
1. Adoni (RM)	$O/C^{+}-O$	O – O	$O/C-P^{+}/C$	O – O	O – O	P – P	P – P	P – K	$P-O/K^{+}$	$P/K^{+}-K/P^{+}$
2. Kurnool (RM)		O – O	$C-C/P^{+}$	$O^{+}-O$	O – O		P/O – O	$P-P^{+}$	$P^{+}-K$	O/P – K
3. Anantapur (PRMC)			O – C/P	O – O	O – O			$O/K^{+}-P/K^{+}$	K/C – K/C	$O/K^{+}-K$
4. Nandyal (PRM)				(L) – O	$C/P^{+}-O$				(L) – K	K – K/P
5. Cuddapah (URM)					O – O					K – K

Source: Drawn from Tables II and III.

+ Canonical variate has a value lying in the range (0.5 – 0.6).
(L) = Very low values of all variates in the set (< 0.5)
O stands for oil prices.
C stands for cake prices.
K stands for kernel prices
P stands for pod prices.

TABLE V NATURE OF MARKETS BEFORE AND AFTER REGULATION

Markets	1963-71	1972-81
Adoni	Oil	Pod
Kurnool	Oil	Pod and oil.
Anantapur	Oil	Pod and oil
Nandyal	Cake and pod	Pod and cake
Cuddapah	Oil	Kernel
Chittoor	Oil	Kernel

Source: Drawn from Table IV.

NOTES

1. For details of the canonical correlation model, refer Dhrymes (1974) and Tintner (1946).
2. The annual correlation coefficients among markets for each product are not reported in the paper.
3. The results on coefficients of variation are not reported in the paper.

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