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Indian Seafood Exports: Issues of Instability, Commodity Concentration and Geographical Spread

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I

INTRODUCTION

Fluctuations in fish production from capture and culture, variations in international prices, adjustments in exchange rates and finally – the variable values of export earnings are grim concerns for developing countries of South Asia and South East Asia. Most of the developing countries (including India) obtain their major share of export earnings from selected few items or commodities and the trade is concentrated with a couple of nations. These developing countries as commodity producers and exporters have hardly any instruments at their disposal to hedge against the adverse effects of instability of export earnings. Managing commodity price risk and stabilising export earnings are still important policy issues for virtually all low income and commodity exporting countries (Pal, 1992).

Imperative effects of variability of export earnings at the macroeconomic level are: disruptions in the investment planning process, misallocation of resources and disturbances of the internal balance of public finances, impacts on the rate of domestic savings, increasing internal and external indebtedness and problems in the balance of payments, which might result in unstable earnings and discourage farmers from producing for export and can lead to a "further" fall in export earnings and gross National Product (GNP). The export oriented producers who suffer from earning shortfalls will also cut back their consumption, which affects the public finances. The persistence of abnormally depressed prices globally during the 1980s has also resulted in a sharp reduction in the living standards of developing countries. Thus the export-earning instability has to be considered as a development problem because it dampens the growth rate, particularly as a result of its negative effect on productivity of capital. Considering the strengths of Indian fisheries sector and steady development in the past four decades, the causes of instabilities in production and

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export of seafood assume immense importance in the economic scenario of India and hence the present study was conducted with the following objectives: (1) To compute concentration measures such as commodity concentration and geographic concentration coefficients for Indian seafood exports. (2) To estimate the instability indices for seafood exports from India and (3) To determine the significant factors that affect the instability in seafood exports from India.

The paper is arranged as follows. Section II discusses the structure and pattern of fisheries development in India during the past four decades. The third section deals with data and transformation procedures. Section IV describes the theoretical and computational framework. Section V presents the results and the final section gives a summary of findings and discusses policy alternatives.

II

INDIAN FISHERIES SECTOR - STATUS AND GROWTH

With an annual fish production of 6 million metric tonnes India occupies the fourth position in fish production and second in aquaculture production globally. The annual domestic per capita fish availability is 9 kilograms and seafood export earnings of India is consistently over Rs. 6,000 crores a year. Fish contributes 1.4 per cent of gross domestic product (GDP) and 4.5 per cent of the agricultural GDP. Till the close of 1960 the export of Indian seafood products mainly consisted of dried items like dried fish, dried shrimp, shark fins, fish maws, etc. From 1961, the export of dried seafood products was on the decline and exports of processed items were making steady increases. Some improvement in the product profile of seafood exports was visible after 1966. Frozen and canned items gained wider acceptance. The markets for Indian products spread fast to developed countries from the traditional buyers in developing countries. Till 1960, the markets for Indian marine products were largely confined to neighbouring countries like Sri Lanka, Myanmar and Singapore. This position continued as long as exports from India were dominated by dried items. When the frozen and canned items increasingly figured in exports, the sophisticated and affluent markets like U.S.A., France, Australia, Canada, Japan, etc., became important buyers. The U.S.A. remained the principal buyer of our frozen shrimp for a long time. But after 1977, Japan emerged as the principal buyer of frozen shrimp followed by Western European countries. For a number of years, Japan continued to be the single largest buyer of our seafood products. However recently, U.S.A. became the largest market for Indian products. Even though a declining trend has been observed in 2003-04 (Table 1) compared to earlier years U.S.A. has continued to be the single largest buyer relegating Japan to the second position. The share of U.S.A. for 2003-04 was 12.9 per cent in terms of quantity and 27.61 per cent in terms of value. China is one of the leading markets for fish items like ribbon fish, crocker etc. China accounted for 31.75 per cent in volume and 10.03 per cent in value of the total export of marine products from India. The export of seafood products had grown to greater proportion as one of the important items of India's export from a few million US$ in 1961-62 to US$ 1330.76 million in 2003-04, accounting for approximately 3.32 per cent of the total exports from India. During the eighties, the canned items slowly disappeared and frozen items gained prominence in India's seafood trade. Amongst the frozen items also, there were changes in the demand for differentiated products from various countries. While Japan indicated their preference for headless shell on shrimp, the U.S.A. demanded peeled shrimp meat and the European countries preferred the IQF shrimp in frozen and cooked form. The European market also absorbed the major share of cephalopods while Japan had taken a small share of it. These frozen fish items had greater demand in the South East Asian countries as well as in the Middle East. In the 1970s, the export was depending mainly on shrimp but due to the export promotional measures, it became possible to diversify the products in the eighties adding cephalopods (cuttlefish, squid and octopus) and frozen fish (such as pomfret, ribbon fish, seer fish, mackerel, reef cod, croakers, snapper, etc). While all these items hold good prospects, live fish, chilled fresh water fish etc. are promising items for the future (Ayyappan and Krishnan, 2005). Due to the introduction of scientific shrimp farming, the export of frozen value added shrimp continued as the major foreign exchange earner among seafood products and the volume of frozen shrimp exported during 2003-04 was 1,29,768 metric tonnes (Table 2).

III

DATA AND METHODS

The value of total seafood exports from India from 1981-82 to 2003-04 were obtained from various issues of *Review of Marine Products Exports* published by Marine Products Exports Development Authority (MPEDA), Cochin, India. The data on shrimp production were obtained from MPEDA. Data regarding GDP, Fisheries Gross Domestic Product (FGDP) was obtained from Central Statistical Organisation's web site www.mospi.nic.in. GDP excluding Fisheries (NFGDP) was computed by subtracting FGDP from GDP.

Measures of Concentration

Several concentration measures are available in the literature, e.g., Tongan (1994), Tegegne (2000), Erlat and Akyuz (2001), Campa and Fernandes (2004) used different measures for different studies. The appropriateness of a measure depends on the data on which the estimates are based and with the purpose of analysis. The present study utilises the most widely employed Gini-Hirschman coefficient of concentration, which defines the degree of concentration in a country's export as

$$G = 100\sqrt{\sum_{i=1}^{n}\left[\frac{X_{it}}{X_t}\right]^2} \qquad \ldots(1)$$

TABLE 1 GEOGRAPHICAL SPREAD OF INDIAN SEAFOOD EXPORTS (1993-94 TO 2003-04)

(Quantity: '000 MT; Value: Rs. crores)

	Japan		U.S.A.		W.Europe		Others		Total	
Year	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(12)
1993-94	44.99	1185.67	26.15	306.17	71.85	645.21	100.97	366.43	243.96	2503.62
1994-95	53.50	1643.82	32.10	490.23	71.22	726.30	150.51	714.92	307.34	3575.27
1995-96	51.79	1576.69	26.01	366.26	87.21	911.87	131.27	646.29	296.28	3501.11
1996-97	64.66	1886.04	29.79	436.05	71.19	790.11	212.56	1009.16	378.20	4121.36
1997-98	70.96	2326.09	32.91	583.75	34.88	412.53	247.07	1375.11	385.82	4697.48
1998-99	67.28	2295.48	34.47	617.32	54.26	684.62	146.92	1029.45	302.93	4626.87
1999-2000	66.99	2272.77	36.65	775.35	65.40	905.56	173.99	1162.98	343.03	5116.67
2000-2001	68.98	2560.39	41.75	1164.40	68.83	1025.36	260.92	1693.74	440.47	6443.89
2001-2002	64.91	1820.69	49.04	1421.38	82.90	1150.07	227.63	1564.91	424.47	5957.05
2002-2003	54.92	1534.76	61.70	2051.12	94.54	1388.47	256.14	1906.65	467.30	6881.00
2003-2004	50.02	1163.69	53.15	1682.06	96.28	1470.99	212.56	1775.21	412.02	6091.95

Source: MPEDA.

TABLE 2. ITEM WISE INDIAN SEAFOOD EXPORTS

(Quantity: '000 MT; Value: Rs. crores)

	Frozen shrimp		Frozen Cuttle fish		Frozen Squids		Fresh/Frozen Fish		Others		Total	
Year	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1993-94	86.54	1770.73	18.99	138.18	34.74	192.47	94.02	296.00	9.66	106.24	244.00	2503.62
1994-95	101.75	2510.27	28.15	224.01	37.20	245.01	122.53	446.57	17.72	149.41	307.34	3575.27
1995-96	95.72	2356.81	33.85	260.86	45.03	319.58	100.09	372.26	21.59	191.60	296.28	3501.11
1996-97	105.43	2701.78	31.18	272.37	40.92	290.45	173.01	636.92	27.67	219.84	378.20	4121.36
1997-98	101.32	3140.56	37.26	323.41	35.10	270.89	188.03	726.73	24.12	235.89	385.82	4697.48
1998-99	102.48	3344.91	34.59	273.31	32.25	268.93	108.56	495.03	25.05	244.69	302.93	4626.87
1999-2000	110.28	3645.22	32.80	286.22	34.92	296.80	131.30	537.34	33.74	351.09	343.03	5116.67
2000-01	111.87	4481.51	33.68	288.99	37.63	324.43	212.90	874.68	44.39	474.28	440.47	6443.89
2001-02	127.71	4139.92	30.57	280.07	39.79	329.67	174.98	713.11	51.43	494.28	424.47	5957.05
2002-03	134.82	4608.31	41.38	417.09	37.84	384.37	196.32	841.63	56.94	629.91	467.30	6881.31
2003-04	129.77	4013.07	39.61	435.18	37.83	372.92	138.02	620.73	66.78	650.05	412.01	6091.95

Source: MPEDA.

Where G = Commodity concentration coefficient (CC)/Geographic concentration coefficient (GC), X_{it} = Export earnings of commodity group i in year t/Export earnings from country i in year t and X_t = Total export earnings in year t.

Measurement of Export Instability

A variety of instability indices are available in the literature from simple to complex. The variance of export growth is the simplest measure of export instability. But owing to fluctuations in export volumes and values, deviations from trend in exports could be more ideal measure of export instability. Various corrections for trend are available in the literature, viz., moving averages, linear and exponential trends (Pinsuwana, 1991, Bhat and Nirmala, 2001, Devkota, 2004). Each of these methods has its own advantages and disadvantages. The present study attempts to compute the instability of exports by using the measure, based on the average percent deviation of the observed values proceed from an exponential path (Paudyal, 1988). The instability index (II) can be expressed by the formula.

$$II = \left[\left| \frac{X_t - \hat{X}_t}{\overline{X}} \right| \right] x100 \qquad \ldots(2)$$

Where II = Instability index, $\hat{X}_t$ = Estimated trend value, X_t = Actual value, $\overline{X}$ = Mean of the actual value.

IV

MODELLING INDIAN SEAFOOD EXPORT INSTABILITY

Theoretical Framework

The literature on the determinants of export instability is well established. The determinants are commodity concentration (CC), geographical concentration (GC), the ratio of food and raw materials to total exports, per capita income of exporting country, openness of the economy and export shares in world trade, etc. The empirical evidence on the relationship between these determinants and export instability appears inconclusive. Studies like Massell (1970) and O’Brien (1972) show no significant link between export instability and its alleged determinants. However, studies like Paudyal (1988), and Tegegne (2000) showed that these determinants do affect export instability. The cross-country analysis by earlier studies implicitly assume a unique relationship between a given explanatory variable and the degree of export instability across the countries. Thus, estimates using cross section data to find the average relationships does not provide much information on the behaviour of producers of specific commodities in the chosen countries. Only few studies such as Love (1992), Wilson (1994), Sinha (1999), Tegegne (2000), used time series analysis on an individual country basis. But, most of the available time series studies do not address the issues of non-stationary nature of data. Hence it could not be ruled out that these estimates are estimated from spurious regression. Mullor-Sebastian (1988) argued that studies, which lump together the exports of all goods, are misleading because export instability of a given product is influenced by the characteristics of the individual product and degree of development of the exporting country. Accordingly, the present study confine itself to instability in Indian seafood export earnings and uses the time series data after considering the non-stationary nature of the data.

Earlier statistical evidences conclude that instability index of exports are largely associated with the degree of commodity concentration of exports, per capita income and with the concentration of exports by geographical area of destination (Paudyal, 1988, Sinha, 1999, Tegegne, 2000). Thus, instability index of seafood exports earnings could be expressed as a function of commodity concentration (CC), Geographic Concentration (GC) and Instability in country's GDP which reflects per capita income of the exporting country.

$$IISFEX = f\,(CC, GC, IIGDP) \qquad \ldots (3)$$

To separate out the effects of the fisheries GDP on instability of seafood exports equation 3 is redefined as follows

$$IISFEX = f\,(CC, GC, IIFGDP, IINFGDP) \qquad \ldots (4)$$

Where IIFGDP represents Instability index of fisheries GDP and IINFGDP Instability index of non-fisheries GDP.

Tegegne (2000) argued that apart from the other key determinants of exports income fluctuations, the relative importance of major commodity, global demand conditions affecting the major commodity, internal supply conditions should also be considered. Among seafood exports, frozen shrimp is the single largest export item. The proportion of exports from cultured shrimp production has kept rising, implying that any instability caused in seafood exports could be mainly due to fluctuations in the cultured shrimp production. Thus to capture the fluctuations in seafood exports, cultured shrimp production is also considered as one of the determinants. Thus equation 4 can be written as

$$IISFEX = f\,(CC, GC, IIFGDP, IINFGDP, IISHPR) \qquad \ldots (5)$$

Computational Framework

To establish cause and effect relationship between major determinants and seafood export instability a double log-linear function is preferred because of ease of interpretation and best fit. Thus the long-run seafood export instability function is specified as follows

$$\text{liisfex} = \beta_0 + \beta_1 \text{lcc} + \beta_2 \text{lgc} + \beta_3 \text{liifgdp} + \beta_4 \text{ liinfgdp} + \beta_5 \text{ liishpr} + \varepsilon_t \qquad \ldots(6)$$

Where, l = Natural logarithm, ii = Instability Index, sfex = Indian seafood exports, cc = Commodity Concentration, gc = Geographic Concentration, fgdp = Fisheries GDP, nfgdp = non-fisheries GDP, shpr = Cultured shrimp production, ε_t = error term assumed to be identical and independent and $\varepsilon \sim N(0, \sigma^2)$, $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are the coefficients to be estimated.

Estimating long-run relationship such as in equation (6) is likely to pose some problems because the variables in the analysis typically exhibit multicollinearity and non-stationarity. These problems are often dealt with by taking first differences of the variables, before any estimations are done, to make the series stationary. This procedure of differencing has a major drawback; it eliminates all information about the long run relationship and thereby only short-run effects was explained (Maddala, 1992). Thus the modelling of seafood exports instability should be based on methods which explicitly take the non-stationarity features of the data into account. The theory of cointegration techniques and vector error correction models (VECM) addresses these issues in an efficient and significant manner (Engle and Granger, 1991) which implies that cointegration tests are superior when investigating the relationships that are believed to be of a long run nature.

There are several advantages in using VECM. Firstly, the VECM approach treats the variables as determined within the same system, without a *priori* assumptions about the nature of interrelationship. Secondly, it clearly distinguishes between long-run and short-run effects since both levels and first differences of the variables enter the VECM. Thirdly, the speed of adjustment towards the long-run relationship can be directly estimated. Finally, the VECM has a sound statistical foundation based on the theory of cointegration developed by Engle and Granger (1987). Despite the above advantages these models can become easily over-parameterised, as each variable is allowed to affect the other variable at a number of lags. The results can also be sensitive to the chosen lag length, although there are significance tests that can be used to determine the appropriate number of lags to be chosen. Thus transformation of equation 6 by incorporating error correction (EC) term can be represented as follows.

$$\Delta liisfex = \beta_0 + \beta_1 \sum_{i=1}^{m} \Delta lcc_{t-i} + \beta_2 \sum_{i=1}^{n} \Delta lngc_{t-i} + \beta_3 \sum_{i=1}^{o} \Delta lliifgdp_{t-i} + \beta_4 \sum_{i=1}^{p} \Delta\, liinfgdp_{t-i} + \beta_5 \sum_{i=1}^{q} \Delta liishpr_{t-i} + \delta\, ECM(-1) + e_t \quad \ldots (7)$$

Where Δ is the difference operator, ECM(-1) is error-correction term lagged by one period in the cointegrating regression, for integrating short term dynamics in the long-run seafood export function. This function allows to estimate short-run relationships between Instability index of Indian seafood exports and its determinants. e_t, the error term follows normal independent and identically distributed (i.i.d) properties. The coefficient δ measures the response of instability index of seafood exports in each period from the long-run equilibrium with the cointegration equation normalised on *iisfex*. The coefficient δ represents the proportion of the disequilibrium in *iisfex* in one period corrected in the next period. δ, is expected to have a negative sign and be statistically significant.

The modelling strategy adopted to estimate VECM involves three steps.

Step 1*: Test for Stationarity*

Before conducting cointegration tests, it is necessary to establish the univariate time series properties of the variables to confirm all the variables are non-stationary and integrated of the same order. This is performed by unit-root test, viz., Augmented Dickey–Fuller (ADF) test. This test finds out the order of integration, which is the minimal number of times a series has to be differenced until it becomes stationary.

Step 2: *Determination of Optimum Lag Length*

The cointegration test is based on vector auto regression and is sensitive to the number of lags included in the model; therefore first we should determine the optimal number of lags used in the cointegration test. One way to determine the number of lags is to select the model with minimum information criterion which are based on log-likelihood and penalise the inclusion of additional regressors (Greene, 1993). The study utilises Akaike information criterion (AIC) to choose the optimum lag length.

Step:3 *Cointegration Test and VECM*

The purpose of cointegration test is to determine whether a group of non-stationary series is cointegrated or not. The presence of cointegration enables to form a vector error correction mechanism to analyse both the short and long-run relationship among cointegrated series.

There are a number of alternative cointegration tests (Engle and Granger 1987; Stock and Watson, 1993 and Johansen, 1988 and 1995). The common objective of these tests is to determine if there exists a long-run relationship among all variables. Johansen cointegration procedure has properties which are superior to alternative methods of cointegration testing. This method treats all the variables as endogenous and take care of the endogeneity problem by providing an estimation procedure that does not require arbitrary choice of a variable for normalisation. It also allows tests for multiple cointegrations (Ghosh, 2003). Even though this methodology is quite complex, the underlying inference is straightforward. In order to find the possible cointegrating vectors the data is divided into two groups, the variables in their levels and their first differences, using the technique of canonical correlation, the linear combinations are stationary and thus so are the cointegrating vectors (Jaffry *et al.*, 1998). The present study empirically evaluates cointegration between variables by utilising ML method of cointegration developed by Johansen (1988, 1995) and extended by Johansen and Juselius (1994).

V

EMPIRICAL RESULTS

The individual variables were processed according to the methods described, before attempting the estimation of model as detailed in the foregoing sections. The summary statistics are presented in Table 3.

TABLE 3. SUMMARY STATISTICS OF MODEL VARIABLES

	1981-1991		1991-2004		1981-2004	
Variable (1)	Mean (2)	Standard Deviation (3)	Mean (4)	Standard Deviation (5)	Mean (6)	Standard Deviation (7)
CC	81.365	5.308	70.600	1.931	75.748	6.701
GC	66.893	5.762	55.041	3.055	60.709	7.510
IISFEX	4.373	3.450	39.100	35.843	22.491	31.022
IIFGDP	24.905	13.383	20.023	11.560	22.358	12.427
IINFGDP	0.810	0.674	11.954	10.713	6.624	9.486
IISHPR	1.872	1.320	13.448	11.884	7.912	10.313

Commodity concentration reflects the composition of exports. It also indicates the direction of growth in terms of variety, product differentiation and sources of value realisation. It is therefore an important parameter to be examined for export data analysis. For computing commodity concentration (CC), careful selection of specific commodities is crucial. As composition of Indian sea food exports have changed with the passage of time as detailed under Section II, the items contributing maximum value were selected. In the early 1970s Indian seafood exports basket contained merely 37 items (including processed). By 2000, it rose to 141 items. These product forms can be mainly categorised into the following: frozen shrimp (6 product forms), frozen fin fish (22), live items (5) chilled items (5), canned items (5) dried items (30), shell items (3), cuttle fish (13) squid (14), frozen lobster (6) others (32). Even though different product forms are exported from India, the major commodities are frozen shrimp, frozen fish, frozen cuttle fish, frozen squid which constitutes nearly 90 per cent of the earnings from seafood exports. Hence, these items are considered in the computation of commodity concentration and rest were included as "others". Mean value of commodity concentration has decreased indicating the fact that India diversified her exports geographically during the 1990s as compared to the 1980s since the index value decreased from 81.37 per cent to 70.60 percent (Table 3). The results (not presented here) also indicate a gradual decrease in commodity concentration from 87.13 per cent in 1981-82 to 68.16 per cent in 2003-04 which reflects the country's diversifying profile of exports. This is confirmed by the fact that though the value added portion in seafood exports is only 20 per cent, this segment is increasing at 55 per cent annually. However, major commodities still make a substantial contribution to the total value realised from exports in value terms.

Geographic concentration (GC) was computed considering Japan, U.S.A. and Western European countries and rest as "others". In spite of decrease in GC index value from 66.89 per cent (1981-91) to 55.04 per cent (1991-2004) indicating in general that the geographic concentration of exports was high. It also meant that the markets for Indian seafood exports remained stable during this period. No structural shift was observed during the period under study. The figures remaining highly stable, as can be seen from decrease in standard deviation from 5.46 per cent to 3.5 percent, the country's seafood exports remained stable. Again, looking at the data on the geographical spread of exports, with the ascendancy of the Euro, India has been making deeper inroads into the EU markets; 27.42 per cent of Indian seafood was exported to the EU in 2004-05 with 23.37 per cent to the US and 18 per cent to Japan.

Using equation 2, the Indian seafood export instability was worked out, following absolute average percentage deviations method of the observed values using an exponential path of trend values. The mean values of instability index of seafood exports were 4.37 per cent during the 1980s and 39.10 per cent during the 1990s, indicating that the instability in sea food exports has increased over the period of time. The potential of seafood exports as a source of enhanced revenue for propping up the foreign exchange reserves and the national GDP was discovered only in the early 1990s. The instability in the 1990s may be due to the gaps in institutionalising the growth which led to short term fluctuations in the sector (Shang *et al.*, 2001).

The decrease in instability indices of fisheries GDP from 24.91 per cent in the 1980s to 20.02 per cent in the 1990s with reduced standard deviation values of 13.38 per cent in the 1980s and 11.56 per cent in the 1990s indicate robust growth of the fisheries sector. But the estimates also show that there is a need for stabilising the growth of the other sectors within the economy. The value of instability indices of non-fisheries GDP increased from 0.81 per cent to 11.95 per cent with its corresponding standard deviation increasing from 0.67 per cent to 10.71 per cent. Instability in growth of lead sectors has been attributed to slow growth of the agricultural sector (1.5 per cent) in the current plan period leading to an overall decline in the performance of the economy.

Before estimating the relationship between seafood exports instability and its determinants, the integration properties or stationarity properties has to be determined. The unit root tests were performed for all the variables by employing ADF test on both levels and first differences of the variables. The results presented in Table 4 indicate that the ADF test in levels does not allow for rejecting the null hypothesis (H_0) but it can be rejected at first differences. This means that all these variables are integrated of the order one, i.e, I(1).

TABLE 4. AUGMENTED DICKEY FULLER UNIT ROOT TEST RESULTS

(1)	Particulars (2)	At levels (3)	At first differences (4)	Decision (5)
Variables	*liisfex*	-1.196	-4.107	I(1)
	lcc	-0.846	-4.905	I(1)
	Igc	-1.283	-5.138	I(1)
	liifgdp	-2.922	-5.389	I(1)
	linfgdp	-1.421	-5.216	I(1)
	liishpr	-2.213	-5.529	I(1)
Critical values	5 per cent level of significance	-3.760	-3.788	
	1 per cent level of significance	-3.005	-3.102	

As mentioned in the methodology, the Johansen cointegration test is sensitive to lag length. It is essential to identify the appropriate lag length before proceeding for the cointegration test. One of the most commonly used procedures to identify the lag length is to estimate VAR using un-differenced data and compare their AIC (Chin and Fang, 2003). Based on AIC results, optimum lag length indicated is 1 for the equation. Since all the variables are I(1) Johansen multivariate cointegration test was applied to determine rank of impact matrix (Π) and estimate the cointegration equations. An unrestricted intercept and a linear trend in the variables, but not in the co-integrating vectors enter the system. The results of λ_{trace} and λmax in Table 5 indicate that the rank of Π can be set to 2 based on λ_{trace} statistic at both 5 per cent and 1 per cent level of significance and λ_{max} indicated that there exists one co-integrating equation at both 5 per cent and 1 per cent level of significance.

Based on the largest Eigen value we considered the first cointegrating equation and normalised long-run cointegration equation on *liisfex* variable. The cointegrating vector corresponding to maximal Eigen value (i.e., dominant long run relationship) is presented as follows.

TABLE 5. JOHANSEN COINTEGRATION TEST RESULTS

Hypothesied no. of CE(s) (1)	Eigen value (2)	Trace statistic λ_{trace} (3)	5 per cent critical value (4)	1 per cent critical value (5)	Max-Eigen Statistic λ_{max} (6)	5 per cent critical value (7)	1 per cent critical value (8)
None	0.937	135.68	94.15	103.18	58.12	39.37	45.10
At most 1	0.771	77.56	68.52	76.07	30.95	33.46	38.77
At most 2	0.663	46.61	47.21	54.46	22.84	27.07	32.24
At most 3	0.566	23.76	29.68	35.65	17.56	20.97	25.52
At most 4	0.242	6.21	15.41	20.04	5.83	14.07	18.63
At most 5	0.018	0.380	3.76	6.65	0.380	3.76	6.65

$$\underset{}{liisfex} = \underset{(2.214)}{-15.462^{*}}\, lcc + \underset{(1.728)}{4.902^{*}}\, lgc + \underset{(0.102)}{0.303^{*}}\, liifgdp + \underset{(0.093)}{0.774^{*}}\, liinfgdp + \underset{(0.077)}{0.610^{*}}\, liishpr \quad \ldots(10)$$

In the above long-run model all coefficients have the anticipated signs indicating *gc, iifgdp, iinfgdp and iishpr* have positive effect on the instability in exports and cc have negative effect. Thus one unit increase in the geographic concentration indicates 4.9 units increase in the instability index of Indian seafood exports. The impact of instability due to non-fisheries GDP is more compared to instability in fisheries GDP as reflected by the magnitude of coefficients. Similarly, instability in shrimp production also has a positive impact on instability index.

However, commodity concentration appears to have a negative effect on the instability in seafood exports indicating that if commodity concentration decreases by one unit the instability of exports will increase by 15.46 times. In this context this may be interpreted as a fall in the proportion of high value frozen shrimp in favour of lower value items in the composition of Indian seafood exports over time. Table 6 provides the short run coefficients of the instability equation including error-correction term.

TABLE 6 ESTIMATES OF SHORT-RUN INDIAN SEAFOOD EXPORTS INSTABILITY MODEL

Variable (1)	Estimated coefficients (2)	t-Statistics (3)
Δliisfex	0.251 (0.237)	1.055
Δlcc (-1)	-5.475 (6.626)	-0.826
Δlgc (-1)	-2.76 (6.576)	-0.421
Δliifgdp (-1)	0.169 (0.179)	0.948
Δliinfgdp (-1)	-0.051 (0.235)	-0.216
Δliishpr (-1)	0.372 (0.150)	2.352
Constant	0.012 (0.242)	0.050
ECM(-1)	-0.546 (0.239)	-2.288

Figures in parentheses are standard errors of estimated coefficients.

The international seafood market is governed by both price and non-price factors. In the post-WTO scheme of globalised scenario, product improvement and differentiation is more of a norm than an exception. Therefore, the short-term coefficients are smaller than their long run counter parts. This suggests that the impact of these variables causing instability in Indian seafood exports requires time for adjustment. The estimated coefficients show that all the variables except instability in cultured shrimp production did not show significant short-run impact on instability in seafood exports. The significance of this short run effect is minimised by the error-correction term, which is significant with the expected sign and of a fairly larger magnitude. This finding not only supports the validity of long-run equilibrium relationship among the variables but also indicates that instability in seafood exports is sensitive and tends to depart from the equilibrium value in the previous period. Its magnitude indicates that deviation from the long-run is adjusted fairly quickly when 54.6 per cent of disequilibrium is recovered in each period. The results also substantiate the fact that the seafood export sector is responsive to the fast changing profile of the market. Conforming to Hazard Analysis and Critical Control Points (HACCP) standards, improvements in processing and packaging standards and development and marketing of niche products to select the markets are enabled quickly in order to take advantage of the gains from trade even in the short run (Dey *et al.,* 2005).

VI

CONCLUSIONS

Stabilisation measures can be realised internally by the government, using domestic stabilisation schemes or externally by the international community, using different policy instruments with or without market intervention. Routine measures to remedy the adverse effects of unstable export earnings are stabilisation of remunerative prices of export products (though price stabilisation alone cannot stabilise export earnings), rationalising balance of payments, restoring balance between foreign exchange outflow and inflow; management of government revenue (since export production provides foreign exchange earnings and tax revenues) ensuring the cash flow of the sector in general and producer incomes in particular.

Considering the instability of export volumes, a strategy aimed at export diversification in general, measures to stabilise supply of seafood products by using research and technology development would be the most appropriate. With regard to price fluctuations of commodities, in addition to price stabilisation policies, appropriate improvement in the product profile with emphasis on value added products which circumvent the price factors including anti dumping duties and bonds could provide the way out. The primary fishery producers, viz., small farm operators who account for the bulk of fish production, can stabilise their own revenues by using instruments of risk management like forward contracts with input dealers for sale of the produce. At the global level, the Minneapolis Grain Exchange (MGE) is the only commodity market which entertains forward trading of seafood. Therefore adoption of advanced strategies in marketing helps to minimise the price risk and ensure assured returns to seafood exports.

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