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Vol XLVII
No. 1

ISSN 0019-5014

JANUARY-
MARCH
1992

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

Ind. Jn. of Agri. Econ.
Vol. 47, No. 1, Jan.-March 1992

Spatial Pricing Efficiency in Groundnut Markets in Tamil Nadu

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Market integration across space is evaluated using zero-order price correlation coefficients and spatial price differences, referred to as transport margin. Several researchers have tested for spatial integration of markets on the assumption that it ensures the existence of free markets and free markets ensure Pareto optimal resource allocation across space. It has been demonstrated by Newberry and Stiglitz (1984) that the existence of free markets, alone, need not necessarily guarantee the existence of Pareto optimal allocation of resources. Further, Harriss (1979) aruges that spatially integrated markets need not necessarily guarantee the existence of free markets. We do not venture into the controversy on free markets and Pareto optimality and also agree that spatial integration of markets need not necessarily guarantee the existence of free markets.

Given that spatial integration does not guarantee the existence of free markets, the question that arises is: why do we study spatial price relationships? Price movements, *per se*, in related markets merit attention as they reflect or represent the movements of equilibrium paths of demand and supply for a particular produce. The degree of proximity of the price movement and the speed and accuracy of price adjustments need to be assessed, as these help to understand the speed and accuracy of diffusion of price information or the efficiency of price transmission between markets. We believe that price transmission or information spread is a pre-requisite for achieving the efficient allocation of resources across space, though it does not necessarily guarantee the Pareto optimal allocation of resources. Information spread also helps the market intermediaries to identify the substitutional possibility between markets. In this regard, the statistical tools that are normally employed like the zero-order price correlation coefficients and absolute spatial price differences are too simple and need to be modified, as will be demonstrated in the following sections. Given the motivation for this study, the paper is divided into seven sections: Section I deals with the adequacy and inadequacy of correlation coefficient analysis. Section II discusses the problems with absolute transport margin analysis and the modifications. Section III deals with the source of data. Section IV provides the zero-order correlation coefficient analysis of absolute prices. Section V deals with correlation analysis of residuals of price series. Section VI provides the regression analysis of residuals of price series, and Section VII presents the concluding remarks.

ADEQUACY AND INADEQUACY OF CORRELATION COEFFICIENT ANALYSIS

For the sake of simplicity, let us assume that there are only three markets A, B and C, of which A is a producing centre, B is a final demand market and C is an isolated market for a homogeneous product. It is assumed further that supply is fixed in the short run in all the three markets, and it is also assumed that markets A and B are equi-distance to C. To

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The author is extremely grateful to U. Sankar, Department of Econometrics, University of Madras and K. Nagaraj and A. Vaidyanathan, Madras Institute of Development Studies for their useful comments. He is also thankful to R. Premakumari and C. Narasimhan for wordprocessing assistance.

start with, let us suppose that all three markets are in equilibrium. The equilibrium prices satisfy the conditions that $P_{tB} = P_{tA} + K_A$, $P_{tB} = P_{tC} + K_C$ and $P_{tA} = P_{tC}$ where K_A and K_C are constants equal to the transportation costs between A and B and between B and C respectively. In this hypothetical situation, the price that prevails in C reflects its own demand and supply condition, which is exactly synchronous with the demand and supply conditions in the other two centres. It should be observed from this imaginary situation that there exists no substitutional possibility and that integrating spatially C with A or B will not help to achieve a better spatial price adjustment.

Let us suppose that in B, the price rises due to an upward shift in demand curve. Price rise in centre B will attract more supply from centre A, as A and B are linked. Increased flow of commodity from A to B reduces the available supply in centre A, which results in increase in price that prevails at centre A. This adjustment continues till a new equilibrium is reached. The new equilibrium between A and B will satisfy the condition that $P_{t+1B} = P_{t+1A} + K_A$.[1] In this new equilibrium situation, K_A will be equal to K_A in the initial period, if and only if price increase in centre B due to increase in demand is exactly transmitted to centre A. Correlation coefficients worked out between prices in centres A and B will be equal to 1.0 as these markets are integrated. Correlation coefficients estimated between the prices of centres A and C, and B and C, will be equal to zero indicating the existence of substitutional possibility. In this situation, as is evident, correlation coefficients equal to 1.0 reflect spatial integration, while correlation coefficients equal to zero indicate spatial disintegration. It appears that correlation analyses of prices between markets by different researchers are based on this simple hypothetical situation.

In order to have a complete understanding of what correlation coefficients indicate and to make the inference from correlation coefficient analysis meaningful, it is fruitful to consider a few other situations. Consider a second situation in which all earlier assumptions are valid; and imagine that the demand curve in centre C also shifts upward. Further, assume that the new equilibrium reached in centre C in this second situation exactly synchronises with the new equilibrium reached between centres A and B; and which fulfils the equilibrium conditions listed in the first situation considered. Correlation coefficients worked out between prices of any two centres will be equal to 1.0. In this situation correlation coefficients of prices between the centres A and B indicates spatial integration while those between A and C, and B and C indicate association of prices.

In a third situation, instead of assuming a shift in demand for the produce, assume that transportation cost between A and B goes up. The increase in the cost of transportation leads to increase in price that prevails in centre B, while prices in the other centres remain constant. Even though markets A and B are spatially integrated, correlation coefficient of prices in centres A and B will be equal to zero. And also, the spatial price difference, that is transport margin, will be exactly equal to transfer cost.

In a fourth situation, instead of assuming that market C is an isolated market, assume that 'C' is also a final demand centre. Now centre 'C' also derives its supply from centre 'A'. Upward shift in demand in centre 'B' results in increase in price at centre 'B'. This increase in price at centre 'B' attracts more supply from centre 'A' which results in reduction in supply for centres 'A' and 'C'. This reduction in supply leads to increase in prices in these centres. The process of adjustment continues till new equilibria are reached simultaneously in all markets. The new equilibria will satisfy the conditions, $P_{t+1B} = P_{t+1A} + K_1$ and

$P_{t+1C} = P_{t+1A} + K_2$, where K_1 and K_2 are transport margins equal to transportation costs between centres 'A' and 'B' and between 'A' and 'C' respectively. Price correlation coefficients worked out between prices that prevail in any two centres will be equal to 1.0. Correlation coefficients of prices between 'A' and 'B' and between 'B' and 'C' are due to spatial integration and those between the prices of 'C' and 'B' are due to price transmission through common supply centre 'A'.

The above examples have concentrated only on price changes in the short run and is restricted to few markets. To generalise these examples, suppose that there are 'M' supply centres, 'N' final demand centres and 'K' intermediary or non-final demand centres form a system of free markets. Further, assume that there exists a group of markets which are outside the system and behave independently. Under this situation, it could be that the 'i'th final demand market and 'j'th non-final demand market that are elements in the free market system are not directly related through trade. However, there exists a 'k'th non-final demand market in the system, which is directly related to the 'j'th final demand market. The 'k'th and 'j'th non-final demand markets have common source of supply, *viz.*, 'r'th assembly market. Now, changes in prices that occur in the 'i'th final demand market are transmitted to 'j'th non-final demand market through 'k' and 'r'. Thus whatever happens in one market is transmitted to all other markets in the system either through direct or indirect trading connections, which help the system to reach equilibrium.

The isolated markets behave differently as changes that occur within the isolated markets do not get transmitted to other market centres. If correlation coefficients are worked out between the prices of different markets that form the system, all the price correlation coefficients will be equal to 1.0, while correlation coefficients of prices worked out between market centres that form the system and the group of markets that are isolated will tend to be zero. Correlation coefficients of prices approaching 1.0 indicate that the markets are either directly or indirectly related. Thus price transmission that takes place either through direct or indirect trading connections helps markets in the system to reach equilibrium simultaneously, which seems to be an appropriate situation in the real world. Correlation coefficients equal to zero indicate that the markets behave independently and that there exists substitutional possibility. Considering the various possibilities, it is strongly felt that correlation coefficients can be used to identify the price transmission between the markets to infer on substitutional possibilities between the markets. However, it is neither a sufficient measure to infer on direct trading linkages or physical flow of goods between markets nor on the market dependence in price formation.

As pointed out in the first example, the equilibrium path may be synchronous, indicating that there exists no substitutional possibility, due to externalities such as synchronous time trend in consumption and production, and seasonality in production and consumption. For this reason, it becomes essential to construct an index that adjusts for these externalities to infer on market dependence. One such index happens to be the correlation coefficients of residuals of price series between centres wherein the trend and seasonal movements in price series in different centres are eliminated and price fluctuations peculiar to each one of the centres are correlated with each other. Thus in this paper, we use both correlation coefficients of absolute prices and residuals of prices to infer on substitutional possibility between markets and market dependency.

So far, we have concentrated on establishing the use of correlation coefficient of absolute

price series and residuals of price series to infer on substitutional possibility and on market dependence, but have not dealt with a statistic to infer on the efficiency of price adjustments. Simply put, the degree of proximity of price movement between markets is analysed through price correlation coefficient and whether the proximity of price movement as reflected by zero-order price correlation coefficient is due to interdependency of markets in price formation is examined through correlation coefficients of residuals of price series between market centres. This in itself is not sufficient to establish that the market dependence results in efficient price formation or efficient price transmission between markets. The spatial price difference at different points of time need to be carefully examined. To this end spatial price difference analysis has been carried out by several researchers such as Cummings (1967), Gupta (1973), Uma Lele (1971), etc., on the assumption that spatial price differences at different points of time will be exactly equal to transfer cost if the markets function as competitive free markets. Problems with such analysis and the modification of the analysis are dealt with in the next section.

II

PROBLEMS WITH ABSOLUTE TRANSPORT MARGIN ANALYSIS AND THE MODIFICATIONS

Analysis of transport margin or spatial price differences rests on two crucial assumptions: unidirectional flow of commodity between markets, and uniformity of the produce transacted between markets. The first assumption requires that the markets considered must be physically connected and there must be direct flow of commodities from one to the other. As discussed earlier, the markets may be directly connected or indirectly connected and the real world trading pattern is complex. And hence the first assumption is *not* valid. However, one could still hold on to the expectation that spatial price differences may be either zero or equal to transfer cost depending on whether the spatial price differences worked out are between supply centres, and between supply centres and final demand or intermediary markets. Here again, it should be pointed out that this analysis depends on the second assumption that the produce transacted between markets is of uniform quality and that price differences arise, at a particular point of time, only due to transfer of the produce between markets. Considering the real world situation, this assumption too seems to be far from reality. In the real world price difference arises due to (1) quality differences in the produce transacted that arise due to intra- and inter-regional variations in agro-climatic conditions, (2) transportation cost, (3) advantage enjoyed by market centres by being located close to a final demand centre, (4) size of the markets and the resultant risk and uncertainty related to trading between them and (5) data defects. Realisation of this fact calls for modification in the analysis so as to take care of these elements of price difference between markets. In order to substantiate the importance of this problem, tables are provided from Uma Lele (1971) and Kainth (1973). One could see (from Table I) that while correlation coefficients of weekly wholesale prices of wheat between primary markets of Punjab and final demand market Delhi are well above 0.90, for a considerable number of weeks, the price differences are negative. And also, it could be seen from the same table that where the price differences are positive, the transportation cost exceeds price differences for large number of weeks. Similarly, in Kainth's study, correlation coefficients for wheat exceeds 0.70 while the price

differences are much lower than transfer cost (Table II). These results could not be explained in terms of *a priori* expectation, which may be because the various components of price variation may be acting in different direction. In this regard Uma Lele herself admits that

TABLE I. PRICE CORRELATION COEFFICIENTS, COST OF TRANSFER AND FREQUENCY DISTRIBUTION OF DIFFERENCES BETWEEN DELHI AND PRIMARY MARKET WHOLESALE PRICES OF WHEAT (JANUARY 1955 - NOVEMBER 1965)

Market	Correlation coefficient	Cost of transfer per qtl.		Frequency distribution of differences in prices per quintal							
				0	0-2.5	2.5-3.5	3.5-5.0	5.0-7.0	7.0-10.0	10.0-15.0	15.0 and 15.0
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Moga	0.95	4.96	A	119	256	91	49	43	8	3	0
			P	21.0	45.0	16.0	8.6	7.5	1.4	0.5	0.0
Khana	0.90	4.42	A	367	131	27	24	16	3	1.0	0
			P	64.5	23.0	4.7	4.2	2.8	0.5	0.2	0.0
Barnala	0.94	5.02	A	51	189	101	109	75	37	7	0
			P	9.0	33.2	17.7	19.1	13.2	6.5	1.2	0.0
Kotkapura	0.95	4.75	A	98	271	89	63	35	11	2	0
			P	17.2	47.6	16.6	11.1	6.1	1.9	0.3	0.0
Jagraon	0.94	4.37	A	191	232	60	54	23	8	0	1
			P	33.6	40.8	10.5	9.5	4.0	1.4	0.0	0.2

Notes: (1) A refers to absolute number of weeks
(2) P refers to percentage of number of weeks to total number of weeks.
Source: Lele (1971).

TABLE II. CORRELATION COEFFICIENT OF PRICES, PRICE DIFFERENCE OF WHOLESALE PRICE OF WHEAT AND PADDY AND COST OF TRANSFER IN THE FREE TRADE PERIOD

Market	Correlation coefficient	Price difference per qtl.	Cost of transfer per qtl.
(1)	(2)	(3)	(4)
		Wheat	
Amritsar - Delhi	0.90	1.16	6.70
Amritsar - Bombay	0.74	13.15	11.18
Amritsar - Hapur	0.90	0.92	7.22
Amritsar - Khagria	0.80	6.70	9.77
		Paddy	
Amritsar - Delhi	0.63	0.18	6.70
Amritsar - Bombay	0.41	0.33	11.18
Amritsar - Khagria	0.74	0.40	9.77

Source: Kainth (1973).

prices for comparable varieties of wheat across markets are not available. Thus this calls for an analysis that takes care of this problem. To this end, regression analysis of residuals of price series may be an appropriate one, wherein we assume that all price variations attributable to factors other than that of demand and supply fluctuations in the long run tend to be additive. To put it in simple words, variations in prices due to other factors are captured in intercepts of regressions of absolute prices which get eliminated with trend. The residuals of prices after eliminating time and seasonal trend reflects only irregular variations peculiar to each one of the centres and the equation takes the form:

$$RP_i = a_o + b_1 RP_j + v_t$$

where RP_i and RP_j are residuals of price series.

III

DATA

Monthly wholesale price series data of groundnut kernels for nine years (*i.e.*, 1975-76 to 1983-84) for ten centres have been collected for this analysis from the 'Annual Statistical Abstracts' of Tamil Nadu. The markets, for the sake of convenient presentation of the results, are classified as assembly markets[2] or producing centres and final demand markets. The first group consists of market centres such as Cuddalore, Panruti, Vellore, Pollachi, Erode, Jayankondam and Salem, while the second group consists of larger cities, such as Madurai, Coimbatore and Madras. These grouping is for convenient presentation of results rather than for strict classification of market centres for analyses, as most of the market centres that form the first group do not remain as assembly centres throughout an year. Depending on the arrival pattern, the markets act as assembly markets in certain months and for the rest of the period act as intermediary markets. Given this observation, the analyses are carried out with respect to Cuddalore, Panruti and Vellore, which are the important assembly and intermediary markets of the two major groundnut producing districts of Tamil Nadu for which data are provided in the 'Statistical Abstract' of Tamil Nadu.

IV

CORRELATION ANALYSIS OF ABSOLUTE PRICE SERIES

Analysis of correlation coefficients of absolute prices, as indicated earlier, has been carried out in relation to the three market centres, *viz.*, Cuddalore. Panruti and Vellore and the results are presented in Table III. From the table, it could be seen that all the 24 price correlation coefficients worked out for the period 1975-76 to 1983-84 are well above 0.90. Fifteen of the 24 correlation coefficients are above 0.97 and eight lie between 0.95 and 0.97,

TABLE III. CORRELATION COEFFICIENTS OF ABSOLUTE PRICES BETWEEN CENTRES (1975-76 TO 1983-84)

Centres	Madras	Coimba-tore	Madurai	Salem	Erode	Pollachi	Jayam-kondam	Panruti	Vellore
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cuddalore	0.977	0.975	0.978	0.961	0.951	0.970	0.964	0.975	0.977
Panruti	0.976	0.969	0.971	0.959	0.948	0.959	0.962	1.000	0.974
Vellore	0.988	0.983	0.983	0.974	0.974	0.976	0.969	0.974	1.000

Note: All the coefficients are significant at 5 per cent level.

while one in less than 0.95 but exceeds 0.90. These correlation coefficients indicate that there exists no great substitutional possibility between markets. Further, they indicate that the price movement in related markets are strongly associated. However, as indicated earlier, this analysis in itself is not sufficient to infer on market dependence and hence correlation coefficient analysis of residuals of price series has been carried out and the details are provided in the following section.

V

CORRELATION ANALYSIS OF RESIDUALS OF PRICE SERIES

Blyn (1973) and Harriss (1979) are of the opinion, as indicated earlier, that markets need not be highly dependent as pictured by the simple correlation coefficients. The homogeneous secular and seasonal trend elements present in the price series might push up the values of zero-order price correlation coefficients. Hence, the residuals of long price series after eliminating seasonal and time trends are correlated. This analysis will help us to identify if price variation due to irregular variations in demand and supply conditions in related markets are transmitted among them or not.

We assume that the price time-series are additive and that cyclical components are unimportant. The assumption that cyclical components are unimportant might look odd, but given the length of the time-series to be nine years, this assumption seems to be more plausible. Given the assumption that price series are additive and cyclical components are unimportant, the price series becomes P = PT+PS+PI, where PT is secular time trend in price series, PS is seasonal trend in price series and PI is the irregular movements in price series. In order to obtain the irregular or random components of price series: the trend component has been eliminated first, by assuming a linear trend; the estimated trend prices have been deducted from the actual or observed absolute prices. Secondly, the seasonal component of the detrend series has been calculated using twelve-month moving averages and this has been subtracted from the trend removed observations to obtain the irregular fluctuation in prices peculiar to each one of the centres.

The residual series of prices have been used to estimate the 24 residual price correlation coefficients, which are presented in Table IV. It could be observed from the table that 17

TABLE IV. CORRELATION COEFFICIENTS OF RESIDUALS OF PRICE SERIES BETWEEN CENTRES (1975-76 TO 1983-84)

Centres	Madras	Coimba-tore	Madurai	Salem	Erode	Pollachi	Jayam-kondam	Panruti	Vellore
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cuddalore	0.785	0.784	0.814	0.649	0.530	0.727	0.724	0.797	0.787
Panruti	0.828	0.745	0.763	0.663	0.562	0.627	0.724	1.000	0.797
Vellore	0.925	0.805	0.783	0.724	0.586	0.662	0.718	0.797	1.000

Note: All the coefficients are significant at 5 per cent level.

of the 24 correlation coefficients are above 0.7, and further all the residual correlation coefficients are significantly different from zero at 5 per cent level. The results imply that markets are interdependent in price formation, but the degree of dependence varies between the markets considered as indicated by the absolute value of the correlation coefficients. All residual price correlation coefficients between the three assembly market centres and final demand centres exceed 0.75, indicating that the degree of dependence is higher between these markets, while the coefficients between assembly markets of the two districts and the assembly markets of the other districts lie between 0.53 (Cuddalore-Erode) and 0.73 (Cuddalore-Pollachi), indicating that among assembly markets the degree of dependence in price formation varies considerably. However, the results do suggest that the markets are interdependent rather than independent in price formation.

VI

REGRESSION ANALYSIS OF RESIDUALS OF PRICE SERIES

Irregular variations in the price series of each of the final demand and producing centres of other regions are regressed on the irregular variations of the price series of the three market centres of South and North Arcot districts. The slope coefficient of each one of these regressions is tested for unity against the alternative hypothesis of not equal to unity, while the intercept in each one of these regressions is tested for zero against the alternative hypothesis of not equal to zero. Testing these null hypotheses will result in any one of the following four situations in each case (regression): *(a)* both the null hypotheses are not rejected, *(b)* both the null hypotheses are rejected, *(c)* the null hypothesis of slope coefficient equal to unity is not rejected, while the hypothesis of intercept equal to zero is rejected and *(d)* the null hypothesis of slope coefficient equal to unity is rejected, but the hypothesis of intercept equal to zero is not rejected. The first situation implies that the price transmission is instantaneous and efficient; while in the second situation the result implies that price transmission is not efficient as (1) the price transmission is not instantaneous and (2) the irregular fluctuations in the markets considered are taken advantage of by the traders. In the third situation, the price transmission is instantaneous, but not efficient, as the traders take advantage of the irregular fluctuations in the markets considered. The results in the fourth situation indicate that the price adjustment is not instantaneous, though the traders do not take advantage of the irregular fluctuations in the markets considered. Such situation might arise as a result of temporary bottlenecks either in the flow of information or the transfer of goods. Given the rationale for the analysis, the results are discussed in what follows.

We have estimated 24 regressions using the residuals of price series obtained for the different centres and the results are presented in Tables V and VI. In 15 of the regressions both the null hypotheses, *i.e.*, the slope coefficient equal to unity and the intercept equal to zero, could not be rejected. This result indicates that the price transmission is instantaneous and efficient. In the other nine regressions the hypothesis of slope coefficients equal to unity is rejected, while the hypothesis of intercept equal to zero could not be rejected. The results obtained in these nine regressions indicate that there are bottlenecks either in the transfer of goods or information as the adjustment is not instantaneous, but the irregular fluctuations in these markets are not taken advantage of by traders. This result calls for identifying the probable cause behind the observed results. Majority of the cases, where the slope coefficient is not equal to 1.0, are in the regressions of residuals between Panruti and other centres. For this centre, we could get the data on weekly arrival in the regulated market,[3] which indicates that Panruti has single peak arrival period and the peak occurs either in the months of February and March or March and April. Hence, in most part of the year, Panruti remains an importer, as either there is no arrival in the market or the arrival is insufficient to run the oil mills at Panruti. Thus this market centre imports from various other market centres depending on the arrival pattern in those markets. The size of the markets and the associated risk and uncertainty vary across these markets; a hypothesis that could be tested subject to the availability of data for the various market centres on market arrival, flow of commodity and transportation and communication facilities available, etc., which might cause lags in the adjustment process either because of bottlenecks in transportation or communication.

TABLE V. REGRESSION RESULTS OF RESIDUALS OF PRICES BETWEEN CENTRES (1975-76 TO 1983-84)

Dependent variables (price) (1)	Independent variables (price) (2)	Coefficient (b) (3)	Constant (4)	R^2 (5)	t-value for b=1 (6)
		(a) Cuddalore and final demand centres			
Cuddalore	Madras	0.999	0.395	0.616	0.012
		(0.081)	(3.644)		
Cuddalore	Coimbatore	1.021	-1.131	0.615	0.253
		(0.083)	(3.123)		
Cuddalore	Madurai	0.924	1.218	0.663	1.118
		(0.068)	(2.922)		
		(b) Panruti and final demand centres			
Panruti	Madras	0.969	0.695	0.686	0.456
		(0.068)	(2.594)		
Panruti	Coimbatore	0.892	-0.748	0.555	1.317
		(0.082)	(3.091)		
Panruti	Madurai	0.796	1.358	0.582	2.957*
		(0.069)	(2.992)		
		(c) Vellore and final demand centres			
Vellore	Madras	0.950	0.825	0.856	0.847
		(0.059)	(2.273)		
Vellore	Coimbatore	0.913	-0.584	0.648	1.261
		(0.069)	(2.602)		
Vellore	Madurai	0.787	1.475	0.613	3.435*
		(0.062)	(2.759)		

* Significant at 5 per cent level.
Note: Figures in parentheses are standard errors.

VII

CONCLUSION

Price integration or transmission, as the results of our analyses indicate, is efficient and instantaneous between markets, at least between majority of the markets considered. The techniques used in this paper, though simple, do offer results that are much better and less controversial compared to the techniques generally adopted. The results of correlation coefficients of residuals of price series between markets support the results of Blyn (1973) as they are lower than those obtained between prices of absolute price series. However, the analysis indicates that even the residuals of price series are well correlated and thus the high values of correlation coefficients of absolute price series between markets are not accidental. One might question why this study has stressed on instantaneous price adjustment rather than on short run and long run market integration as considered by Ravallion (1986). We firmly believe that, given the nature of time-series, *i.e.*, monthly price series used and the production period of the crop, it is essential to concentrate on instantaneous price adjustment, as is done in this paper. The production period is very short, which varies from 105 days to

TABLE VI. REGRESSION RESULTS OF RESIDUALS OF PRICES BETWEEN CENTRES (1975-76 TO 1983-84)

Dependent variables (price) (1)	Independent variables (price) (2)	Coefficient (b) (3)	Constant (4)	R^2 (5)	t-value for b=1 (6)
	(a) Cuddalore and producing centres outside the region				
Cuddalore	Salem	0.848 (0.102)	0.732 (3.925)	0.401	1.490
Cuddalore	Erode	0.767 (0.127)	0.442 (4.271)	0.281	1.835
Cuddalore	Pollachi	1.096 (0.107)	0.062 (3.455)	0.529	0.897
Cuddalore	Jayamkondam	0.701 (0.069)	0.669 (3.470)	0.524	4.333*
	(b) Panruti and producing centres outside the region				
Panruti	Salem	0.796 (0.093)	0.952 (3.464)	0.440	2.193*
Panruti	Erode	0.747 (0.114)	0.708 (3.830)	0.315	2.219*
Panruti	Pollachi	0.868 (0.111)	0.173 (3.609)	0.393	1.189
Panruti	Jayamkondam	0.657 (0.062)	0.423 (3.122)	0.524	5.532*
	(c) Vellore and producing centres outside the region				
Vellore	Salem	0.824 (0.081)	1.668 (3.441)	0.524	2.173*
Vellore	Erode	0.740 (0.105)	0.879 (4.481)	0.343	2.478*
Vellore	Pollachi	0.864 (0.101)	-0.575 (3.289)	0.438	1.345
Vellore	Jayamkondam	0.850 (0.085)	-0.846 (3.620)	0.515	1.762
	(d) Cuddalore and producing centres of same region				
Cuddalore	Vellore	0.902 (0.073)	-0.461 (3.105)	0.619	1.342
Cuddalore	Panruti	0.867 (0.068)	-0.223 (0.554)	0.635	1.956
	(e) Panruti and producing centres of same region				
Panruti	Vellore	0.841 (0.066)	-0.156 (2.620)	0.635	2.409*

* Significant at 5 per cent level.
Note: Figures in parentheses are standard errors.

120 days in North and South Arcot districts, the major groundnut producing districts of Tamil Nadu; and the crop is cultivated in three seasons. Thus between the end of one crop season and beginning of the other, there is a gap of hardly a month or two. Hence, price adjustment mechanism should ensure instantaneous price adjustment between related markets to help the producers to allocate their limited resources between crops efficiently. To this end, essentially this study has concentrated on instantaneous price adjustment between markets.

Received May 1991. Accepted July 1991.

NOTES

1. It is assumed that the length of time required for reaching a new equilibrium is one period.

2. The classification has been done for convenient reference. In the strict sense, none of the assembly markets or producing centres remains as an exporter of raw material throughout an agricultural year. The assembly market centres import kernel from other centres during their off-peak season. Hence, by producing centres we mean those markets that act as assembly markets as well as intermediary markets.

3. More than 80 per cent of the arrival of groundnut in South Arcot district is through regulated markets and that too in the form of kernel.

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