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INSTABILITIES IN INDIAN SEAFOOD EXPORTS: SOURCES, SHORTFALLS AND STABILISATION MEASURES – A TIME SERIES ANALYSIS

C.Sarada, T.Ravisankar, M.Krishnan and C. Ananadanarayanan

केन्द्रीय खारा जलजीव पालन अनुसंधान संस्थान

(भारतीय कृषि अनुसंधान परिषद्)

75, संथोम हाई रोड, आर.ए. पुरम्, चेन्नई - 600 028

CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE

(Indian Council of Agricultural Research)

75, Santhome High Road, R.A. Puram, Chennai – 600 028, India

Phones: 044-2461-6948/8817/0565 Fax: 044-2461-0311

URL: www.ciba.tn.nic.in

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PREFACE

The share of seafood exports in agricultural commodities exports from India has been increasing overtime. It has varied from 16 – 18 percent during the past few years. The performance of Indian seafood exports has been remarkable in the Indian context. Seafood exports have earned US$ 1.62 billion in the last fiscal 2005-06 with frozen shrimps registering 59 % of the total value realized followed by other species and product forms.

But in the international scenario, Indian seafood exports are only notching up 1.5 – 2 % of the value of total international trade in seafood. The reasons for this are not very difficult to understand. With the acceptance of the WTO regime and the HACCCP guidelines, product differentiation, market diversification and highest quality standards alone will help improve market share and gross turnover.

It is also important to learn the relationships between the various factors that enter into the determination of such numbers. How does the numbers relating to fisheries GDP, the non fisheries GDP and shrimp production behave in respect of commodity concentration and geographical spread? What bearing do these factors have on the instability in turnover from seafood exports? How does the data behave to a given approach in methodology to analyze instability?

The Social Sciences Division of this institute examines various important socio-economic issues relevant to the sector in the institute funded project, “Technology Transfer, Socio-economic Aspects and Informatics in Brackishwater Aquaculture”. Dr (Mrs.) C.Sarada, Scientist (Ag. Statistics) and co-authors have done a remarkable job in trying to find answers to the questions stated above. Nevertheless, it may be stated that the results and interpretations are only a reflection of the data set that have been examined and the methodology employed. The study does not reflect the views of the ICAR and the institute on the subject.

PROJECT LEADER   DIRECTOR

INSTABILITIES IN INDIAN SEAFOOD EXPORTS: SOURCES, SHORTFALLS AND STABILISATION MEASURES – A TIME SERIES ANALYSIS

C.Sarada, T.Ravisankar, M.Krishnan, and C.Anandanarayanan

ABSTRACT

For developing countries like India, major share of export earning is mostly concentrated on few commodities and from a couple of nations. It is difficult to hedge the adverse effects of instability of export earnings. Thus managing commodity price risk and stabilising export earnings are important policy issues for all low income and commodity exporting countries. This paper investigates commodity concentration and geographical spread of seafood exports and significant factors that affect the instability in the seafood exports from India. In empirical analysis of Indian seafood exports instability function, cointegration and error correction modelling approaches have used. In the seafood exports, instability in exports is found to be cointegrated with instability in commodity concentration, geographical concentration, fisheries GDP, non fisheries GDP and shrimp production. The long run estimates suggests that all the variables have positive effect except instability in commodity concentration. The estimated coefficient value of the error correction term suggests that the system corrects its previous period's disequilibrium by 54.6 per cent. In addition to price stabilization policies, with emphasis on value added products, forward trading could be the way out to circumvent the instabilities.

Key words: Instability, Indian Seafood, Commodity Concentration, Geographic Concentration, Cointegration, Vector Error Correction Models

1. Introduction

Fluctuations in fish production from capture and culture, variations in international prices, adjustments in exchange rates and finally – the wavering of the 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 future fall in export earnings and Gross National Product (GNP). Export oriented producers who suffer from earning shortfalls will also cut back their consumption, which affects the basis of 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 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 export of seafood assume immense importance in economic scenario of India and hence the present study was attempted with the following objectives

1. To develop 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 those affect the instability in the seafood exports from India.

The paper is arranged in following sections. In the second section we discuss the structure and pattern of fisheries development in India during the past four decades. The third section deals with data and transformation procedures. The fourth section describes theoretical and computational framework. In the fifth section results are presented. The final section gives a summary of findings and discusses policy alternatives.

2. Indian Fisheries Sector - Status And Growth

With an annual fish production of 6 million metric tones India occupies the position of fourth in fish production and second in aquaculture production globally. Annual domestic per capita fish availability is nine kilograms. Seafood export earnings of India remains steady above Rs. 6,000 crores. Fish contributes 1.4 per cent of GDP and 4.5 per cent of 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. The frozen items entered the export basket for the first time in 1953 in negligible quantities. From 1961, the export of dried seafood products was on decline and exports of processed items were making steady progress. Some improvement in the product profile of seafood exports was visible after 1966. Frozen and canned items gained wider acceptance. 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 etc. 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 affluent markets like USA, France, Australia, Canada, Japan etc. became important buyers. The USA was 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. While Japan continued to be the single largest buyer of our marine products accounting for

15.29 per cent in volume and 30.56 per cent in value during 2001-02. USA accounted for 11.55 per cent of volume and 23.86 per cent of the value during the same period. Share of USA is increasing steadily. 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 item 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 export from India. During eighties, the canned items slowly disappeared and frozen items gained prominence in India's seafood trade. Amongst the frozen items also, there was changes in the demand for differentiated products from various countries. While Japan showed their preference to headless shell on shrimp, the USA 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 seventies, 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 is continuing as the major foreign exchange earner among seafood products and the volume of frozen shrimp exported during 2003-04 was 412017 metric tons.

3. **Data And Methods**

3.1 Data

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 also obtained from MPEDA. Gross Domestic Product (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.

3.2 Methodology

3.2.1 Measures of Concentration

Several concentration measures are available in the literature for e.g. Bailey and Boyle (1971), Tongan (1994), Tegegne (2000), Erlat and Akyuz (2001), Zulfiqar (2001), Campa and Fernandes (2004) used different measures for different studies. The appropriateness of a measure depends on data on which estimates based and with the purpose of analysis. The present study utilizes the most widely employed Gini-Hirschman coefficient of concentration, which defines the degree of concentration in a country’s export as

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

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

X_t = Total export earnings in year t

3.2.2 Measurement of Export Instability

A variety of instability indices are available in literature from simple to complex. The variance of export growth is the simplest measure of export instability. But owing to fluctuations in exports volumes and values , deviations from trend in exports could be more ideal measure of export instability. Various corrections for trend are available in literature viz., moving averages, linear and exponential trends. Massell (1964, 1970) and Kingston (1973, 1976) used deviations between observed and estimated values obtained by fitting the linear and exponential trend lines. Mac bean (1966) used another measure based on the deviations of actual values from the trend values, obtained from the five yearly moving averages. Knudsen and Parnes (1975) used a transitory index to measure instability. Pinsuwana (1991) employed Coppock's logarithmic variance instability index to study the market stability for the Thai Frozen shrimp exports. 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, FAO, 2002). The instability index (II) can be expressed by the formula.

$$\mathrm{II} = \left[\left| \frac{X_t - \hat{X}_t}{\overline{X}} \right| \right] \text{ x}100 \qquad \ldots(2)$$

Where II = Instability index

$\hat{X}_t$ = *Estimated trend value*

X_t = *Actual value*

$\overline{X}$ = *Mean of the actual value.*

3.2.3. Modelling Indian Seafood Export Instability

3.2.3.1 Theoretical Framework

The literature on 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 Coppock, (1962), Erb and Shiavo-camp (1969) Massell (1970) O'Brien (1972), show no significant link between export instability and its alleged determinants. However, some of the recent studies like David Murray (1978), Paudyal (1988), Love (1985) and Tegegne (2000) showed that these determinants does affect export instability. Almost all previous studies concentrated on cross-country regression with some measure of export instability as the dependent variable. This cross-country analysis implicitly assumes 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 average relationships does not provide much information on behaviour of producers of specific commodities in the chosen countries. Only few studies such as Love (1985, 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 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 confines to instability in Indian seafood export earnings. The present study uses the time series data to study the determinants of seafood exports instability after considering the non-stationary nature of the data.

It is an established fact that volatility/ fluctuations in export earnings originate from variations in supply or demand variables or other price and non- price factors. Most of the recent studies based on the statistical evidence conclude that instability index of exports are largely associated with degree of commodity concentration of exports, per capita income and with the concentration of exports by geographical area of destination (Murray, 1978, Paudyal, 1988, Sinha, 1999, Tegegne, 2000). Thus, instability index of seafood exports earnings can 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 other key determinants of exports earning 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

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

3.2.3.2 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

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

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 draw back; it eliminates all information about the long run relationship and there by only short-run effects was explained. (Hendry, 1986, Maddala, 1992 and Bentzen and Engsted 1992).

Thus the modelling of seafood exports instability should be based on methods which explicitly take the nonstationarity 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.

The concept of cointegration is that even if two or more variables are non-stationary in their levels, a linear combination of the variables which is stationary may exist (Engle and Granger, 1987). When cointegration is verified the variables exhibiting a long run relationship implies the existence of an equilibrium condition. Variables may drift apart due to random shocks in the short run, but in the long run economic equilibrium processes forces the variables back to their equilibrium paths (Engle and Granger, 1991). The implication here therefore is that cointegration tests are superior when investigating 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 *apriori* 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-parameterized, 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 normalized 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 and unit root tests.

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 become stationary. The procedure is to estimate the statistic by applying the ordinary least squares (OLS) method to the following equation.

$$\Delta X_t = \alpha + \beta X_{t-1} + \sum_{i=1}^{k} \delta_i \Delta X_{t-i} + \varepsilon_t \qquad \ldots(8)$$

where Δ is the difference operator and k is number of lags, error ε_t is the white noise. The inclusion of lagged first differenced terms in the regression controls the higher order correlation in the series. The null hypothesis $\beta = 0$

implies that the series is non-stationary (i.e., ~ I(1)) against the alternative hypothesis of stationary (i.e., ~ I(0)). If the compared test statistic is larger than the critical value in their absolute terms, the hypothesis of non-stationary and unitroot could be rejected.

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 number of lags is to select the model with minimum information criterion which are based on log likelihood and penalize the inclusion of additional regressors (Greene, 1993). Normally multivariate forms like Akaike information criterion (AIC) and Schwartz Bayesian Criterion (SBC) are used to choose the lag length. In the present study AIC is chosen over SBC as it chooses longer lags since it penalizes the additional regressors less than SBC and also has superior small sample properties. The AIC is given by

$$\mathrm{AIC} = \mathrm{T}\ln\left|\hat{\Sigma}\right| + 2\mathrm{m} \ \text{ and } \mathrm{AIC} = \mathrm{T}\ln\left|\hat{\Sigma}\right| + \mathrm{m}\ln\mathrm{T} \qquad \ldots(9)$$

Where T= length of the time series, m= number of the parameters in the model, k = lag length, $\Sigma = \sum_{t-k}^{T} \hat{e}\hat{e}'/T$ and $\hat{e}$ is n x l residual vector. The optimum lag length can be decided by choosing the specification minimizing the AIC.

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. The common objective of these tests is to determine if there exists a long-run relationship among all variables. Consequently, all of these tests are designed to find the stationary linear combinations of vector time series, and in all of these tests a number of cointegrating factors must be determined.

Engle and Granger (1987); Stock and Watson (1993); and Johansen (1988, 1991) have suggested different methods of selecting cointegrating vectors. Johansen (1988) illustrated a procedure to determine the number of cointegrating vectors in a given set of variables. Johansen's procedure uses the maximum-likelihood (ML) method of estimation to obtain number of cointegrating vectors. Later expansion Johansen (1990) Johansen and Juselius (1990, 1992, 1999), Johansen (1991) incorporated analysis for inclusion of factors like seasonality and time trends. Gonzalo (1994) concluded 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 normalization. It allows tests for multiple co-integrations (Gonzalo, 1994; Gosh, 2003).

Even though this methodology is quite complex, the underlying inference is straightforward. In order to find 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 stationary and thus so are the cointegrating vectors. (Jaffry *et al*, 1998).

The present study empirically evaluates cointegration between variables by utilizing ML method of cointegration developed by Johansen (1988, 1990) and extended by Johansen and Juselius (1990, 1992, and 1994).

4. Empirical Results

Individual variables were processed according to the methods described, before attempting the estimation of model as detailed in foregoing sections. The summary statistics are presented in Table1.

TABLE 1. SUMMARY STATISTICS OF MODEL VARIABLES.

	1981-1991		1991-2004		1981-2004	
Variable	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
(1)	(2)	(3)	(4)	(5)	(6)	(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 realization. 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 passage of time as detailed under section II, the items contributing maximum value were selected. In early 70's India seafood exports basket contained merely 37 items (including processed). By 2000, it rose to 141 items. These product forms can be mainly categorized into the following: frozen shrimp (6), 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 earnings from seafood exports. Hence, these items are considered in 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 90s compared to 80's since the index value decreased from 81.37 percent to 70.60 percent (Table 1). The results (not presented here) also indicate a gradual decrease in commodity concentration from 87.13 percent 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, USA 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 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 observed values using an exponential path of trend values. The mean values of instability index of seafood exports were 4.37 per cent during 80's and 39.10 per cent during 90's, 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 early 90's. The instabilities in the 90's maybe due 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 80's to 20.02 per cent in 90's with reduced standard deviation values of 13.38 per cent in 80's and 11.56 per cent in 90's indicates 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 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 presented in equation 8 on both levels and first differences of the variables. The results presented in Table (2) 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 order one i.e I(1).

TABLE 2. AUGMENTED DICKEY FULLER UNIT ROOT TEST RESULTS

Particulars		At levels	At first differences	Decision
Variables	*liisfex*	-1.196	-4.107	I(1)
	lcc	-0.846	-4.905	I(1)
	lgc	-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 % level of significance	-3.760	-3.788	
	1 % 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 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 (1991) and Johansen and Juselius (1990,1992, 1994) multivariate cointegration test was applied to determine rank of 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 3 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.

TABLE 3. 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

Based on the highest eigen value we considered the first cointegrating equation and normalized 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.

$$liisfex = -15.462^{*}\ lcc + 4.902^{*}\ lgc + 0.303^{*}\ liifgdp + 0.774^{*}\ liinfgdp + 0.610^{*}\ liishpr$$

$$(2.214) \quad (1.728) \quad (0.102) \quad (0.093) \quad (0.077) \qquad \ldots(10)$$

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 instability in seafood exports indicating that if commodity concentration decreases by one unit the instability of exports will increases by 15.46 times. In this context this maybe 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 overtime. Table 4 provides the short run coefficients of the instability equation including error-correction term.

TABLE 4. ESTIMATES OF SHORT-RUN INDIAN SEAFOOD EXPORTS INSTABILITY MODEL

Variable (1)	Estimated Coefficients (2)	t-Statistics (3)
ΔIiisfex	0.251 (0.237)	1.055
ΔIcc(-1)	-5.475 (6.626)	-0.826
ΔIgc(-1)	-2.76 (6.576)	-0.421
ΔIiifgdp(-1)	0.169 (0.179)	0.948
ΔIiinfgdp(-1)	-0.051 (0.235)	-0.216
ΔIiishpr(-1)	0.372 (0.150)	2.352
Constant	0.012 (0.242)	0.050
ECM(-1)	-0.546 (0.239)	-2.288

The international seafood market is governed by both price and non price factors. In the 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 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 minimized by the error-correction term, which is significant with expected sign and of a fairly a 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 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 HACCP standards, improvements in processing and packaging standards and development and marketing of niche products to select markets are enabled quickly in order to take advantage of gains from trade even in the short run (Dey et al., 2005).

5. Conclusions

Stabilization measures can be realized internally by government, using domestic stabilization 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) rationalizing 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.

Domestic stabilization schemes easily could become hidden subsidies, expensive to administer and can create heavy demands on government budgets. Instruments to stabilize income of individual smallholders include variable export taxation or the institution of stabilization funds (single or multi-commodity marketing boards like APEDA, MPEDA and so on). National marketing organizations have also been used in India (Rubber Board, NDDB, NECC and so on) for protecting producers from price volatility in world markets is a desired social objective. Such a policy may, however, weaken the link between supply and world price signals, reducing the risks associated with price fluctuations, and thereby contributing to oversupply.

Considering instability of export volumes, a strategy aimed at export diversification in general, measures to stabilize 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 stabilization policies, appropriate improvement in 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 fishery commodity production, can stabilize their own revenues by using instruments of risk management like forward contracts with input dealers for sale of 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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Project : CIBA/TTEIS/03: Technology Transfer, Socio-economic aspects and Informatics in Brackishwater Aquaculture Web site: www.ciba.tn.nic.in		
	Project Team	
1.	Dr. M.Krishnan	Principal Scientist (Ag. Economics) and Project Leader
2.	Dr. T.Ravisankar	Senior Scientist (Ag. Economics)
3.	Dr. V.S.Chandrasekaran	Senior Scientist (Ag. Extension)
4.	Dr. B.Shanthi	Senior Scientist (Home Science Extension)
5.	Dr. D. Deboral Vimala	Senior Scientist (Ag. Extension)
6.	Dr.M.Kumaran	Scientist (Senior Scale) (Ag. Extension)
7.	Dr. K.Ponnusamy	Scientist (Sr. Scale) (Ag. Extension) w.e.f. 11 May 2006
8.	Dr. C.Sarada	Scientist (Senior Scale) (Ag. Statistics)
9.	Mrs. P. Mahalakshmi	Scientist (Computer Applications) w.e.f. 17 Feb, 2006
10.	Mr. M.Shenbagakumar	Technical Officer
11.	Mr. S. Rajukumar	Technical Assistant
12.	Mr. M.Ravi	Technical Assistant
13.	Mr. C.Anandanarayanan	Technical Assistant
14.	Mr. K.Nityanandam	Supporting Staff Gr II

Corresponding Author: Dr. C.Sarada, Scientist (Senior Scale)
E-mail: saradac@yahoo.com