Res. Jr. of Agril. Sci. **11**(6): 1308-1313, Nov-Dec 2020

ISSN: 0976-1675

www.rjas.org

Research Journal of Agricultural Sciences

Research Paper

DI: 6220-2406-257

Export Performance and Extent of Market Integration in Indian Fish Trade

C Prabakar*

Department of Agricultural Economics,

Faculty of Agriculture, Annamalai University, Annamalai Nagar - 608 002, Tamil Nadu, India

Received: 24 June 2020; Revised accepted: 27 August 2020

ABSTRACT

In this study the export performance and extent of market integration in Indian fish trade was analyzed considering the following specific objectives viz. (i) to analyze the trends in the performance of Indian fish export and (ii) to examine the nature and extent of market integration between fish export markets in India. For estimating the degree of price transmission between different fish markets, five major export markets viz. Cochin, Chennai, Vizagapattinam, Kolkatta and Tuticorin were purposively selected, considering the higher degree of consistency in the export of shrimp through these ports. The daily export prices via the above mentioned ports were collected from the respective ports on daily basis. The study revealed that in all the years, value wise share of Shrimp was not less than 50 per cent of total fish trade of India. In a long run perspective reliance on this single item, shrimp does not reflect a healthy sustainable trend which needs to be addressed with. It is suggested that, the fishery export promotion agencies like MPEDA (Marine Products Export Development Authority) may take efforts to encourage and enhance the performance of all items of fish export as like Shrimp export. Co-integration analysis revealed that export markets of India are not integrated to the needed and required level. The data access to exporters on fish trade, to enhance market intelligence, should be made more liberal, faster and widespread to all export markets. Efforts need to be enhanced to coordinate relevant fishery and export agencies so as to ensure proper dissemination of market information on time to needed stakeholders.

Key words: Fish export, Export market integration, Shrimp trade, Co-integration analysis

India with a fishery production of about 12.59 million tonnes (2017-18) from both captured and cultured source is ranked second among the largest fish producing countries and 5th among the fish exporting countries of the world. During the year 2017-18, the exports of fish products from the country stood at 13,77,243 tonnes with a value of 45,106 crores (MPEDA 2018). Shrimp continued to be the mainstay of fish exports, contributing more than 50 per cent in terms of value. The share of fish products in the total exports of the country was 2.3 per cent (NFDB, 2018) and India has a share of 6.00 per cent of the world fish trade. In recent years, there has been a consistent decline in international fish product prices for various reasons and the increased production did not contribute a proportionate increase in the export earning in dollar terms. While in over 27 years (1991-2017), the volume of exported fish products increased 7.7 times, whereas unit value increased only by 3.3 times (Indiastat 2018). Also, it is a fact that in the post liberalization era, export price undulations are more severe which, apart from affecting export earnings, also has serious impacts on domestic prices leading to consequent fall outs. The degree of price integration between various export markets, its pros and cons are needed to be investigated, which would help for future policy revamp. With the understanding on the problems discussed above, investigation was carried out with the following specific objectives.

1. to analyze the trend in the export of fish products in India.
2. to examine the nature and extent of market integration between fish export markets in India.

Hypotheses

1. There exists scope in enhancing the spatial and temporal attributes of Indian fish industry.

***Corresponding author:** Dr. C. Prabakar, Associate Professor, Department of Agricultural Economics, Faculty of Agriculture, Annamalai University, Annamalai Nagar - 608 002, Tamil Nadu

e-mail: prabakaragri@yahoo.co.in

2. The degree of price transmission between fish markets needs to get enhanced.

MATERIALS AND METHODS

The study relied mostly on secondary sources for data. The data related to fish production, international prices, volume of exports and market prices over the years (1982 to 2018) were collected from the secondary sources viz. Central Marine Fisheries Research Institute (Cochin), Marine Products Exports Development Authority (Cochin), Directorate of Fisheries in the concerned states, Central Institute of Fisheries Technology (Cochin), Department of Animal Husbandry, Dairying and Fisheries (GOI, New Delhi), Directorate General of Foreign Trade (GOI, New Delhi), Hand Book of Statistics on Indian Economy published by Reserve Bank of India (Mumbai), Publications of Food and Agricultural Organization (Rome) and www.indiastat.com. For estimating the degree of price transmission between different fish markets, five major export markets viz. Cochin, Chennai, Vizagapattinam, Kolkatta and Tuticorin were purposively selected, considering the higher degree of consistency in the export of shrimp through these ports on daily basis. The export prices via the above-mentioned ports pertaining to the year 2017-18 were collected from the respective ports on daily basis and used for the co-integration analysis.

Tools of analysis

Compound growth rate: In this study, compound growth rates were calculated for the volume and value of fish exported, and item-wise volume and value of fish exported.

Market integration: The study aims to estimate the price transmission between the different fish export markets in India. The time series data on fish prices utilized for the analysis has been deflated by the whole sale price index for fish to form real price series.

Stationarity: Before analyzing any time series data, testing for stationarity is a prerequisite since econometric relation between the time series has the presence of trend components. Testing for stationarity of the variables has been done by employing Augmented Dickey Fuller (ADF) test. A stationary series is one whose parameters are independent of time, exhibiting constant mean and variance and having autocorrelations that are invariant through time. If the series is found to be non-stationary, the first differences of the series are tested for stationarity. The number of times (d) a series is differenced to make it stationary is referred as the order of integration, I (d). The ADF test considers the null hypothesis that a given series has a unit root, i.e. it is non-stationary. The test is applied by running the regression of the following form:

$$\Delta Y_t = B\beta_1 + \delta Y_{t-1} + \alpha_i \sum \Delta Y_{t-1} + e_t \ldots\ldots\ldots (1)$$

If the coefficient δ is not statistically different from zero, it implies that the series has a unit root, and, therefore, the series is non-stationary.

The fish price series of export markets were tested for stationarity in the above equation (1), where Y_t denotes price series of export markets, and i = 1,2,....,5 (1 – Cochin; 2 – Chennai; 3 – Vizag; 4 – Calcutta; 5 – Tuticorin respectively).

Johansen's multiple cointegration framework

It is possible that individual time series of the commodity prices may be nonstationary in levels, but a linear combination of them may be stationary indicating a long run equilibrium relationship between them (Engle and Granger 1987). If a linear combination of two nonstationary series is stationary, then the two series are considered to be cointegrated. To test whether or not the residual term of the regression between the two-time series in question is stationary, cointegration tests start with the premise that for a long-run equilibrium relationship between two variables it is necessary that they should have the same inter temporal characteristics.

The ADF test is supplemented by Johansen multivariate cointegration approach to examine cointegration among price series. In this technique, the hypothesis of presence of cointegration vector is formulated on a group of non-stationary series, as the hypothesis of reduced rank of the long-run impact matrix. Likelihood ratio and maximum likelihood tests are applied to derive test statistics for the hypothesis of given number of cointegration vectors and their weights. Inference concerning linear restrictions on the cointegration vectors and their weights is performed using usual chi square methods (Johansen 1988). The order of integration is ensured to be the same for each time series of prices, and then is tested for cointegration. Only variables of the same order of integration qualify for the pair wise cointegrating relationships. The specific linear combinations tested are the residuals from a static cointegrating regression such as:

$$Y_{ti} = \beta_i + \beta_i X_{ti} + Z_i \ldots\ldots\ldots\ldots\ldots (2)$$

Where Y_{ti} and X_{ti} are (i = 1, 2, . . . 5) price series in levels and Z_{ti} is the residual term. Testing for cointegration implies testing stationarity of the residual term Z_{ti}. In the current study, the dependent variable Y_{ti} are prices of different sea food markets (i = 1, 2, . . . 5) and the independent variables X_{ti} are (i = 1, 2, ... 4) prices of other four sea food markets, under study.

In the current study, the relationships between the different fish market prices were studied through the Johansen's multiple cointegration analysis under error correction framework.

Error correction mechanism (ECM)

The last step in cointegration analysis involved application of error-correction mechanism. Since the procedure of differencing results in loss of valuable long-run information in the data, an error correction (EC) term is introduced in the theory of cointegration that integrates or ties short run dynamics of a series to its long run value. The residuals obtained from the linear equation are introduced as explanatory variable into the system of variables in levels. The error correction term, thus, captures the adjustment towards long-run equilibrium.

A generalized ECM formulation to understand both the short run and long run behaviour of prices can be considered by first taking the autoregressive distributed lag (ADL) equation as follows:

$$Y_t = a_{01} X_t + a_{11} X_{t-1} + a_{12} Y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots \quad (3)$$

By adding and deleting Y_{t-1}, $a_{01} X_{t-1}$, rearranging terms, and using the difference equator, the above equation can be written in the ECM format as follows:

$$\Delta Y_t = a_{01}\ \Delta X_t + (1-a_{12})\left[\frac{(a_{01}+a_{11})}{(1-a_{12})} X_{t-1} - Y_{t-1}\right] + \varepsilon_t \ \ldots\ldots\ldots \quad (4)$$

The generalized form of this equation for k lags and an intercept term is as follows:

$$\Delta Y_t = a_{00} \sum_{i=0}^{k-1} a_{i1}\ \Delta X_{t-1} + \sum_{i=1}^{k-1} a_{i2}\ \Delta Y_{t-1} + m_0\ [m_1\ X_{t-k} - Y_{t-k}] + \varepsilon_t \ldots\ldots\ldots\ldots (5)$$

$$where,\ m_0 = \left(1 - \sum_{i=1}^{k} a_{i2}\right),\ and\ m_1 = \frac{\sum_{i=0}^{k} a_{i1}}{m_0}$$

If all the variables are 1(1), i.e. they are integrated of order 1, they are stationary in first difference. Therefore, all the summations in the above equations are also stationary. Moreover, if the variables are cointegrated, the ECM term, i.e. the linear combination of variables represented in parentheses is also stationary. The a_{ij} coefficients capture the short run effects and m_j coefficients represent the stationary long run impacts of the right-hand side variables. The parameter m_0 measures the rate of adjustment of the short run deviations towards the long run equilibrium. Theoretically, this parameter lies between 0 and 1. The value 0 denotes no adjustment and 1 indicates an instantaneous adjustment. A value between 0 and 1 indicates that any deviations will have gradual adjustment to the long run equilibrium values.

So, the Vector Error Correction Mechanism is used to distinguish short term from long term association of the variables included in the model. When the variables are not integrated, then in the short-term deviation from this long-term equilibrium would feed back to the changes in the dependent variable in order to force the movement according to the long run equilibrium relationship. The long-term causal relationship among the sea food markets is implied through the significance of the ‘t’ tests of the lagged error correction term as it contains the long-term information because it is derived from the long-term relationship. The coefficient of the lagged error correction term is a short-term adjustment coefficient and represented the proportion by which the sea food market prices adjusted in response to the long run disequilibrium.

Before computing the error correction mechanism, the order of lag for the variables to be included in the models is to be ascertained. The orders of lag for the variables are chosen by the smallest Akaike Information Criterion (AIC) / Schwartz Bayesian Criterion (SBC) of the sea food markets price series.

The commodity prices are expected to be integrated because of the Information Technology revolution. In view of that, the price linkages between the export markets prices are studied through cointegration and VECM approach. The time series econometric analyzes were carried out using E-views 7.

RESULTS AND DISCUSSION

Trend in export of fish product

The overall performance with regard to the export of fish product is found to be satisfactory over years. This could be evident from the positive Compound Growth Rates accounted for different variables viz. Quantity of export, value of export and unit value of export for the period between 1967-68 and 2016-17. The compound growth rates are 8.5, 17.4 and 8.3 respectively for the above variables (Table 1).

Table 1 Decade wise compound growth rate of fish export in India (1967-68 to 2016-17)

Decade	Compound growth rate		
	Quantity	Value	Unit value
1967-68 to 1976-77	10.76	31.51	18.73
1977-78 to 1986-87	10.07	22.21	11.03
1987-88 to 1996-97	5.87	11.31	5.13
1997-98 to 2006-07	8.82	16.63	7.18
2007-08 to 2016-17	6.78	7.55	0.72
Over all period	8.5	17.4	8.3

The decade wise Compound Growth Rate analysis reveals that, in all the contexts of export viz. Quantity, Value and Unit value, the CGRs were higher during the earlier decades between 1967-68 and 1986-87. The point to be taken care and considered is that the CGR of Unit value realization during the last decades (2007-08 to 2016-17) was only 0.72 which was very much lower compared to previous four decades. Though the lower growth rate in unit value was attributed to, the increase in share of item other than shrimp, the industry should find means to sustain its unit value realization by exploring new markets and new items of fish for export.

Share of fish export in total fish production

With regard to the share of fish export to total fish production, it seems to remain very low all the years. It could be seen from (Table 2), that the per cent share of fish export to total fish production ranges between 6.4 per cent and 10.9 per cent only, during the years from 2001-02 to 2017-18. Though it is a good indication that Indian fish industry is not dependent on export alone, efforts should be sustained to further increase the volume of export by enhancing the production to the maximum potential possible.

Item wise export of fish products

With regard to the estimated Compound Growth Rate for the period between 1990-91 to 2017-18 for various items of export, quantity wise, 'Dried products' stands first whereas, value wise, 'Frozen shrimp' stands first among all other items of export, with a CGR of 56.72, which is much appreciable (Table 3). The important point to be noticed is that in the last two decades, the value wise contribution of frozen shrimp, in Indian fish export over years, is commendable but in a long run perspective reliance on this single item shrimp may not reflect a healthy sustainable progress which needs to be addressed with. The performance of all items of fish export needs to be enhanced as like the performance of 'Frozen shrimp'.

Table 2 Share of fish export in total fish production (2001-02 to 2017-2018) (In '000 Tonnes)

Year	Total fish production	Total fish export
2001-02	5956	424 (7.00)
2002-03	6200	467 (7.5)
2003-04	6399	412 (6.4)
2004-05	6305	482 (7.6)
2005-06	6572	551 (8.4)
2006-07	6869	613 (8.9)
2007-08	7127	542 (7.6)
2008-09	7616	603 (7.9)
2009-10	7998	678 (8.5)
2010-11	8423	813 (9.7)
2011-12	8666	862 (9.9)
2012-13	9019	928 (10.3)
2013-14	9580	983 (10.3)
2014-15	10070	1050 (10.4)
2015-16	10800	946 (8.75)
2016-17	11431	1135 (9.92)
2017-18	12590	1377 (10.93)

Figures in parentheses refer to percent to total production

Table 3 Item wise compound growth rate of fish export in India

Item	Compound growth rate (1990-91 to 2017-18)	
	Quantity	Value
Frozen shrimp	4.08	56.72
Frozen cuttlefish fillets	6.82	13.54
Frozen squids	7.33	10.92
Fresh and frozen fish	7.84	14.10
Dried products	23.06	27.18
Others	16.63	21.23
Total	7.24	10.94

Market integration analysis on major Indian export markets

Co-integration analysis on shrimp (P. Vannamei) export prices at major ports of India

The shrimp especially the species P. Vannamei occupies a predominant position in Indian fish Export, in recent years. Hence an attempt was made to estimate the level of price transmission among the major shrimp (P. Vannamei) exporting ports of India namely Kolkatta, Cochin, Chennai, Tuticorin and Vizagapattinam. With regard to International trade, the bargaining influence of buyer country would very much impact the export prices. In order to nullify this effect, among different trade destinations, U.S.A alone was considered purposively and price data were collected accordingly. The price transmission among different export markets has serious implications on various stakeholders of the business esp. on consumers and producers of shrimp. In order to study the integration of prices between different shrimp exporting ports, as the first step, an Augmented Dickey-Fuller (ADF) unit root test was applied to ascertain the non-stationarity of average weekly shrimp export prices obtained from the ports of Kolkatta, Cochin, Chennai, Tuticorin and Vizagapattinam.

Table 4 ADF unit root test on Shrimp (P. Vannamei) export price at the major ports of India

Port	With constant	With constant and time trend	Without constant and time trend
Kolkatta	5.71*	3.08	3.78*
Cochin	4.62*	2.21	2.05**
Chennai	2.99**	3.18	1.72
Tuticorin	3.01**	1.27	2.15**
Vizagapattinam	2.61	3.41	1.81

*Significance at 1 per cent level; **Significance at 5 per cent level

To allow for the various possibilities, the ADF test was estimated in three different forms viz. with constant, with constant and time trend, without constant and time trend (As random walk). The time series corresponding to all the ports were found to be stationary at level itself, in the forms "with constant" and "without constant and time trend" as the null hypothesis of the presence of a unit root could be rejected. The price series were found to be non-stationary when ADF test was estimated in the form "with constant and time trend" at level. Hence subsequently co-integration and error correction model were estimated with the assumption that all the series takes the form of "with constant and intercept" (Table 4).

The co-integration rank test for export prices of Shrimp at Kolkatta, Cochin, Chennai, Tuticorin and Vizagapattinam ports indicated five co-integrating equations at 0.05 probability level (Table 5).

Table 5 Co-integration rank test on Shrimp (P. Vannamei) export prices at the major ports of India

Hypothesized No. of CE(s)	Unrestricted co-integration rank test (Trace)			
	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability**
None *	0.604196	106.3458	69.81889	0.0000
At most 1 *	0.590395	71.12603	47.85613	0.0001
At most 2 *	0.411273	37.20865	29.79707	0.0058
At most 3 *	0.271780	17.07650	15.49471	0.0287
At most 4 *	0.123860	5.024729	3.841466	0.0250

*Rejection of the hypothesis at the 0.05 probability level; **MacKinnon-Haug-Michelis (1999) p-values

It could be observed from (Table 6) that, the one-week lagged export price of Shrimp at Kolkatta, Cochin and Chennai ports have influence on their respective own current export prices. The other observations made are as follows:

- One-week lagged Shrimp export price at Cochin port influences the current prices at Kolkatta port.
- One-week lagged Shrimp export price of Chennai market influences current Tuticorin export prices.
- Two-weeks lagged Shrimp export price of Chennai market also influences the current Tuticorin export prices.
- The one-week lagged Shrimp export price of Tuticorin influences the current export prices at Cochin market.
- The one-week lagged Shrimp export price of Vizagapattinam influences the current export prices at Cochin.
- The two-week lagged Shrimp export price of Vizagapattinam also influences the current prices at Cochin.

The conclusion that could be derived from the above observations are,

- In general, in the Indian export markets the current export prices are considerably influenced by the lagged prices.
- Chennai and Tuticorin Markets are integrated to a reasonable extent, which might be because of the mutual proximity of the locations.
- Cochin market is more integrated with other markets than any other Indian export market. This might be because of the higher level of market intelligence of the exporters. The functioning of more number of fishery related organizations like MPEDA, CMFRI, CIFT etc., may also be the reason for this.

The overall observation from the price integration analysis with the export prices of the five Indian fish export markets viz. Kolkatta, Cochin, Chennai, Tuticorin and Vizagapattinam is that, though certain level of integration is noticed among markets, the markets are not integrated to the needed or required level. The data availability to exporters to enhance market intelligence should be made more liberal, faster and widespread to all export markets.

Policy implication

- It is inferred that the value wise share of shrimp was not less than 50 per cent of total fish trade of India. In a long run perspective, reliance on this single item, shrimp does not reflect a healthy sustainable trend which needs to be addressed with. It is suggested that, the fishery export promotion agencies like MPEDA (Marine Products Export Development Authority) may take efforts to encourage and enhance the performance of all items of fish export as like shrimp export.
- Co-integration analysis revealed that export markets of India are not integrated to the needed and required level. The data access to exporters on fish trade to enhance market intelligence, should be made more liberal, faster and widespread to all export markets. Efforts need to be enhanced to co-ordinate relevant fishery and export agencies, so as to ensure proper dissemination of market information on time to needed stake holders.

Table 6 The vector error correction estimates on the Shrimp (P. Vannamei) export prices at major ports of India

Error correction	D (CCU 1)	D (COK 1)	D (MAA 1)	D (TUT 1)	D (VIZ 1)
CoinEq1	-0.121062	153.6959	-0.053375	0.096666	0.070496
	(0.07294)	(55.7933)	(0.05259)	(0.05608)	(0.05740)
	[-1.65971]	[2.75474]	[-1.01487]	[1.72376]	[1.22811]
D (CCU -1)	-0.600542	-255.8622	0.284610	-0.124935	0.125353
	(0.20621)	(157.731)	(0.14868)	(0.15854)	(0.16228)
	[-2.91230]	[-1.62215]	[1.91419]	[-0.78805]	[0.77245]
D (CCU -2)	-0.262212	-176.8839	0.184844	0.210442	0.016681
	(0.20413)	(156.144)	(0.14719)	(0.15694)	(0.16065)
	[-1.28450]	[-1.13282]	[1.25583]	[1.34089]	[0.10383]
D (COK -1)	-0.000605	-0.430224	-4.68E-05	0.000199	0.000264
	(0.00025)	(0.18909)	(0.00018)	(0.00019)	(0.00019)
	[-2.44698]	[-2.27529]	[-0.26271]	[1.04458]	[1.35591]
D (COK -2)	-0.000381	-0.322764	3.63E-05	0.000117	6.43E-05
	(0.00022)	(0.17153)	(0.00016)	(0.00017)	(0.00018)
	[-1.69929]	[-1.88168]	[0.22457]	[0.67911]	[0.36454]
D (MAA-1)	0455331	-427.1029	-0.576148	-0.706805	-0.219451
	(0.37683)	(288.242)	(0.27171)	(0.28971)	(0.29655)
	[1.20831]	[-1.48175]	[-2.12045]	[-2.43966]	[-0.74001]
D (MAA -2)	0.203272	-11.83251	-0.287490	-0.617942	-0.021345
	(0.27983)	(214.043)	(0.20177)	(0.21514)	(0.22022)
	[0.72642]	[-0.05528]	[-1.42486]	[-2.87232]	[-0.09693]
D (TUT -1)	0.212794	-460.2821	0.249898	-0.426004	0.131544
	(0.28251)	(216.095)	(0.20370)	(0.21720)	(0.22233)
	[0.75322]	[-2.13000]	[1.22679]	[-1.96135]	[0.59167]
D (TUT -2)	0.066907	-91.79715	0.373152	-0.217974	0.165662
	(0.26587)	(203.365)	(0.19170)	(0.20440)	(0.20923)
	[0.25165]	[-0.45139]	[1.94653]	[-1.06639]	[0.79178]
D (VIZ -1)	0.316963	887.4888	-0.181986	-0.152912	-0.458451
	(0.40584)	(310.427)	(0.29262)	(0.31201)	(0.31938)
	[0.78101]	[2.85892]	[-0.62191]	[-0.49008]	[-1.43545]
D (VIZ -2)	0.332931	538.2988	-0.105065	-0.134887	-0.097448
	(0.30595)	(234.023)	(0.22060)	(0.23522)	(0.24077)
	[1.08819]	[2.30020]	[-0.47627]	[-0.57345]	[-0.40473]
C	-8.448992	-6120.840	-3.163626	-1.536151	-0.876526
	(19.9206)	(15237.4)	(14.3635)	(15.3153)	(15.6768)
	[-0.42413]	[-0.40170]	[-0.22025]	[-0.10030]	[-0.05591]

D(CCU1): Current Price at Kolkatta Market
D(CCU -1): One week lagged Price at Kolkatta Market
D(CCU -2): Two weeks lagged Price at Kolkatta Market
D(COK1): Current Price at Cochin Market
D(COK -1): One week lagged Price at Cochin Market
D(COK -2): Two weeks lagged Price at Cochin Market
D(MAA1): Current Price at Chennai Market
D(MAA -2): Two weeks lagged Price at Chennai Market
D(TUT1): Current Price at Tuticorin Market
D(TUT -1): One week lagged Price at Tuticorin Market
D(TUT -2): Two weeks lagged Price at Tuticorin Market
D(VIZ1): Current Price at Vizagapattinam Market
D(VIZ -1): One week lagged Price at Vizagapattinam Market
D(VIZ -2): Two weeks lagged Price at Vizagapattinam Market
D(MAA -1): One week lagged Price at Chennai Market
Standard error in () & 't' statistics in [ ]

Acknowledgement

The author gratefully acknowledges the financial support provided by University Grants Commission, New Delhi, under Research Award Scheme for the project titled "Revamp of Indian Sea Food Trade Towards Futurity – An Economic Analysis".

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