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How far do egg markets in India conform to the law of one price?

Sendhil R.[1], D. Babu[2], Ranjit Kumar[2] and K. Srinivas[2]

[1]Directorate of Wheat Research, Karnal (Haryana), India.
[2]National Academy of Agricultural Research Management, Hyderabad, India.

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Growing demand for eggs in India is also accompanied by its production at six per cent compound annual growth rate. The law of one price states that in an efficient market, all identical goods or commodities should have a single price. Johansen's cointegration test was done to identify whether spatially separated egg markets in India share a common linear deterministic trend and the law of one price holds true. Daily wholesale prices from January 2011 to November 2012 in major egg markets across the country were collected and analysed. Post checking for unit root employing the Augmented Dickey Fuller test statistic, cointegration results indicated a strong spatial integration between regional egg prices in the long-run implying the price co-ordination despite production in multiple regions. However, empirical results indicated that the law of one price does not hold true in Indian egg market.

Key words: Egg, cointegration, law of one price.

INTRODUCTION

Eggs are one of the nature's most perfectly balanced foods, containing proteins, vitamins and minerals essential for good human health. Besides nutritional value and culinary purpose, it has immense export potential. India ranks fifth in the world producing 66.45 billion eggs with an average growth rate of 6 per cent per annum (Karthikeyan and Nedunchezhian, 2013). The country stands fourth in exporting eggs to the rest of the world with a turnover of 40.76 US$ million by exporting 33.92 million tonnes of eggs. However, the country has imported 315 tonnes of eggs valued at 1.25 US$ million (FAO Stat, 2011).Among Indian states, Tamil Nadu accounts for the maximum egg production followed by Andhra Pradesh, Karnataka, Maharashtra, Gujarat, Madhya Pradesh, Odisha and North Eastern States (GoI, 2012; APEDA, 2012).

Poultry eggs are considered to be identical goods, which are marketed across the regions through well connected infrastructure facilities. The industry witnessed rapid strides in egg production till late 70's. However, rising primary input costs *viz.,* medicines, feed, electricity, taxes, etc., coupled with domination of middlemen had led to the crisis in 1981-1982 when egg prices fell drastically. Consequent to this, over 20,000 marginal poultry farmers lost their only source of livelihood in India. In order to prevent the ailing poultry sector, the National Egg Coordination Committee (NECC) was formed in 1982 as an institutional support to the poultry farmers. Since then, the NECC has been performing its designated functions, including declaration of market prices across various markets on daily basis, in order to enhance transparency in the egg marketing system (Saran and Gangwar, 2008). However, in the recent past, the soaring price of eggs across the country set a serious concern on the welfare of consumers. The difference in prices prevailed across egg markets in India raised the question of price integrity among the spatially separated markets.

*Corresponding author. E-mail: r.sendhil@gmail.com. Tel: +91 8929063645. Fax: +91 184 2267390.

Economic theory states that price variables should have a long-run equilibrium relationship and even if they drift away from equilibrium for a while, economic forces will bring these back to its equilibrium position (Kaur et al., 2010). Technically, the co-movement or long-run relationship between the spatial prices has been conceived as market integration (Fackler, 1996). The concept of cointegration was originally proposed by Granger (1981) which recognised that even though several price series have unit root, a linear combination of them could exist which would not have such a property. Integration between markets and price transmission largely depends on the dynamic relationship that arises due to trade distortions. In the case of eggs too, there is a likelihood of market integration and price transmission, if the markets are efficient in their performance.

Empirical studies on market integration of poultry products typically use bilateral price relationships as an indicator of market integration which falls under the law of one price (LOOP). The law states that the identical commodity should sell for the same price in each region of a country which can be measured empirically (Moodley et al., 2000). Despite extensive studies carried out in India on market integration with respect to foodgrains, fish and horticultural commodities, only a few studies dealt with the price integration of poultry products. Among them, none of the studies have empirically tested the LOOP among regional egg markets which are highly geographically concentrated. Given the importance and the structural transformation of the poultry sector in general and egg markets in particular after the establishment of the NECC, the present study has been carried out with the objective of finding out the extent of market integration and price transmission within India and whether the LOOP holds true in the case of egg markets.

MATERIALS AND METHODS

Spatial market integration is a situation in which prices of a commodity in spatially separated markets move together due to arbitrage and the price signals and information are transmitted smoothly across the markets. With the free flow of information in a competitive market, the difference in prices of a product in the two markets would be equal to or less than the transportation cost between them (Vasciaveo et al., 2013). Hence, spatial market performance may be evaluated in terms of the relationship between the prices in spatially separated markets. Estimation of bivariate correlation coefficients between price changes in different markets has been employed as the most common methodology (Cummings, 1967; Lele, 1967; 1971) for testing market integration. But, this gives the integration of markets only in the short-run. Hence, cointegration analysis is suggested to know the long-run integration.

Data source

The study is purely based on the secondary data. Time series data on wholesale daily prices of eggs were collected from the NECC portal from January 2011 to November 2012 for major seven markets across different states *viz*., Hyderabad, Mumbai, Delhi, Chennai, Namakkal, Kolkata and Bangalore and used for the present analysis.

Instability in prices

Instability index has been used to examine the extent of variation and risk involved in prices. It is measured by Cuddy-Della Valle Index (Cuddy and Della Valle, 1978). This method is superior to others as it de-trends the time series while computing the instability in the selected variable. The index is computed as,

Cuddy-Della Valle Instability Index (%) $= CV \times \sqrt{(1-\overline{R}^2)}$

Where, CV is the coefficient of variation in per cent, and $\overline{R}^2$ is the coefficient of determination estimated from a time trend regression adjusted to its degrees of freedom.

Market integration and price transmission (Cointegration test)

Cointegration test has been the most popular and widely adopted methodology among economists to study the integration between commodity markets. A number of mathematical improvements has been done including the methodology suggested by Hendry and Anderson (1977), Engle and Granger (1987), Johansen (1988, 1991, 1994, 1995) and Goodwin and Schroeder (1991). Among the available methodologies, Johansen's technique was considered to be the superior technique (Kumar and Sharma, 2003) since it permits the testing of cointegration as a system of equation in one step without any prior assumption of endogenous or exogenous variables. In addition, it does not impose any restrictions beforehand: test and estimation of the number of cointegration relationships can be carried out simultaneously.

Johansen's maximum likelihood method of cointegration

Before testing for cointegration, the time series has been checked for its stationarity. The stationarity properties and the exhibition of unit roots in the time series are substantiated by performing the Augmented Dickey-Fuller (ADF) test. This test was conducted on the variables in level (original price series) and first differences. The variables that are integrated of the same order may be cointegrated, while the unit root test finds out which variables are integrated of order one, or I(1) (Vasciaveo et al., 2013). The following ADF regression equation was tested for stationarity:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + u_t$$

where, Y_t is a vector to be tested for cointegration, t is the time, $\Delta Y_t = Y_t - Y_{t-1}$ and u_t is a pure white noise error term. The null hypothesis that δ = 0 signifies unit root which means the time series is non-stationary, while the alternative hypothesis, δ < 0 signifies that the time series is stationary, thereby rejecting the null hypothesis.

In a cointegrated equation system, $\Delta Y_t = \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \alpha\beta' Y_{t-k} + \varepsilon_t$, where Y_t is the price time series, Δ is the first difference operator ($Y_t - Y_{t-1}$) and matrix $\Pi = \alpha\beta$ is (n x n) with rank r ($0 \le r \le n$), which is the number of linear independent cointegration relations in the vector space of matrix. The Johansen's method of cointegrated system is a restricted maximum likelihood method with rank restriction on matrix $\Pi = \alpha\beta'$. The rank of Π can be determined by λ_{trace} test statistics, and is estimated by

$$\lambda_{trace} = -T\sum_{i=r+1}^{n}\ln(1-\hat{\lambda}_i)$$, for r = 0, 1,…, n-1

Where, $\hat{\lambda}_i$'s are the Eigen values representing the strength of the correlation between the first difference part and the error-correction part. Following hypotheses were tested, H_0: rank of Π = r (null hypothesis), and H_1: rank of Π > r (alternate hypothesis), where 'r' is the number of cointegration equations. The above test was carried out with the assumption of linear deterministic trend in original data and only intercept in the cointegrating equation. The cointegrating equation has only the intercept (no trend) because of difference in the price series while checking for its stationarity, whereas; the original price series follows a trend since the mean and variance is non-constant over a period of time (non-stationary property). Integration between two markets can be checked in a similar fashion through bi-variate Johansen's test.

Determination of lag lengths

Johansen's cointegration test is very sensitive to price lag length. Hence, the choice of lag length (k) is determined using the multivariate forms of Akaike Information Criterion (AIC). The length of lag distribution is decided by choosing the specification minimizing the AIC. The model is given as:

$$AIC = T\ln|\hat{\Sigma}| + 2m \quad \text{and} \quad AIC = T\ln|\hat{\Sigma}| + m.\ln T$$

where, T is the length of the time series and m is the number of parameters. The lag length (k) is represented by

$$\Sigma = \sum_{t-k}^{T}\frac{\hat{e}_t\,\hat{e}'_t}{T}$$, and $\hat{e}_t$ is (n x 1) residual vector.

Speed of convergence (Error correction mechanism)

After testing for cointegration, the residuals show the deviation from equilibrium and this can be captured by the vector error correction model (Brosig et al., 2011). In this case, a linear deterministic trend model is run only in the cointegrated markets specifying the number of cointegration equations between them. The model is represented as:

$$\Delta A_t = \alpha_0 + \alpha_1\Delta B_t + \alpha_2 u_{t-1} + \varepsilon_t$$

where A_t is the price of market A, B_t is the price of market B and u_t is the cointegration vector. The coefficient (α_2) of the error correction term (u_{t-1}) indicates the speed at which the series returns to equilibrium. If it is less than zero, the series converge to long-run equilibrium and if it is positive and zero, the series diverge from equilibrium. If the estimated coefficient of market B is negative (positive), it indicates that decrease (increase) in the previous period's equilibrium error leads to a decrease (increase) in the current period price, and *vice versa*.

LOOP analysis

Price integration between spatially separated markets does not indicate the efficiency but it can be considered as one of the indicators of overall market performance. This is ideally reflected by the LOOP. Johansen and Juselius (1990) indicated that LOOP can be proved by testing the hypothesis on the cointegration coefficients of both α and β using the likelihood ratio. For this, restrictions can be placed and parameters can be tested from the resultant β matrix of the cointegration equation following the Johansen's approach. Hence, in the case of testing integration between two markets, the rank of $\pi = \alpha\beta'$ will be equal to 1 and α and β matrices will be of order 2 x 1. Now, the LOOP for two markets is tested by imposing the restriction $\beta' = (1, -1)'$, and this test can be considered a valid test for LOOP in the long-run as the β matrix contains the long-run parameters within the cointegrated system. Alternatively, finding n-1 cointegrating vectors indicate that all prices contain the same stochastic trend and hence pairwise cointegrated validating the LOOP (Gandhi and Koshy, 2006; Awokuse and Bernard, 2007).

RESULTS AND DISCUSSION

Price behavior

It is imperative to know the price trend in order to know the behavior of the variable in different markets across the country (Figure 1). The major egg markets have been chosen purposefully covering different regions of the country (Table 1). The figure shows the symmetric pattern in the movement of prices in all the markets of the country with Kolkata having the highest price and Hyderabad with the status of major producer in the country, has the lowest price (Table 2). The rest of the markets exhibited a similar price movement in a band. The egg markets in India are highly geographically concentrated which allows for a varying price relationship between high and low production centres vis-à-vis consumption centres. The average price during the study period was higher in Kolkata (INR 289.39/100 eggs) which registered the maximum price too. It is also due to the huge demand from consumers', a highly populous region with a meagre share in the country's production. It is explicitly evident from the table that standard deviation and variance was higher in the case of Delhi market. Owing to these statistics, the estimated instability was highest in Delhi (14%). It is also noted that the Delhi market prices are more volatile during the study period and Chennai market prices are less volatile. The variance statistic ranged from 745 in Mumbai to as high as 2141 in Delhi indicating the wide spread of the price data in the respective market. Egg prices also showed the presence of skewness and kurtosis in the selected market. It confirms the scientific fact related to fat tails and scattered extreme observations which is a common feature of a high frequency data. All the markets exhibited a positive skew distribution indicating most of the observations concentrate on the left of the mean

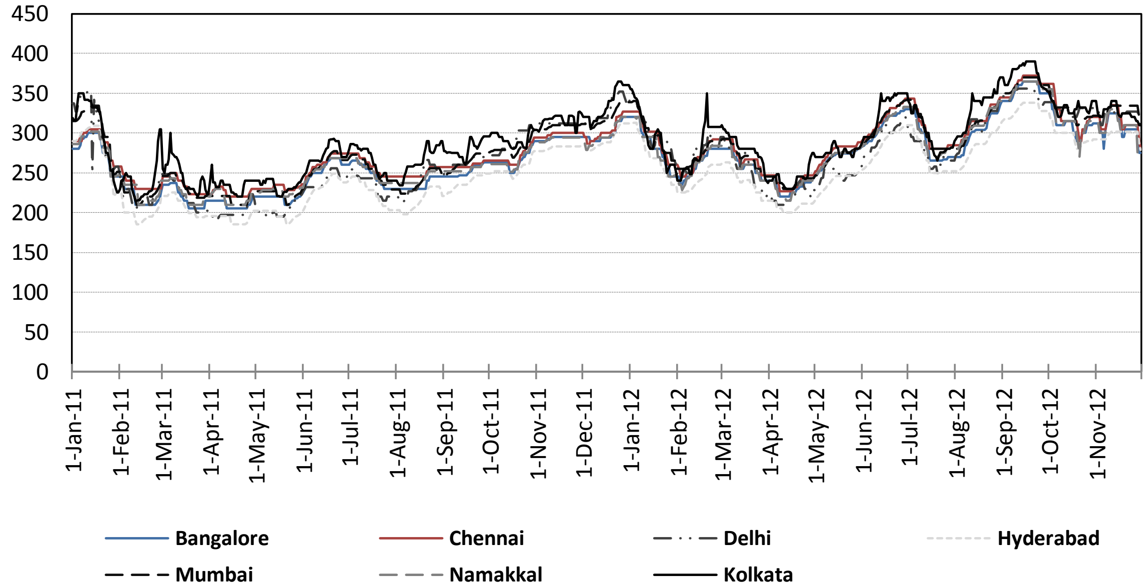

Figure 1. Price trend (INR/ 100 eggs) in major egg markets of India**.**

Table 1. Selected egg markets from different states/union territory.

SN	Selected market	State / Union Territory	Basis for selection*
1	Bangalore	Karnataka	Consumption
2	Chennai	Tamil Nadu	Consumption
3	Delhi	Delhi	Consumption
4	Hyderabad	Andhra Pradesh	Production
5	Mumbai	Maharashtra	Consumption
6	Namakkal	Tamil Nadu	Production
7	Kolkata	West Bengal	Consumption

*Indicate the selection from the National Egg Coordination Committee (NECC) portal.

Table 2. Summary statistics of egg market prices.

Particulars	Bangalore	Chennai	Delhi	Hyderabad	Kolkata	Mumbai	Namakkal
Observations (days)	700	700	700	700	700	700	700
Maximum price (INR/100 eggs)	365	372	356	338	390	370	365
Minimum price (INR/100 eggs)	205	220	190	185	215	210	210
Range (INR/100 eggs)	160	152	166	153	175	160	155
Mean price (INR/100 eggs)	268.69	278.25	271.66	251.56	289.39	279.66	271.40
Standard deviation	38.78	37.18	46.27	40.28	41.89	41.77	37.79
Variance	1503.87	1382.47	2141.04	1622.88	1754.55	745.11	1428.39
Skewness	0.31	0.44	0.08	0.17	0.24	0.17	0.39
Kurtosis	-0.58	-0.49	-1.16	-1.04	-0.77	-1.00	-0.52
Instability index (%)	10.51	9.76	14.00	12.67	11.67	11.41	10.27

value, with extreme observations to the right. Kurtosis statistic turned negative for all the markets specifying the fat or short tailed (platykurtic) pattern of probability distribution in egg prices. This indicates that the prices

Table 3. Price correlation between major egg markets in India.

Market(n = 700)	Bangalore	Chennai	Delhi	Hyderabad	Mumbai	Namakkal	Kolkata
Bangalore	1	0.99*	0.92*	0.98*	0.98*	0.99*	0.95*
Chennai		1	0.91*	0.97*	0.97*	0.99*	0.94*
Delhi			1	0.96*	0.95*	0.91*	0.93*
Hyderabad				1	1.00*	0.97*	0.96*
Mumbai					1	0.97*	0.96*
Namakkal						1	0.95*
Kolkata							1

*Indicates the significance of Karl Pearson's correlation coefficient at one per cent level of probability.

Table 4. Estimated ADF statistic for unit root test.

Market	Level series		1st differenced series	
	ADF statistic	AIC lag length	ADF statistic	AIC lag length
Bangalore	-2.87	2	-8.70*	4
Chennai	-2.98	3	-10.83*	2
Delhi	-3.09	2	-17.76*	1
Hyderabad	-3.46	4	-8.87*	3
Mumbai	-3.47	4	-11.75*	1
Namakkal	-3.08	2	-15.18*	1
Kolkata	-3.74	4	-14.36*	3

*Indicates the significance at one per cent level of MacKinnon (1996) one-sided probability value.

show a flatter distribution than a normal distribution with a wider peak. Further, the probability of extreme egg prices is less, and they are widely spread around the mean price.

Market integration

Market integration is the co-movement or long-run relationship between spatial prices. For the present study, major egg markets in India were purposively selected on the basis of production and consumption criteria (Table 1), and tested for cointegration analysis using Johansen's (1988) approach. Before cointegration, correlation between different egg markets was carried out to know the short-run integration. Correlation analysis revealed a positive co-movement between the egg price series, *a priori* (Table 3). The results indicated a high degree of significant positive correlation between all the major egg markets that are spatially separated.

Before testing for cointegration relationship between different egg market prices, it becomes mandatory to check the order of integration of the level variables. Therefore, unit root tests of each variable at their levels as well as first differences of non-stationary level variables were conducted for each market (Table 4). The results indicated the presence of a unit root at their levels, that is, non-stationarity of each market price time series. However, all the non-stationary variables are found to be stationary at their first differences, and therefore, are integrated of order one, I (1) if statistically tested, supporting the findings of Saran and Gangwar (2008). The conformation that each level series is I (1) helped to carry out the Johansen's cointegration test.

The cointegration test results furnished in Table 5 revealed the Eigen value and the trace statistic for the selected markets. The test rejected the null hypothesis of no cointegration relationship to at most three relationships between the egg markets (r = 0 to r ≤ 3) at 5% level of probability indicating the presence of four possible cointegration relationships among the selected seven markets. The extent of price transmission and integration could be influenced by the market structure. Increased geographical concentration and vertical coordination of poultry markets may be the plausible reasons for strong market integration (Awokuse and Bernard, 2007). The purpose of this analysis is to know whether the egg markets are integrated in the long-run and thereby price transmission holds true. The flow of market information across markets helps to realise the law of one price in Indian eggs barring the transportation cost in each market. However, the speed of information flow can be estimated through the error correction model.

Johansen's test revealed the long-run equilibrium

Table 5. Estimates of the Johansen's multivariate cointegration test.

Data period	01/01/2011 to 30/11/2012
Included observations	696 after adjustments
Trend assumption	Linear deterministic trend
Lag length	3
Selected markets: Hyderabad, Mumbai, Delhi, Chennai, Namakkal, Kolkata, and Bangalore	

Null hypothesis	Eigen value	Trace statistic	Critical value at 5%	Probability**
r = 0*	0.1250	303.8397	125.6154	0.0000
r ≤ 1*	0.1194	210.8885	95.7537	0.0000
r ≤ 2*	0.0768	122.3820	69.8189	0.0000
r ≤ 3*	0.0534	66.7931	47.8561	0.0003
r ≤ 4	0.0243	28.6006	29.7971	0.0682
r ≤ 5	0.0138	11.4699	15.4947	0.1842
r ≤ 6	0.0026	1.7881	3.8415	0.1812

Trace test indicates four cointegrating equations at five per cent level of probability,* denotes rejection of the null hypothesis at five per cent probability and ** shows the MacKinnon-Haug-Michelis (1999) probability values.

between all selected egg markets, justifying the use of vector error correction model (VECM) for showing the short-run dynamics. For this, bi-variate (2 markets) analysis was done and the integrated markets were tested for error correction mechanism. The results of the VECM indicated that barring Hyderabad and Mumbai, the rest of the market pairs registered expected coefficients (Table 6). In those pairs, Market 'A' exhibited negative coefficients whereas market B exhibited positive coefficients. This indicated that the price series with positive coefficients diverge from equilibrium in the short-run; and price series with negative coefficients converge to the long-run equilibrium. In other words, within a short time, positive changes tend to persist whereas; negative changes tend to move the price series towards equilibrium in the long-run. Further, it should be noted that the average time taken for correcting the errors due to positive news is much lesser in comparison to negative shocks which is evident from the magnitude of the error correction coefficients. However, price adjustments will occur only when there is a wide deviation from the equilibrium which is expected to be more than the transaction costs causing arbitrage activities to be profitable (Kaur et al., 2010).

The vector error correction coefficient was estimated at -0.0173 for market A (Bangalore) and 0.1209 for market B (Chennai). This indicated that how quickly the dependent variables such as Chennai and Bangalore prices absorb and adjust themselves for previous period disequilibrium errors. In other words, the coefficient measures the ability of the prices to incorporate shocks or price news available in the market. In this case, Chennai and Bangalore market absorb 12.09 and 1.73% respectively to bring about the equilibrium in prices. The information flow is more in Chennai market as evident by the magnitude of the coefficient (0.1209). Hence Chennai is more efficient than the Bangalore market in terms of reaction to news on price. Similar kind of interpretation can be done for rest of the markets.

Law of one price (LOOP)

Trace tests showed four cointegrating vectors for all the selected egg markets, the number of common stochastic trends turned out to be three of these seven markets (Table 7). The number of common stochastic trends was determined by deducting the number of cointegrating vectors from the dimension of the impact matrix given by the number of variables (*n*) included in the cointegration test (Gandhi and Koshy, 2006). Despite price linkage, the findings of n - 1 cointegrating vectors implied that different stochastic trend existed and hence the LOOP does not hold true for all the major egg markets across India. The analysis of the LOOP has a significant role in determining the efficient functioning of the egg markets across India underlying the importance of transaction costs. If their role is ignored, the results of integration may be misleading. Hence, the NECC which is responsible for egg market information should take additional responsibility for collecting and disseminating various components of transaction costs *viz.,* loading and unloading costs, transport costs, insurance and financing.

CONCLUSIONS AND POLICY IMPLICATIONS

The degree of market integration assessed using the Johansen's cointegration test indicated that major egg markets across the country are cointegrated in the long-

Table 6. Estimates of the Johansen's bivariate cointegration test and error correction model.

Markets under test for cointegration	Null hypothesis	Lag length criteria		Cointegration test		Error correction estimates		Log likelihood
		AIC value	Order of lags	Eigen value	Trace statistic	Market A	Market B	
A. Bangalore	r = 0*	-12.19	3	0.0570	45.3155	-0.0173	0.1209	4246.92
B. Chennai	r ≤ 1*			0.0064	4.4542	(0.0337)	(0.0284)	
A. Bangalore	r = 0*	-10.34	4	0.0230	20.2133	-0.0320	0.0344	3610.61
B. Delhi	r ≤ 1*			0.0058	4.0483	(0.0104)	(0.0179)	
A. Bangalore	r = 0*	-11.95	8	0.0343	32.6833	-0.0044	0.0638	4163.07
B. Hyderabad	r ≤ 1*			0.0123	8.5411	(0.0189)	(0.0154)	
A. Bangalore	r = 0*	-12.14	8	0.0352	34.0860	-0.0225	0.0656	4228.16
B. Mumbai	r ≤ 1*			0.0134	9.3196	(0.0235)	(0.0175)	
A. Bangalore	r = 0*	-11.53	7	0.0377	32.9160	-0.0733	0.1478	4020.52
B. Namakkal	r ≤ 1*			0.0091	6.3124	(0.0312)	(0.0402)	
A. Bangalore	r = 0*	-10.54	7	0.0567	47.0708	-0.0349	0.1121	3674.03
B. Kolkata	r ≤ 1*			0.0096	6.6831	(0.0137)	(0.0205)	
A. Chennai	r = 0*	-10.58	4	0.0237	20.9956	-0.0313	0.0322	3691.56
B. Delhi	r ≤ 1*			0.0062	4.3314	(0.0093)	(0.0181)	
A. Chennai	r = 0*	-12.11	3	0.0262	18.4606	-0.0405	0.0309	4225.35
B. Hyderabad	r ≤ 1*			0.0071	4.9251	(0.0153)	(0.0151)	
A. Chennai	r = 0*	-12.30	8	0.0298	28.8425	-0.0137	0.0526	4282.77
B. Mumbai	r ≤ 1*			0.0114	7.9026	(0.0159)	(0.0140)	
A. Chennai	r = 0*	-12.26	3	0.0943	73.4250	-0.1895	0.1579	4272.31
B. Namakkal	r ≤ 1*			0.0064	4.4849	(0.0283)	(0.0555)	
A. Chennai	r = 0*	-10.79	7	0.0616	50.9119	-0.0447	0.1125	3763.05
B. Kolkata	r ≤ 1*			0.0099	6.8961	(0.0122)	(0.0208)	
A. Delhi	r = 0*	-10.80	8	0.0350	31.4770	-0.0009	0.0456	3768.74
B. Hyderabad	r ≤ 1*			0.0098	6.8290	(0.0206)	(0.0097)	
A. Delhi	r = 0*	-10.97	8	0.0271	26.2419	-0.0062	0.0328	3827.792
B. Mumbai	r ≤ 1*			0.0104	7.2322	(0.0188)	(0.0081)	
A. Delhi	r = 0*	-10.04	3	0.0318	26.0887	-0.0314	0.0352	3511.37
B. Namakkal	r ≤ 1			0.0052	3.6222	(0.0136)	(0.0091)	
A. Delhi	r = 0*	-9.50	8	0.0443	36.7426	-0.0274	0.0706	3316.88
B. Kolkata	r ≤ 1*			0.0079	5.4542	(0.0161)	(0.0146)	
A. Hyderabad	r = 0*	-15.54	8	0.0250	20.0332	-0.1358	-0.1121	5406.43
B. Mumbai	r ≤ 1			0.0037	2.5585	(0.0354)	(0.0322)	
A. Hyderabad	r = 0*	-11.56	8	0.0334	32.0735	-0.0506	0.0320	4033.53
B. Namakkal	r ≤ 1*			0.0124	8.6257	(0.0132)	(0.0179)	
A. Hyderabad	r = 0*	-10.97	8	0.0675	58.4773	-0.0237	0.1486	3820.47
B. Kolkata	r ≤ 1*			0.0146	10.1967	(0.0135)	(0.0242)	
A. Mumbai	r = 0*	-11.76	8	0.0316	31.0341	-0.0458	0.0489	4099.61
B. Namakkal	r ≤ 1*			0.0127	8.8496	(0.0139)	(0.0206)	
A. Mumbai	r = 0*	-11.14	8	0.0636	54.0138	-0.0133	0.1443	3879.43
B. Kolkata	r ≤ 1*			0.0124	8.5910	(0.0119)	(0.0232)	
A. Namakkal	r = 0*	-10.30	7	0.0556	46.9449	-0.0484	0.1055	3592.23
B. Kolkata	r ≤ 1*			0.0106	7.3703	(0.0159)	(0.0212)	

Figures within parentheses indicate the standard error of the estimate. * The critical value for rejecting the null hypothesis, H_0: r=0 is 15.49 and r ≤ 1is 3.81at five per cent level of probability.

run with the possibility of four cointegration equations which is evident by the trace statistic. Price transmission occurred from one market to another market due to the flow of market information owing to the development in

Table 7. Confirmation of the LOOP for egg markets.

Selected markets	Number of cointegrated vectors	Number of stochastic trends	Confirmation of LOOP
Hyderabad, Mumbai, Delhi, Chennai, Namakkal, Kolkata and Bangalore (7 markets)	4	7 – 4 = 3	No

information tools and technology as well as the establishment of NECC. The speed of convergence of egg prices between markets depends more on the government policies and investment on infrastructure facilities. Further, market integration relies heavily on the efficient functioning of markets. In fact, markets that are spatially integrated themselves serve an indicator of market efficiency. However, the law of one price does not occur in the egg markets indicating the significance of transaction costs.

The present study suggests some policies. This kind of analysis on market integration and price transmission enlighten the significance of commodity based research. Such kind of studies is equally important as they provide better information on which decisions can be taken for scarce resource allocation. Government and private investors can invest and allocate more resources for efficient markets that are highly integrated. On the contrary, additional investment on infrastructures for less integrated markets will bring down the transaction costs and further improve the degree of integration between markets. Obviously, efficient markets provide less or no market distortions, thereby making the resource allocation more efficient and increase the welfare of producers and consumers.

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