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Spatial Price Integration and Price Transmission among Major Fish Markets in India

P. Shinoj*[a], B. Ganesh Kumar[a], R. Sathiadhas[b], K.K. Datta[a], Muktha Menon[a] and Shiv Kumar Singh[a]
[a]National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi - 110 012
[b]Central Marine Fisheries Research Institute (CMFRI), Cochin - 682 018, Kerala

Abstract

The domestic fish marketing system in India deserves to be developed into a strong network of efficiently functioning markets, as more than three-fourths of the country's total fish production is channellised domestically. With the unleashing of a new global economic order, the efficiency of markets needs to be dealt with utmost importance. The degree of spatial market integration and price transmission between the major coastal markets in India have been reported using monthly retail price data on important marine fish species. It has been observed that degree of integration and rate of price transmission differ according to species. The highest integration has been observed in mackerel, probably because of its affordability to all income classes, resulting in a wide consumer base. Among various markets, a near full transmission of prices has been observed between Kerala and Tamil Nadu markets, except in the case of shrimp. Even though a major landing centre, the price movement in Maharashtra market has been found independent of other markets. The spatial market integration between major shrimp markets in the country has appeared to be the least, possibly because of its greater market share outside the country. The study has suggested to devise strategies to bring about greater integration between these markets so that both fishermen and the fish-consuming community in the country are benefitted.

Introduction

The fisheries is one of the key sectors in India with around 6.7 million people dependent on it for livelihood (GoI, 2001). The sector is undergoing fast transformation, from subsistence level to a multi-million industry. The fish production (both marine and inland) of the country has increased from 0.75 million tonnes in 1950-51 to 6.4 million tonnes in 2003-04 (Narayankumar and Sathiadas, 2006). The marine landings alone were valued at Rs 13019 crores at the landing centre level in 2004, while the value at the final consumer point was estimated at Rs 22,653 crores (Sathiadas, 2005). For the past many years, marine exports have been a substantial source of foreign-exchange earning to India's exchequer and hence are accorded utmost priority. However, the domestic fisheries marketing system in the country has long been neglected due to various reasons. It deserves its due share primarily because around 85 per cent of the total fish production is consumed within the country. It is, therefore, important to develop a strong network of efficient marketing system within the country so that a substantial chunk of country's fish production is efficiently managed and delivered to the consuming masses, while not negating the due share of the fishermen.

*Author for correspondence, Email: pshinoj@ncap.res.in
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Essentially, an efficient marketing system is one where there is a perfect market integration and full price transmission, with instantaneous price adjusment to changes from within or outside the system. Such a system would enable the producers, middlemen and consumers in the marketing chain to derive maximum gains. It would also help in elimination of unprofitable arbitrage and isolation of spatially differentiated markets and would ensure that efficient allocation of resources across space and time is achieved (Nkang *et al.,* 2007). In the fish marketing system, price movements in different markets depend to a large extent on the cross market movement of available catch, which in turn, is governed by the demand and supply factors. The extent of price transmission from one market to the other and its direction are the important aspects to be looked into, as these would provide valuable information on the degree of integration, and in turn, the efficiency of these markets. In the present paper, the degree of spatial market integration between the major coastal markets in India has been studied using monthly retail price data on important fish species. The study has highlighted the supply side constraints, which are essentially the major factors responsible for poor integration between the markets.

Data and Methodology

For the study, monthly price data for a ten-year period from January 1998 to December 2007 were collected on important marine fish species, viz. mackerel, sardine, pomfret and shrimp from the major coastal states of India. The states covered were Andhra Pradesh, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu and West Bengal. The retail markets around major landing centres in each of these states were selected for this purpose. The data were collected through regular and systematic primary surveys conducted by the Central Marine Fisheries Research Institute (CMFRI), Cochin.

Analytical Framework

Two price series belonging to spatially separated markets are said to be integrated if there exists a long-term equilibrium relationship between them. The degree of transmission of price signals between these two markets can be obtained by fitting a classical regression model given by Equation (1):

$$Y_t = \beta_0 + \beta_1 X_t + e_t \qquad \ldots(1)$$

where,

Y_t = Price at the dependent market,
X_t = Price at the independent market,
β_0 = Constant,
β_1 = Long-run elasticity of price transmission, and
e_t = Error-term.

However, assumptions of the classical regression model necessitate that both Y_t and X_t variables should be stationary and the errors should have a zero mean and finite variance. A stationary series is one whose parameters (mean, variance and autocorrelations) are independent of time. Regression between two non-stationary variables may result in spurious relationship with high R^2 and t-statistics that appear to be significant, but with the results of having no economic meaning. Under such circumstances, the series have to be first checked for stationarity. If a time series requires first order differencing to be stationary, then it is said to be I (1), which means integrated of the order one. I (2) series requires differencing twice to become stationary and so on. If it is verified that both the series are stationary, then the classical regression model [Equation (1)] would hold good and the β coefficient would represent the coefficient of price transmission. However, if the two series prove to be non-stationary but integrated of the same order, the validity of regression can be checked by testing the residuals of the regression for stationarity. Engle and Granger (1987) had demonstrated that, if the residuals from such a regression turn out to be stationary, then the series are co-integrated and there existed a long-run relationship between the two series. Engle-Granger theorem states that if a set of variables are co-integrated of order (1, 1), then there exits a valid error-correction representation of the data. Converse of this theorem also holds good, that is, if an error-correction model (ECM) provides an adequate representation of the variables, then they must be co-integrated. However, if the series are integrated of different orders, the regression equations using such variables would be meaningless and it can be concluded that there cannot exist any long-term relationship between the two.

The stationarity of a series can be tested using a unit root test, the most widely used being Augmented Dickey-Fuller unit root test. It would test the null hypothesis that the series has a unit root, i.e. non-stationary.

The test is applied by running the regression of the form given in Equation (2):

$$Y_t = \beta_1 + \delta Y_{t-1} + \alpha_i \Sigma_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \qquad \ldots(2)$$

where, ε_t is a pure white noise error-term and $\Delta Y_{t-i} = (Y_{t-1} - Y_{t-2})$.

Once it is established that the order of integration is the same for the variables of interest, the second stage of testing co-integration can be undertaken. The co-integrating equation is the same as Equation (1). The error-term arising from this regression is then subjected to testing of stationarity. The ADF test in this context is known as Augmented Engle-Granger test whose critical values were provided by Engle and Granger (1987). Davidson and Mackinnon (1993) have revised these values and in the present study, these values have been used. The stationarity in the error-term confirms co-integration between the series and the existence of long-term equilibrium. However, there can be short-term disequilibrium, which means that a price change in one market is not immediately passed on to the other market. Using the Error Correction Model (ECM), the speed of adjustment towards the long-run path can be ascertained and the model is represented by Equation (3):

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t + \alpha_2 e_{t-1} + \varepsilon_t \qquad \ldots(3)$$

where, e_{t-1} is the lagged error-term of the co-integrating regression and ε_t is the disturbance- term. The magnitude of α_2 explains the speed at which the price approaches equilibrium and it is expected to be negative, so that the equilibrium is restored in the long-run.

Results and Discussion

The degree of price integration and transmission between major markets across the coastal states of India for important marine fish species were determined and have been presented in this section. The results have been presented and discussed separately species-wise, as the market dynamics are different for each of them.

Mackerel

Mackerel is a pelagic scombroid shoaling fish, the bulk of which comes from the west coast of India, between Cape Comorine and Ratnagiri. The contribution from the east coast of India (Tamil Nadu, Andhra Pradesh and Orissa) is relatively less. The past catch data shows that the annual mackerel catch in the total marine landings in India was of the order of 8 per cent. A major share of this catch is consumed domestically, barring limited exports to the Middle East countries. As in any other fish species, mackerel catch is also seasonal; the fishing season starts in August and lasts till February and sometime extends till March in the northern zone (Mangalore to Ratnagiri). Due the seasonal nature, the mackerel prices vary considerably across seasons and markets.

As a first step to determine the price transmission mechanism in mackerel, an augmented Dickey-Fuller (ADF) unit root test was applied to ascertain the stationarity of the monthly price series obtained from various markets across the coastal states of the country. The results of this exercise are presented in Table 1.

Table 1. Augmented Dickey-Fuller unit root test on domestic retail market prices of mackerel

Market price series (in log)	Level	First difference
Andhra Pradesh	-3.05	-7.14*
Gujarat	-6.80*	-7.93*
Karnataka	-4.20*	-7.14*
Kerala	-3.82**	-6.2*
Maharashtra	-3.35	-7.42*
Orissa	-2.57	-5.92*
Tamil Nadu	-4.36*	-6.86*
West Bengal	-6.06*	-5.46*

Notes: * and ** denote significance at 1per cent and 5 per cent levels respectively.

McKinnon critical values of ADF statistic under the assumption of both constant and time trends in the series are -4.04 (1 per cent) and -3.44 (5 per cent).

Unit root test assumes both constant and time trends.

The price series corresponding to Gujarat, Karnataka, Kerala, Tamil Nadu and West Bengal were found to be stationary at level as well as at first difference, as the null hypothesis of the presence of a unit root could be rejected. However, the prices of Andhra Pradesh, Maharashtra and Orissa became stationary only after the first differencing. The elasticity of price transmission was obtained by fitting a regression model, as explained under methodology. A double log model was fitted so that the elasticities could be obtained directly. A single step was required for all the combinations of stationary (at level) price series, but for other series, which were not stationary at level, a further two-step procedure was followed to ascertain the presence of co-integration. Table 2 presents a matrix with the price transmission coefficients for each of the market pair combinations.

Out of all the market pairs, 13 pairs were found to be integrated with a certain degree of price transmission from one to the other. Among the integrated market pairs, three (Orissa-Andhra Pradesh, Maharashtra-Andhra Pradesh and Kerala-Tamil Nadu) were co-integrated with some degree of short-term fluctuations with an error-correction mechanism. Rest of the pairs were found to be in long-run equilibrium. The highest elasticity of price transmission was observed in Kerala-Tamil Nadu market pair with 95 per cent of the price change in Kerala market getting transmitted to Tamil Nadu market. Such a response could be due to movement of a large bulk of mackerel between these two markets. The direction of price transmission was from Kerala to Tamil Nadu, as indicated by the arrow corresponding to the pair in Table 2, implying that Kerala prices dictated the Tamil Nadu market prices. The direction of causation was ascertained by comparing the Schwarz Information Criteria (SIC) of the models. The one which resulted in minimum SIC value was selected as the best model. A high degree of price transmission was also observed between Orissa-Andhra Pradesh (0.87) and West Bengal-Tamil Nadu (0.81). The direction of price transmission from Orissa to Andhra Pradesh was contrary to the expectation, as Andhra Pradesh is the larger market of mackerel. It is probably due to the monopsonistic ability of the Orissa market by virtue of its large market share. A price transmission of 79 per cent was observed between Kerala and West Bengal, which is also quite high. The spread of price signals between Tamil Nadu and Gujarat was negligible.

The Error Correction Models for the co-integrated series are shown below; the figures in parentheses are the standard errors:

Table 2. Elasticity of price transmission between various domestic market pairs for mackerel

Markets	West Bengal	Gujarat	Tamil Nadu	Andhra Pradesh	Orissa	Maharashtra	Kerala
Karnataka	**0.19**$^{*}_{\rightarrow}$	**0.28**$^{*}_{\rightarrow}$	**0.51**$^{*}_{\rightarrow}$	NI	NI	NI	**0.43**$^{*}_{\leftarrow}$
West Bengal		**0.44**$^{*}_{\rightarrow}$	**0.81**$^{*}_{\rightarrow}$	NI	NI	NI	**0.79**$^{*}_{\leftarrow}$
Gujarat			**0.01**$^{*}_{\leftarrow}$	NI	NI	NI	**0.42**$^{*}_{\leftarrow}$
Tamil Nadu				NI	NI	NI	**0.95**$^{*}_{\leftarrow}$ (-4.90*)
Andhra Pradesh					**0.87**$^{*}_{\leftarrow}$ (-4.65*)	**0.66**$^{*}_{\leftarrow}$ (-5.47**)	NI
Orissa						**0.58**$^{*}_{\leftarrow}$	NI
Maharashtra							NI

Notes: * and ** denote significance at 1 per cent and 5 per cent levels, respectively;
NI denotes lack of price integration, as the series were of different orders of integration;
Numbers in **bold** fonts denote price integration;
The arrows in the subscripts indicate the direction of price transmission between markets.
Figures within the parentheses are Engle-Granger tau statistics for co-integration.
McKinnon critical values of ADF tau statistic are -3.48 (1 per cent) and -2.88 (5 per cent).

1. Maharashtra- Andhra Pradesh:

$$\underset{}{\Delta \ln MH} = \underset{(0.20)}{0.004} + \underset{(2.13)}{0.20\,\Delta \ln AP} - \underset{(-6.92)}{\mathbf{0.65}^{*}}\, e_{t-1} \quad \ldots(4)$$

2. Orissa- Andhra Pradesh:

$$\Delta \ln AP = \underset{(0.19)}{0.004} + \underset{(0.42)}{0.40\,\Delta \ln OR} - \underset{(-10.08)}{\mathbf{0.95}^{*}}\, e_{t-1} \quad \ldots(5)$$

3. Kerala -Tamil Nadu:

$$\Delta \ln TN = \underset{(0.27)}{0.003} + \underset{(0.31)}{0.21\,\Delta \ln KL} - \underset{(-5.37)}{\mathbf{0.43}^{*}}\, e_{t-1} \quad \ldots(6)$$

The coefficient of the lagged error-term indicates the speed of adjustment of the short-term fluctuations in prices towards the long-term equilibrium. In the Maharashtra-Andhra Pradesh combination, 65 per cent of the short-term fluctuations were found to be getting corrected in a month's time [Equation (4)]. The corresponding speed of adjustment for Orissa-Andhra Pradesh and Kerala-Tamil Nadu pairs were 95 per cent and 43 per cent, respectively [Equations (5) and (6)]. The coefficients were significant at 1 per cent level of significance.

Sardine

Sardine is also a shoaling fish species which occurs both in the east and west coasts of India, with highest catches obtained from Kerala, Karnataka, Maharashtra and Goa coasts. The commercial fishing of sardine extends from July to March, with maximum intensity during October to January. In India, a major bulk of the catch is disposed off in the fresh condition, mainly in the domestic market. The price varied from Rs 20/kg to Rs 40/kg in the year 2007. A small share of it is cured and dried to be exported to countries like Sri Lanka. It is also used to extract oil for the paint industry and for making fish meals.

The price integration between various markets of sardine was determined by analyzing the respective monthly price series from the year 1998 to 2007. Augmented Dickey-Fuller unit root tests on these prices suggested that only in Andhra Pradesh, Gujarat, Karnataka and Orissa, the prices were stationary at level (Table 3). The other price series corresponding to Kerala, Maharashtra and Tamil Nadu were rendered stationary after taking their first differences. The prices in the West Bengal market were not available and hence were not used in the analysis.

Table 3. Augmented Dickey-Fuller unit root test on domestic retail market prices of sardine

Market price series (in log)	Level	First difference
Andhra Pradesh	-4.53*	-7.80*
Gujarat	-5.26*	-6.40*
Karnataka	-5.61*	-7.08*
Kerala	-2.50	-6.30*
Maharashtra	-2.93	-5.83*
Orissa	-4.27*	-6.33*
Tamil Nadu	-1.96	-6.55*
West Bengal	NA	NA

Notes: Same as in Table1.

The market pairs, viz. Karnataka-Gujarat, Karnataka-Andhra Pradesh, Karnataka-Orissa, Andhra Pradesh-Gujarat, Gujarat-Orissa and Orissa-Andhra Pradesh were observed to be in long-run equilibrium in terms of price movements of sardine. Their respective long-run price transmission elasticities and direction of causation are presented in Table 4. An almost complete pass through of price changes from the Karnataka market to Gujarat market, as indicated by the elasticity of 0.96, suggested that the law of one price holds true in this scenario. A determining reason for such a high price integration between the markets can possibly be the existence of big dry fish markets in both the states, which cater to the demand of the whole country for fish meal production and to the north-eastern states for consumption. The field studies have also pointed towards a definite flow of consignments and price information about this important raw material fish species between these states. A high level of transmission was also observed between Andhra Pradesh and Gujarat markets. Similar to that of mackerel, Orissa market dictated the sardine prices in the Andhra Pradesh market, in spite of the latter being a bigger market. The Kerala and Tamil Nadu

Table 4. Elasticity of price transmission between various domestic market pairs for sardine

Markets	Gujarat	Tamil Nadu	Andhra Pradesh	Orissa	Maharashtra	Karnataka
Karnataka	**$0.96^{*}_{\rightarrow}$**	NI	**$0.58^{*}_{\rightarrow}$**	**$0.31^{*}_{\rightarrow}$**	NI	NI
Gujarat		NI	**$0.83^{*}_{\leftarrow}$**	**$0.73^{*}_{\rightarrow}$**	NI	NI
Tamil Nadu			NI	NI	0.23^{*} (-2.24)	**$0.90^{*}_{\leftarrow}$ (-2.89**)**
Andhra Pradesh				**0.57^{*}**	NI	NI
Orissa					NI	NI
Maharashtra						-0.09

Notes: Same as in Table 2.

prices were found to be co-integrated with a high long-run elasticity of 0.90 and a speed of adjustment coefficient of 0.20, as shown in the Error Correction Model [Equation (7)]. The strong relationship between these two markets could be due to the strong preference of lower-income group in these states for sardine, which resulted in large-scale exchange of consignments.

4. Error Correction Model for Tamil Nadu-Kerala market pair:

$$\Delta \ln TN = \underset{(0.48)}{0.008} - \underset{(-0.47)}{0.09\ \Delta \ln KL} - \underset{(-3.84)}{\mathbf{0.20}^{*}\ e_{t-1}} \quad \ldots(7)$$

Except the market pairs described above, all other market pairs were found to be not integrated and the prices in these markets moved independent of each other.

Pomfret

Pomfret is one of the main groups of table fish in India. Though it occurs all along the coast of India, the main areas of its abundance are Bombay on the west coast and Orissa and West Bengal on the east coast. Pomfret is a premium priced commodity due to its high demand from the high-end consumers in Indian market. The retail prices varied between Rs 250/kg to Rs 300/kg in the Gujarat market in the year 2007. However, in West Bengal, the prices were lower and ranged between Rs 140/kg to Rs 180/kg.

The unit root test for stationarity established that the prices were stationary at level in the Karnataka, Orissa and West Bengal markets with constant means and variances (Table 5). However, other price series were integrated of the first order, suggesting higher intra-year and inter-year fluctuations.

The retail prices of pomfret prevailing in West Bengal and Karnataka markets were found to be in the long-run equilibrium with the price transmission elasticity of 0.27. Similarly, long-run equilibria were found prevailing among Karnataka-Orissa and West Bengal-Orissa market pairs. In both these cases, the price signals moved towards Orissa. A co-integration relationship was observed between Gujarat and Tamil Nadu markets with a high price transmission elasticity of 1.10, implying that one percentage change in Gujarat will result in a greater than proportional change of 1.10 per cent in Tamil Nadu. Clearly there was an overreaction of the latter market prices to the changes in the former. A similar co-integration was obvious in Kerala-Tamil Nadu pair also with an even higher elasticity of 1.48. The field survey showed that there was no physical flow of pomfret between Gujarat and Tamil Nadu, while

Table 5. Augmented Dickey-Fuller unit root test on domestic retail market prices of pomfret

Market price series (in log)	Level	First difference
Andhra Pradesh	-2.95	-7.57^{*}
Gujarat	-2.76	-6.18^{*}
Karnataka	-6.60^{*}	-7.07^{*}
Kerala	-2.87	-4.99^{*}
Maharashtra	-2.25	-5.31^{*}
Orissa	-8.87^{*}	-6.87^{*}
Tamil Nadu	-2.56	-6.35^{*}
West Bengal	-5.42^{*}	-5.97^{*}

Note: Same as in Table1.

Table 6. Elasticity of price transmission between various domestic market pairs for pomfret

Markets	West Bengal	Gujarat	Tamil Nadu	Andhra Pradesh	Orissa	Maharashtra	Kerala
Karnataka	$\mathbf{0.27}^{*}_{\leftarrow}$	NI	NI	NI	$\mathbf{0.23}^{*}_{\rightarrow}$	NI	NI
West Bengal		NI	NI	NI	$\mathbf{0.82}^{*}_{\rightarrow}$	NI	NI
Gujarat			$\mathbf{1.10}^{*}_{\rightarrow}$ **(-3.07**)**	0.31^{*} (-2.61)	NI	0.35^{*} (-2.47)	$\mathbf{0.34}^{*}_{\rightarrow}$ **(-3.66**)**
Tamil Nadu				0.19^{*} (-2.50)	NI	0.10	$\mathbf{1.48}^{*}_{\leftarrow}$ **(-3.02**)**
Andhra Pradesh					NI	-0.04	0.23^{**} (-2.33)
Orissa						NI	NI
Maharashtra							0.44^{*} (-2.31)

Notes: Same as Table 2.

there existed an exchange between Kerala and Tamil Nadu. However, there were evidences that the price information was exchanged between these markets earlier also. The Gujarat and Kerala markets were also co-integrated, but with a lesser elasticity of price transmission (0.34).

The Error Correction Models (ECM), corresponding to the co-integrated price series, are shown in Equations (8)-(10). The results show that the speed at which Gujarat prices adjust to the changes in Kerala prices in an effort to achieve the long-run static equilibrium was to the tune of 28 per cent in a month's time. The error-correction coefficient corresponding to Tamil Nadu-Gujarat pair was 0.29 and that of Tamil Nadu-Kerala pair was 0.17. All the ECM coefficients were significant at 1 per cent level of significance.

5. ECM for Kerala-Gujarat pair:

$$\underset{}{\Delta \ln KL} = \underset{(0.47)}{0.003} + \underset{(0.61)}{0.04\,\Delta \ln GJ} - \underset{(-4.70)}{\mathbf{0.28}^{*}\, e_{t-1}} \quad \ldots(8)$$

6. ECM for Tamil Nadu-Gujarat pair:

$$\Delta \ln TN = \underset{(0.52)}{0.007} + \underset{(2.42)}{0.32\,\Delta \ln GJ} - \underset{(-4.71)}{\mathbf{0.29}^{*}\, e_{t-1}} \quad \ldots(9)$$

7. ECM for Tamil Nadu-Kerala pair:

$$\Delta \ln TN = \underset{(0.51)}{0.007} + \underset{(0.69)}{0.27\,\Delta \ln KL} - \underset{(-3.19)}{\mathbf{0.17}^{*}\, e_{t-1}} \quad \ldots(10)$$

Shrimp

The shrimp production in India constitutes around 15 per cent of the total world production, with a substantial share belonging to *Penaeid* shrimp from the Maharashtra and Kerala coasts. *Penaeus monodon*, commonly known as 'Jumbo tiger shrimp', is a highly demanded and priced commodity, a substantial share of which is exported to Japan and the European Union. However, with a recent stagnation in India's shrimp exports to the biggest Japan market, its demand in the domestic market is expected to rise. The existence of wide price differentials between various domestic markets within the country reveals better prospects for up-scaling the intra-national trade of this commodity. In the year 2007, while a kilogram of shrimp in the Maharashtra market fetched as high as Rs 500, the average prices in Andhra Pradesh market were only Rs 200/kg and in Orissa, Rs 310/kg. In this background, the extent of price integration among these markets would prove quite helpful in taking decisions on the domestic marketing strategies.

The results (Table 7) suggested that price series belonging to Gujarat, Orissa and West Bengal were stationary at level, the rest being integrated to the order one. It provides a clear indication that these three markets are not integrated with other markets. The degree of integration among these three markets and that across other non-stationary price series was determined by fitting the regression equations and extending them to error-correction models in the case of co-integrated series, as explained under methodology.

The integration analysis has shown that a long-run equilibrium existed between the Orissa and West Bengal prices, with a price transmission elasticity of 0.81, which was significant at one per cent level of significance (Table 8). This is assumed to be the result of large-scale movement of shrimp lots between the markets on account of their proximity. The fast exchange of price information also must have contributed to their integration. The direction of movement of price signals was from West Bengal to Orissa market, the former being a much bigger market than the latter. Gujarat and West Bengal markets were also found integrated with around 58 per cent of the price changes in Gujarat getting transmitted to West Bengal. A comparison of the catch statistics in both the markets corroborated the direction of price movement. While Gujarat and Orissa markets were in long-term equilibrium with regard to movement of prices, Tamil Nadu and Karnataka markets were observed to be co-integrated with short-term disequilibria arising intermittently. However, the long-run price transmission elasticity between these markets was very high to the tune of 0.90, implying a near full pass over of price changes. The bivariate vector error-correction equation [Equation (11)] for the Tamil Nadu-Karnataka market pair has suggested an 18 per cent recovery of short-run divergences towards the statistic long-run equilibrium per month.

Table 7. Augmented Dickey-Fuller unit root test on domestic retail market prices of shrimp

Market price series (in log)	Level	First difference
Andhra Pradesh	-2.03	-4.94*
Gujarat	-4.72*	-7.50*
Karnataka	-2.29	-6.57*
Kerala	-2.43	-6.70*
Maharashtra	-2.63	-5.94*
Orissa	-7.34*	-6.78*
Tamil Nadu	-2.89	-6.09*
West Bengal	-7.40*	-6.96*

Notes: Same as in Table1

8. ECM for Karnataka-Tamil Nadu market pair:

$$\Delta \ln KA = \underset{(0.56)}{0.005} + \underset{(1.10)}{0.08\,\Delta \ln TN} - \underset{(-3.73)}{\mathbf{0.18}\, e_{t-1}} \quad \ldots(11)$$

Though, being large landing centres, the Kerala and Maharashtra markets were not integrated with any other domestic market. This could be perhaps due to their larger share in export than domestic markets. The Andhra Pradesh market, which produces mostly cultured shrimp, was also found to be not integrated with rest of the markets, as it transports most of its catch to Tamil Nadu for further dispatch to export markets.

Table 8. Elasticity of price transmission between various domestic market pairs for shrimp

(in per cent)

Markets	West Bengal	Gujarat	Tamil Nadu	Andhra Pradesh	Orissa	Maharashtra	Kerala
Karnataka	NI	NI	**0.90*** ←	-0.13	NI	0.14*	1.14*
			(-3.44)**		(-2.64)		(2.13)
West Bengal		**0.58*** ←	NI	NI	**0.81*** →	NI	NI
Gujarat			NI	NI	**0.33*** →	NI	NI
Tamil Nadu				-0.21	NI	0.14*	1.14*
						(-2.62)	(-2.40)
Andhra Pradesh					NI	0.36	-0.32
Orissa						NI	NI
Maharashtra							0.07

Notes: Same as Table 2.

Conclusions

The level of price integration among various coastal fish markets in India has been assessed using a ten-year monthly price data. The degree of integration and rate of price transmission have been found to differ according to species. The highest integration has been observed in mackerel, perhaps because of its affordability to all income classes, resulting in a wide consumer base. The price changes in mackerel market in Kerala have been found to be transmitted almost in entirety to Tamil Nadu, in spite of having short-term divergences. Prices in the Orissa and Andhra Pradesh markets have been found moving synchronously with high rate of price permeability, but with direction of price transmission contrary to the expected lines. The monopsonistic ability of Orissa market has been assumed to be the causative factor.

The short-term divergences in the price movements in these markets are being corrected with a very high speed of 95 per cent per month. Similar to that of mackerel, a high level of price integration between the Kerala and Tamil Nadu markets has been observed in sardine also. The sardine prices of Karnataka and Gujarat markets have also been found to be moving together closely, as this species is the major raw material for their dry fish industry. The dictating power of Orissa market over the Andhra Pradesh market has been confirmed in sardine also, but with a lesser degree of price transmission. An overreaction of price changes has been depicted between the Kerala-Tamil Nadu and Gujarat-Tamil Nadu market pairs in the case of pomfret, supposedly due to its preferential and premium priced status. In both these cases, the elasticity of price transmission has been recorded more than one. Shrimp markets in West Bengal and Orissa have been found to be integrated with the existence of long-run price equilibrium. In the same token, Tamil Nadu and Karnataka prices have been found also moving in tandem. In spite of being large producers, the Kerala, Maharashtra and Andhra Pradesh shrimp markets have not been found integrated with any other domestic market, possibly because of their larger market share outside the country.

The study has unveiled the complicated price transmission mechanism between different fish markets in the country and has conveyed an important message of the necessity of price integration between the markets as a remedy to address the supply-side constraints existing in these markets. It has highlighted the lack of integration between important markets of major marine fish species and has suggested to devise strategies to bring about greater integration between these markets, so that both the fishermen and the fish consuming community in the country are benefitted.

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