

IMPACT OF SANITARY AND PHYTOSANITARY (SPS) MEASURES ON INDIAN SEAFOOD INDUSTRY: A MACRO AND MICRO LEVEL ANALYSIS

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ABSTRACT

This study represents an attempt to estimate the effects of SPS measures in terms of trade elasticity of regulations and competitiveness of exports. In spite of the generalized acknowledgment of growing liberalization of trade between countries, there are still numerous obstacles to trade, more of the non-tariff type. This study aims to contribute to the literature on quantifying the economic impact of health and environmental regulations expressed in the form of SPS measures on international trade in agro-food products, by taking Indian seafood exports case study. The gravity analysis, complemented with the CMS model, helped to obtain an insight into the overall dynamics of the export markets, trade flows and competitiveness of fish and fishery products (aggregate level), shrimp and cephalopods. For the regulatory variable, the maximum residue limit (MRL) on cadmium in the model is used as an independent variable. Thus, it was made much insightful in understanding the relationship between trade restrictiveness of regulatory stringency and export competitiveness of the commodities. A detailed study on micro level dynamics of Kerala seafood export sector has been carried out, particularly to understand what the industry level changes are experienced during the food safety regime. The results indicate that regulations on cadmium appear to be moderately trade restrictive. At the same time results are divergent at the disaggregate level, which is significant from the point of view of policy. The most important aspect of the existing chain in Kerala seafood sector is the gradual disappearance of the independent pre processing sector which has been an important stake holder of the seafood value chain of Kerala. The pre processing node of the value chain is getting integrated to the processing sector causing a major restructuring of the existing value chain.

Keywords: Competitiveness, Food safety, Seafood Industry, Value Chain

INTRODUCTION

The proliferation and increased stringency of food safety and agricultural health standardsⁱ is a source of concern among many developed countries either because these countries lack the technical and administrative capacities needed for the compliance or because these standards can be applied in a discriminatory or protectionist manner. Therefore, it is important to understand the impact of such standards on various agricultural export sectors in the developing countries. Here, I attempt to capture the impact of food safety standards on seafood exportsⁱⁱ from India.

Mandatory standardsⁱⁱⁱ fall within the purview of the World Trade Organization (WTO), specifically the Sanitary and Phytosanitary (SPS)^{iv} and Technical Barriers to Trade (TBT) Agreements. These agreements have established international rules that aim to prevent mandatory standards impeding trade unless they are required to achieve a legitimate objective and, in such circumstances, to ensure that the measures applied are least trade distortive. Quantifying the trade impact of SPS measures is essential to resolve trade disputes and to provide a basis for calculating compensation claims. As Otsuki, Wilson and Sewadeh (2001) pointed out; one major issue in trade policy is to compare the compliance costs of exporters with possible gains from complying. In the survey of the methodologies for quantifying the effects of SPS measures on trade, Beghin and Bureau (2001); Ferrantino (2003) note that estimating the trade forgone as a result of stringent SPS measures is an important step. They mentioned that a comprehensive impact assessment of SPS measures is necessary for the following reasons; 1) to address the role to be given to non-tariff instruments and barriers in a future trade agreement and 2) to inform governments the costs of their SPS policies and provide the tools necessary to define more efficient solutions and regulations. Without quantification of the trade effect of SPS and TBT, it is unclear as to how significant they are as trade barriers. The direction and magnitude of the impact of SPS measures are essentially an empirical issue.

Unnevehr (2003) documents four cases from developing countries whose access to export markets was denied due to sanitary or phytosanitary issues, resulting in substantial costs in terms of lost sales, market share, and investments required to re-enter export trade. They included fish from Kenya, raspberries from Guatemala, shrimp from Bangladesh and horticultural crops from Guatemala, Jamaica and Mali. Wilson and Otsuki (2001) investigated the effect of aflatoxin^v standards in the EU on Africa-EU trade flows and health risks. They examine three regulatory

scenarios: standards set at pre-EU harmonized levels, the standard set by Codex Alimentarius Commission (CAC)^{vi}, and the new harmonized EU standards. The human health implications of strengthening aflatoxin standards come from risk assessments conducted by the Joint FAO-WHO Expert Committee on Food Additives (JECFA). Using a gravity model, which includes aflatoxin standards as one of the explanatory variables, they predicted the effect of changes in the aflatoxin standard on trade flows between Africa and Europe. They conclude that compared to Codex standards, the implementation of the new harmonized aflatoxin standard in the EU would reduce health risk by approximately 1.4 deaths per billion a year, but would simultaneously decrease African exports to the EU by about US \$670 million. Jaffee and Henson (2005) provide a different picture by arguing that standards are not necessarily barriers for developing countries. They estimate the value of agro-food exports from developing countries rejected at the border due to SPS measures at about US \$1.8 billion, 74 per cent of which is accounted for by middle-income countries. The estimated value of low-income country agricultural and food product trade rejected at the border of importing country is US \$275 million, representing just less than one per cent of the agricultural and food exports of these countries. Other recent works on quantifying the impact of SPS regulations are by Bakshi (2003) and Gebrehiwet (2004). Bakshi (2003) looked at the markets for Mexican avocados and examined the effect of demand, supply, imports and prices of partial easing of SPS barriers to trade in the US markets. Gebrehiwet (2004) quantifies the trade effects of SPS regulations on South African exports to the markets of Organization for Economic Cooperation and Development (OECD) countries by employing a gravity model, focusing only on a single regulation.

Marine products have long been the most buoyant among Indian export lines, following the imposition of stringent quality controls for marine products after the SPS regulations came into force. The demand for stringent and high hygienic standards in the production and processing facilities greatly increased, after the stipulation of Hazard Analysis Critical Control Point (HACCP) by United States Food and Drug Administration (USFDA), European Community (EC) directives (especially EC91/493^{vii}). The Government of India responded to these developments by taking important steps to maintain higher quality standards based on the health safety regulation requirements of the importing countries. The Seafood Exporters Association of India (SEAI) claims to have spent US\$25 million on upgrading their facilities to meet the food safety regulations of the importing countries. The resultant impact on the structure of supply chains can have significant economic and social consequences for developing countries. In many cases, this impact reflects the fact that investment in upgrading supply chains and/or regulatory systems has not been correlated with the expansion of exports. On the other hand, there can be very positive returns in terms of continued and expanded access to high-value markets for those exporters that are able to comply with. The case of seafood exports from Kerala^{viii} provides a manageable case study that throws light on the challenges faced by exporters in India as a whole. At the same time, it highlights the particular challenges faced by the Kerala seafood sector that reflect the distinct manner in which it has evolved.

In the present study I put forth two hypotheses, 1) The evolving stringent food safety standards imposed by the developing country export markets are trade restrictive to the Indian seafood export, 2) such a rise in standard will not only affect the export firms alone but also the entire supply chain will have to adjust accordingly. In other words there would be a possible reshuffling and restructuring of the supply chain. As far as hypothesis 1 is concerned, for quantifying the effects of stringent food safety standards on Indian seafood export, a gravity analysis is performed. To test hypothesis 2, a case study of seafood export sector in Kerala to analyze the implications of standards related parameters on market structures and small-scale farmers, laborers and firms in export oriented supply chain is also conducted.

SOURCES OF DATA

Data on international trade are sourced from the Commodity Trade Database (COMTRADE) of the United Nations Statistics Division. The data used are for the period 1995 to 2006 (12 years). Select bilateral trade data are also taken from the Statistical bulletin of the Marine Products Export Development Authority (MPEDA), Cochin. The study focused on member countries of the EU, Organization for Economic Co-operation and Development (OECD)^{ix} and select countries in Asia. The selection of countries in each analysis was also based on the value of trade (with regard to relevant years in the analysis) with India. The commodities covered are (Fish and fishery products, frozen shrimp, squids and cuttle fish)^x. The variables like gross national product (GNP) and population are taken from the UN Statistical Division's database. They are taken in constant US dollars of 1995. Data on *cadmium*^{xi} regulations are sourced from a range of databases which include USFDA, Codex reports and the European Commission Regulations (EC) No 466/2001.

QUANTIFYING THE TRADE EFFECTS USING GRAVITY MODEL

Quantifying the elasticity of regulation is much complex since regulations affect market supply and demand in various ways. Some studies (Wilson and Otsuki, 2004, and Roberts and Unnevehr, 2004) assume a hypothetical relationship between food safety, and the forces of demand for and supply of safe food. Information on regulations (such as maximum permissible levels^{xiii} of contaminants as numerical values) could be used in the model as explanatory variables. Among the regulations on food safety issues, the ones on the maximum permissible level of aflatoxin and pesticide residue are unique in a way that can be expressed in terms of numerical values, making them ready to be used in econometric models as independent variables. A positive coefficient indicates that the regulation is trade restrictive. The coefficient is expected to be positive if this standard impedes trade. The coefficient for the regulation (maximum permissible level) implies the change in the value of trade for an incremental change in the regulation (numerical value of maximum permissible level).

Having reviewed the limited existing literature on the quantification of the effects of public health regulations on commodity trade, it is proposed to employ a similar model to estimate the effect of a similar regulation in the context of Indian seafood exports. This analysis addresses the specific question on how much trade restrictive (trade effect or elasticity of regulation) are the Maximum Residue Limit (MRL) on *cadmium* for Indian seafood export in the export markets in the OECD and Asia. The difficulties in quantifying a range of different types of regulatory standards and restrictions are widely acknowledged. While recognizing the difficulties and limitations of such exercises, it is useful to obtain at least some (admittedly crude) quantitative assessment of the effect of regulations on *cadmium*.

Classical gravity models generally use cross-section data to estimate trade effects and trade relationships for a particular time period. But cross-section data observed over several time periods (panel data) result in more useful information than cross-section data alone. The advantages of this method are (1) Panel data can capture the relevant relationships among variables over time, (2) Panels can monitor unobservable trading partner's individual effects, (3) If individual effects are correlated with the regressors, the Ordinary Least Squares (OLS) estimates will be biased. Therefore, it is more ideal to use the Generalized Least Squares (GLS) estimation so that individual effects are captured. This also successfully tackles the problems of heteroscedasticity and autocorrelation. These are the prime considerations in employing panel data for estimations. Some additional terminology associated with panel data describes whether some observations are missing. A balanced panel has all its observations, and unbalanced otherwise.

Panel data can be estimated using various methods which include fixed effects, random effects and mixed models. Fixed effects estimation is a method of estimating parameters from a panel data set. The fixed effects estimator is obtained by OLS on the deviations from the means of each unit or time period. This approach is relevant when one expects that the averages of the dependent variable will be different for each cross-section unit, or each time period, but the variance of the errors will not. The essential difference between fixed and random effects is that the one associated with the error term. When the individual effects are important for the interpretation then binary variables are introduced to capture either the cross section or time effects, which otherwise simply accrue to the error term. Within effects fixed effects estimator estimates individual effects first which do vary across entities but do not vary across time periods. But time specific effects can be extracted by employing binary variables for time as well. Thus, the model will have $n - 1$ entity specific binary variables and $t - 1$ time specific binary variables.

MODEL SPECIFICATION AND ESTIMATION

Using the available data set, I estimate three gravity models of seafood trade from India: (1) for the total fish and fishery products (aggregate level) exports from India (2) For the shrimp exports from India (3) For the cephalopod exports from India. The shrimp and cephalopods contribute a major share in the value of seafood exports from India. More over, it is very important to look at the disaggregate level of seafood exports to get a better insight on the issue of food safety standards and the trade relations. To determine the elasticity of food safety on Indian seafood exports (for all the scenarios mentioned above) the following model is considered:

$$\ln(X_{ij})^t = b_0 + b_1 \ln(GNP_i)^t + b_2 \ln(GNP_j)^t + b_3 \ln(PCGNP_j)^t + b_4 \ln(PCGNP_{ji})^k + b_5 \ln(TGDP_j)^t + b_6 \ln(TGDP_i)^t + b_7 \ln(ER_{ij})^t + b_8 \ln(INF_j)^t + b_9 \ln(TIM P_j)^k + b_{10} \ln(CAD_j)^t + b_{11} \ln(DIST_{ij})^t + e_{ij} \quad (Eq.1)$$

Where the dependent variable $\ln(X_{ij})^t$ denotes value of exports of seafood from India (i) to countries (j) in year t . GNP_i , $PCGNP_i$, GNP_j , $PCGNP_j$ stand for the real GNP (expressed in 1995 US \$) and percapita GNP of exporting and importing countries respectively. $PCGNP_{ij}$ is the product of percapita GNP of exporting country and importing countries. $DIST_{ij}$ is the geographic distance between exporter and importers. Initially the variables ER and INF are considered so as to capture the effects of changes in exchange rate between the exporting and importing countries and inflation in the exporting country. All these values are in natural logarithms. $TGDP_i$ and $TGDP_j$ are the trade-GDP ratio of the exporter and importer respectively to capture the effects of openness of the economies. A unidirectional gravity model is used where India's exports to 35 countries in case of total seafood exports and shrimp exports and 27 countries in case of cephalopod exports are modelled by taking food safety standard/sanitary regulation as the key independent variable, apart from the typical gravity variables such as size of the economy and geographic distance. For the regulatory variable, the maximum residue limit (MRL) on *cadmium* in the model is used as an independent variable. All observations are annual for the period 2001-2006, making the total number of observations 210 in first two scenarios and 162 in the third scenario. Use of the gravity model is ideal to get the level of trade restrictiveness of the MRL of *cadmium*, which is a numerical value directly employable in the equation. Wherein $\ln(CAD)$ in equation is the variable for food safety, given as the maximum permissible level of *cadmium* in OECD and Asia. The gravity model of India's seafood exports has been estimated taking all the explanatory variables in equation (1) for all the observations. There are many variables which are found to be either insignificant or having strong multicollinearity, which were dropped. The variable for ER (Exchange rate) and INF (inflation) were also found to be insignificant and having multicollinearity. Thus, dropping out a few variables, the final estimated gravity equations for three scenarios are the following:

SCENARIO 1

FISH AND FISHERY PRODUCTS

$$\ln(X_{ij})^t = b_0 + b_1 \ln(TGDP_j)^t + b_2 \ln(PCGNP_j)^t + b_3 \ln(CAD_j)^t + b_4 \ln(DIST_{ij})^t + e_{ij} \quad (Eq.2)$$

In the equation, i denote the exporting country, j denotes the importing country and t denotes year $\ln(X_{ij})^t$ is the value of exports of total fishery products from India to various countries (35 countries in the OECD and Asia). $\ln(PCGNP_j)^t$ stands for the per capita GNP of the importing country. The proxy for transportation costs are captured by the variable $\ln(DIST_{ij})^t$ which stands for the geographical distance between exporters and importers. There are some limitations associated with the measure of distance, as they are taken from the Great Circle Distance, and represents the distances between country capitals, which may not represent the actual distances between commercial ports or cities. $\ln(CAD_j)^t$ is the variable to capture the trade effects of food safety stringency, given as the MRL on *cadmium* in OECD and select Asian countries. The model employs variable to capture the effects on trade as a consequence of trade liberalization. This is the openness variable represented by trade-GDP ratio, in the equation as $TGDP_j$ and e_{ij} is the error term assumed to be normally distributed.

In the estimation, individual effects are included. The estimation has followed fixed effects specification so as to get individual coefficients for all countries. So fixed effects is estimated after carrying out *Hausman test* (the test to decide whether to adopt fixed effects or random effects specification) which favored the fixed effect model. Dummy variables for countries ($i - 1$, where $i = 1..35$) are employed as independent variables, so that the effects on heterogeneous intercepts (countries) are isolated. The GLS regression is used which is corrected for heteroscedasticity and auto-correlation in the first step of the estimation. As one of the methods of estimating individual effects in the presence of time invariant regressors, transformation is used for estimations. The first step of estimation is done using all variables except distance and regulatory variables for 210 observations. There is a problem with variables such as distance and regulation as the inherent transformation wipes them out if used along with other variables in the first estimation, because they do not vary across time. However, this problem is solved by estimating these variables in a second step, by running another regression with the individual effects as dependent variable and distance and regulatory variables as independent variables as described in the model below:

$$IE_{ij} = b_0 + b_1 \ln(DIST_{ij}) + b_2 \ln(CAD_j) \quad (Eq.3)$$

Where, IE_{ij} are the individual effects, which are the individual country coefficients in the first step of estimation.

SCENARIO 2

SHRIMP EXPORTS

$$\ln(X_{ij})^t = b_0 + b_1 \ln(TIM P_j)^t + b_2 \ln(TGDP_j)^t + b_3 \ln(CAD_j)^t + b_4 \ln(DIST_{ij})^t + e_{ij} \quad (Eq. 4)$$

Here the variable $TIM P_j$ is total import of fish and fishery product of importing country and the remaining variables are same as mentioned in equation 2

SCENARIO 3

CEPHALOPOD EXPORTS

$$\ln(X_{ij})^t = b_0 + b_1 \ln(PCGNP_{ij})^t + b_2 \ln(TGDP_j)^t + b_3 \ln(CAD_j)^t + b_4 \ln(DIST_{ij})^t + e_{ij} \quad (Eq. 5)$$

Here the variable $PCGNP_{ij}$ is product of percapita GNP of exporting and importing countries and the remaining variables are same as mentioned in equation 2

RESULTS AND INTERPRETATIONS

In case of fish and fishery products (aggregate level), the estimated coefficients for the variables are described in table 1. Coefficients estimates can be interpreted as elasticities, as the model is estimated in the log linear form. In the model, the coefficient of the GNP per capita is positive and highly significant. This implies that India tends to export more to high income economies. India’s export to country j increases by 0.628 percent as the per capita GNP of importing increases by one per cent.

Table 1: Gravity analysis for fishery exports

Variables	Coefficients	Standard error
$\ln TGDP_j$.807	.402*
$\ln PCGNP_j$.628	.205**
$\ln CAD_j$.714	.328*
$\ln DIST_{ij}$	-1.048	.415**
<i>No of Observations</i>	210	
<i>Adjusted R²</i>	.92	

*, ** Indicates significance at 5% and 1% levels respectively

The regulation is found to be trade restrictive. The coefficient of the regulatory variable is positive and significant. The magnitude of the coefficient, which can be described as the elasticity of *cadmium* MRL, shows moderate response (in comparison with the coefficients of regulations which has been reviewed in this section) to regulations. The value of 0.714 means that a 10 percent tightening of regulatory stringency or a reduction in the maximum permissible level of *cadmium* will result in a reduction of exports by 7.14 percent. The positive sign of the regulatory variable also has to suggest that total fishery imports are greater for a country that has less stringent regulation on *cadmium*. The trade-GDP ratio of importing country, the openness variable, has the expected positive sign and is significant. The coefficient of this variable is 0.807, which means that India can further increase its exports by liberalizing exports. The distance variable is significant and has the anticipated negative sign, which indicates that India tends to trade more with its immediate neighboring countries during the period of food safety regulations. The co-efficient value is -1.048, which indicates that when distance between India and country j increases by 1 percent, the bilateral trade between the two countries declines by 1.048 percent.

Table 2: Gravity analysis for Shrimp exports

Variables	Coefficients	Standard error
$\ln TIM P_j$	1.028	.254**
$\ln TGDP_j$	-1.732	.681**
$\ln CAD_j$	0.782	.424*
$\ln DIST_{ij}$	-1.187	.690
<i>No of Observations</i>	210	
<i>Adjusted R²</i>	.90	

*, ** Indicates significance at 5 %and 1% level respectively

The results of gravity analysis for shrimp exports are depicted in table 2. Here the variable $TIMP_j$ denotes the total import of fish and fishery products in the importing country j . The coefficient was found positive and highly significant which means as the total import of fish and fishery product of the importing country increases by 1 percent the shrimp import do increase by 1.028 percent reflects that the shrimp import of the importing country is directly proportional to the import propensity of fish and fishery products of the country. In tune with what I have already observed in case of total fish and fishery products here also the regulation is found to be trade restrictive. The coefficient of the regulatory variable is positive and significant. The magnitude of the coefficient, which can be described as the elasticity of *cadmium* MRL, shows moderate response to regulations. Here the value 0.782 means that a 10 percent tightening of regulatory stringency or a reduction in the maximum permissible level of cadmium will result in a reduction of exports by 7.82 percent. The positive sign of the regulatory variable also has to suggest that total fishery imports are greater for a country that has less stringent regulation on *cadmium*. Surprisingly on contrary to the result in scenario 1, the trade-GDP ratio of importing country, the openness variable, is negative and significant. The coefficient of this variable is 1.732. Considering this result with the coefficient of *cadmium*, it supports the hypothesis that regulation may have a trade diversion effect to less liberated economies during the period under study. However, even among the OECD countries during the period trade must have been diverted to countries that have experienced relatively low trade openness in comparison with other OECD countries. The distance variable is significant and has the anticipated negative sign.

Table 3: Gravity analysis for cephalopod exports

Variables	Coefficients	Standard error
$LnPCGNP_{ij}$.442	.190**
$lnTGDP_j$	1.48	.507*
$lnCAD_j$	-.97	.525*
$lnDIST_{ij}$	1.9	.987*
<i>No of Observations</i>	135	
<i>Adjusted R²</i>	.86	

*, ** Indicates significance at 5 %and 1% level respectively

Differing from the earlier results I obtained in scenario 1 and 2, in case of cephalopods export model the coefficient of regulation has significant negative value, which indicates the trade augmentation aspects of stringent standards in case of cephalopod exports (table 3). The magnitude of the coefficient, which can be described as the elasticity of *cadmium* MRL, shows value of 0.97 means that a 10 percent tightening of regulatory stringency or a reduction in the maximum permissible level of *cadmium* will result in an increase of exports by 9.7 percent. The negative sign of the regulatory variable also has to suggest that total cephalopod exports from India have positively responded to countries with stringent regulation on *cadmium* during the period under consideration. The product of per capita GNP of India and the importing country was found positive and significant. This implies that India tends to export more to high income economies. India’s export to country j increases by 0.442 percent as the product of per capita GNP of India and importing country increases by 1 per cent. The trade-GDP ratio of importing country, the openness variable, has an expected positive and significant. The coefficient of this variable is 1.9. The distance variable is significant and has the positive sign, which indicates that in case of cephalopods India tends to trade more with distant countries (mainly OECD Countries) where the food safety regulations are relatively more stringent than the Asian countries. The coefficient value is 1.9, which indicates that when distance between India and country j increases by 1 percent, the bilateral trade between the two countries escalates by 1.9 percent.

Here, I have analyzed three scenarios of seafood exports from India to OECD and Asian countries. The first two scenarios where total seafood export from India at an aggregate level and shrimp exports show the trade restrictiveness of the maximum residue level of cadmium, while in scenario 3 where I considered cephalopod exports from India has shown trade augmenting aspect of the stringent food safety regulations. Thus, the analyses exhibit the dual nature of the stringent quality measures at the disaggregate level of the seafood items. Another point worth emphasizing is that there can be other important variables, which are not included in the model (mainly due to data and estimation problems). Here, the gravity analysis is used as a desirable exercise to indicate the direction and magnitude of the effect on exports and has to be seen in this perspective.

The results obtained from the gravity model analysis obviously triggered the curiosity on cephalopods, and has lead to the finding that Kerala is the major producer and exporter of cephalopods from India. Subsequently, I looked for

Kerala’s sanitary and phytosanitary compliance records *viz a viz* other states in India. Going by the evidences, Kerala has a better record of compliance. It was found that during 2006, Cochin (the major seafood export hub of Kerala) has received only two complaints regarding non-compliance of seafood exports, which is the lowest number of complaints among the seafood exporting states (ports) in India. The number of complaints of non-compliance has reduced drastically during 2002 -2007.

These evidences solve to a great extent the puzzle spawned, where I found that in case of gravity analysis the maximum residue limit (stringency) on *cadmium* has a positive impact on cephalopod exports from India. Kerala is the major exporter of cephalopod from India and food safety compliance ability of seafood exporters in Kerala is far better than other states in India. This would be the logical answer to the puzzle posed during gravity analysis. Kerala’s seafood export sector presents a positive case of the efforts to comply with the stricter food safety requirements in export markets. However, challenges still remain. To understand the specific industry level changes experienced during the food safety regime, a detailed study on Kerala seafood export sector is been carried out in the next section as a micro level case.

MICRO LEVEL CASE: KERALA’S SEAFOOD EXPORT SECTOR

Since 1997, the EU has been imposing a set of food safety regulations on India’s fishery exports, leading to a conditional ban on seafood exports and a subsequent crisis within the fish processing and export industry when the required standards could not be met. The new EU standards were followed by the enforcement of the seafood HACCP law in the US from December 1999. In response, the fish processing and exporting industry successfully engaged in learning and innovation activities with the support of government institutions (Henson and Rajasenan, 2005). But the institutional finance commensurate with the need was not forthcoming. As a result, many processors had to divert their working capital resources for upgradation of their plants. This coupled with the uncertainty prevailed in the international markets had adversely affected the seafood industry. A large number of seafood units became sick and non-viable. With a large number of seafood exporters facing recovery actions by financial institutions, the industry was looking for an exit route for non viable units.

EU has been the major destination of Kerala’s marine exports. EU holds around fifty percent share of Kerala’s exports during 2005-2006. Thus, any policy shock from the EU can have significant impact on Kerala’s seafood exports. Japan and US are other major markets with around 12 percentage shares in value of export (table 4). EU is the predominant driver behind the food safety controls being implemented in Kerala. There seemed to be a continuous flow of emerging challenges, most of which originally come to light through border detentions. Currently, controls on residues of antibiotics in the EU are a major concern, not only for India but also for its major competitors. Additional issues include limits on heavy metals (like *cadmium*) and other environmental contaminants. For all of these concerns, it is clear that the EU imposes significantly stricter controls than Japan and US. Kerala is more dependent on EU and US markets than the rest of India, and the state is dominated by exports of shrimp and cephalopods. EU’s food safety requirements related to general hygiene controls and limits on antibiotics, as well as biological and chemical contaminants, have emerged as the dominant challenge.

Table 4: Market wise export share of marine products from Kerala (*Export value in percentage*)

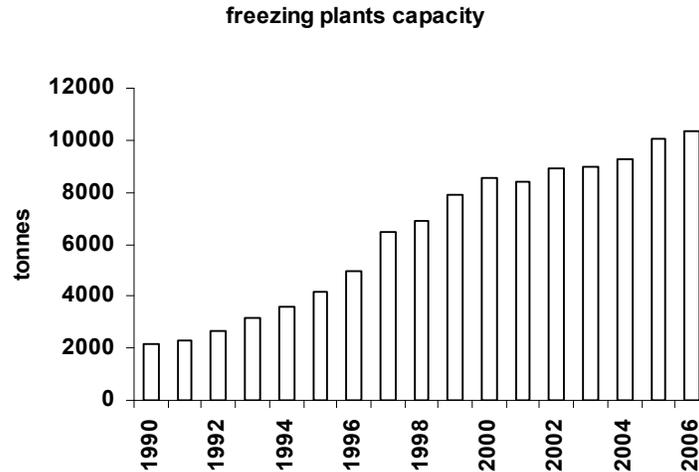
Country/Year	2001-02	2002-03	2003-04	2004-05	2005-06
Japan	18.75	13.1	18.74	15.40	11.76
USA	17.5	18.37	12.92	12.01	11.56
EU	42.37	48.35	47.77	49.50	50.32
China	6.7	7.14	7.01	6.41	7.98
South East Asia	6.5	5.31	4.46	5.18	5.53
Middle East	2.84	3.22	3.28	5.04	4.86
Others	5.36	4.52	5.55	6.45	8.00

Source: Kerala Planning Board Economic Review 2007

IMPACT ON SEAFOOD PROCESSING SECTOR

Seafood processing facilities in Kerala traditionally procure the raw material in pre-processed form from the peeling sheds. Products have traditionally been frozen in block form, although an increasing number of plants have installed capacity to manufacture Individually Quick Frozen (IQF) products. How ever, in most cases the value addition is

very less and the products exported to EU and US is further processed in the importing countries before they reach final consumer. The evidences from the survey as well as MPEDA records point out that majority of export firms operates with one freezing plant, although there is a shift toward consolidated businesses that operate multiple plants. The seafood industry in Kerala is highly export oriented where a very little share finds its way to the domestic markets. The period from 1990s to 2006 has witnessed significant increase in processing plant capacity as may be seen from figure 1, but the availability of raw material for processing has not kept in pace with the capacity build up in processing sector which has ultimately resulted in less than 25 percent capacity utilization of the processing plants.



The rapid expansion of the processing sector during the 1990s, did not keep pace with the emerging requirements of India’s export markets, especially the EU. Even the new export processing facilities established during the period did not pay much attention to the importance of food safety standards and quality parameters. The standards of hygiene in the processing sector have shifted to an entirely different platform only after the EU ban on Indian exports in 1997. The compliance cost across the surveyed plants varied from US\$0.057 million to \$0.88 million. The average compliance cost across the seafood processing firms was found to be US\$0.40 million, which is at least a modest indicator of the investment cost spending per processing units for maintaining market access to the EU. The changes required to comply with the hygiene requirements varied significantly among fish processing plants. In extreme cases, plants had to be extended and/or the entire layout needed to be changed. According to the majority of the exporters the integrated pre processing facility was the major item among the compliance cost components. In fact the integrated pre processing facility is a mandatory requirement according to the Export Inspection Council (EIC). More over the Processing plants also had to implement significant changes to their operational procedures. The majority had not implemented HACCP. These plants were required to establish the necessary plans, control procedures, and documentation systems. Furthermore, cleaning, maintenance, and rodent and pest control procedures had to be enhanced. In many cases, quite extensive programmes of workers’ training had to be undertaken. The cost of implementing these new procedures has, in many cases, been considerable including laboratory analysis, record-keeping, ongoing staff training, and maintenance of worker medical records. To undertake these tasks, new technical and supervisory staff had to be employed, and/or better qualified (and more expensive) personnel were needed. Monitoring fee paid to the Export Inspection Agency (EIA) has also increased significantly. In addition, the costs of preprocessing had to be internalized within each processing plant. These costs are significantly greater than purchasing ready preprocessed raw material.

THE LEVELS OF CONCENTRATION

The levels of concentration in share among the seafood exporters from Kerala are presented in table 5. The concentration in market share is evident, as a few firms hold a large share of exports. Nevertheless, the pattern of change in concentration is very interesting. During the year 2002-03 there was only one firm holding more than INR 500 million^{xiii} business turn over, while during 2006-07 there were nine firms having a share of more than INR 500

million businesses turn over. The number of firms over the years has declined, or more specifically a consolidation of export firms is happening. The concentration ratio is found to be stable without any increase; rather the concentration ratio has declined during 2006-07 in comparison with the 2003-04 (table 6). It seems that the dominant trend over the next few years in fish processing node of the export value chain will be both consolidation and concentration.

Table 5: Distribution of seafood firms in Kerala according to their business turnover (Firm size measured in Indian Rupees million)

Firm size/year	2002-03	2003-04	2004-05	2005-06	2006-07
500 >	1	2	4	3	9
250-500	6	1	5	9	8
100-250	15	11	17	17	24
50-100	22	18	22	22	22
10-50	54	45	42	22	36
< 10	118	101	71	73	52
Number of firms	216	178	161	146	151

Source: Authors' compilation

Table 6: Change in concentration of seafood firms in Kerala

Year	Total Number of firms	Industry (US \$ million)
2002-03	216	215
2003-04	178	243
2004-05	161	257
2005-06	146	285
2006-07	151	339

Source: Authors' compilation

IMPACT ON THE PREPROCESSING SECTOR IN KERALA

Preprocessing of seafood has been undertaken by independent preprocessing facilities that supply preprocessed materials to the processing plants. These units are called *peeling sheds* and they operate with lower capital and are less organized. Recently, many of the preprocessing units are getting integrated with the processing units. Shrimp, squid, cuttle fish, etc. are brought by the *peeling shed* owners who employ large number of women to peel them. Thus, peeled products are graded and sold to the processing factories for further processing and export. The independent preprocessing sector has played an important role in the fishery economy by absorbing much of the risk associated with fluctuations in raw material prices and carrying the significant fixed and variable costs associated with preprocessing. The stability of the export companies directly affects the depending peeling sheds. With the new regulations based on the EU stipulations more and more factories are needed to have their own pre processing facilities, however even now the pre processing is still done largely in the pre processing centers. It is found that today hardly 50 percent of the sheds operate regularly round the year.

In 2002, around 265 preprocessing units were deregistered from business (MPEDA, 2003). While the number of preprocessing facilities declined during 1997-2006, installed capacity actually increased to around 100 percent over day during that period. Consequently, the average preprocessing plant capacity increased from 2.9 tonnes per day in 1997 to 9.2 tonnes per day in 2006. It could be inferred that the new preprocessing facilities registered have sufficiently large processing capacity.

A survey covering 32 preprocessing establishments was conducted across *Aroor - Chandiroor*^{xiv} belt to get an in depth understanding on the impact of international food safety regulations on seafood preprocessing sector. Out of 32 preprocessing facilities surveyed seven were functioning without MPEDA registration. About 72 percent of the labour force was women who worked on a casual basis. The pre processing facilities procure the raw materials either directly from the landing sites or through agents. Most of the pre processing facilities supplied the processed

material to one or two exporters on a regular basis for many years thus having a trust based relationship between the exporters and pre-processors. The average annual turnover of the surveyed facilities was around US \$ 1 Million. The rough estimate of average capacity utilization was found to be 58 percent. Scarcity of raw materials and working capital were observed as the main reasons for the lower capacity utilization of these preprocessing facilities. Moreover, it was observed that more than 95 percent of labour employed is on a casual basis. In fact, the casualization of the labour has increased over last four years. Thus, the controlled workforce cultures in tune with the improvements in hygienic measures are found to be lacking in these facilities.

The preprocessing facilities witnessed a very drastic change in the operational structure. For example, even the way the workers used to do the pre processing activity has changed. Earlier, the workers used to sit on the floor to do the peeling operations, but due to the mandatory hygienic requirement the peeling operations has to be conducted on a table. Facilities like potable running water, change rooms, cold store, hand washbasins, toilets, staff uniforms and clothing and air conditioning has become mandatory for obtaining the MPEDA approval and subsequent registration. The respondents duly acknowledge the demand and requirements of the exporters in this regard. Thus, the importance of international food safety and quality measures has been properly diffused to this particular node of the seafood value chain of Kerala. The annual average cost of sanitary improvements of the surveyed pre processing facilities was found to be INR 95,000. The amount spent was ranging between INR 16,000 to INR 0.51 million. The surveyed respondents have reported a rise of 6 percent in production costs. It was also noted that seafood exporters are maintaining a close relationship with the preprocessing facilities and imparting training regarding hygienic standards of the workers and quality measures to be practiced in the pre processing facilities.

Scarcity of adequate financial capital for modernizing the preprocessing facilities and problem of volatile working capital were the major constraints expressed by the respondents. Apart from this the scarcity of fresh water and good quality ice were also expressed. *Peeling shed* operators usually procure seafood from the landing centers from agents or directly from the boat owners on a payment on the spot mode. The raw material is transported to the pre processing facilities and processed in a day or two. Subsequently the raw material is transferred to the seafood processing units. The payment usually takes 3 weeks to 2 months in most cases. On an average, a preprocessor requires INR 0.4 million to 0.6 million per day. Thus, to be in business he has to borrow money from private financials at exorbitant interest rates. This ultimately resulted in the acute financial instability in many cases.

Although most of the pre processing facilities in the business have achieved the required mandatory standards stipulated by MPEDA, the unhygienic house and hut peeling still continues in the surveyed area. These practices lack good quality water and ice and has been carried out without proper supervision and quality checks. Though these facilities are not registered with MPEDA, the exporters do procure from these facilities at cheap rates. The co existence of few unhygienic pre processing operations along with the approved pre processing facilities may deteriorate the improvements made in the quality front.

SUMMARY AND CONCLUSIONS

The present study employs gravity analysis to find out the trade elasticity of a particular regulation (here the maximum residue level of *cadmium* on seafood export at aggregated and disaggregated commodity level). The main purpose of this exercise is to estimate the trade restrictiveness of regulations in the popular econometric framework. In earlier literature, the studies which employed gravity model in the similar context yielded results which indicated a positive coefficient for the regulatory variable suggesting that the tighter regulations will be trade limiting. In the context of Indian seafood exports too, a typical gravity model is employed (choice of variables was mainly drawn from previous literature). Here, I have analyzed three scenarios of seafood exports from India to OECD and Asian countries. The first two scenarios where total seafood export from India at an aggregate level and shrimp exports shows the trade restrictiveness of the maximum residue level of *cadmium*, while in scenario 3 in which, I considered cephalopod exports from India has shown trade augmenting effect of the stringent food safety regulations. Thus, the analyses exhibit the dual nature of the stringent quality measures at the disaggregate level of the seafood items. Here, the gravity analysis is used as a desirable exercise to indicate the direction and magnitude of the effect on exports and has to be seen in this critical viewpoint. At best, these figures are the modest indicators of the different forces that are in action at the international markets for Indian seafood. As far as International food safety regulations and compliance are concerned, Kerala has a better record compared to other states in India.

In Kerala, it is seen that concentration and consolidation is taking place at the processing node of the chain where the number of exporters has come down and professional players are upgrading their position in the value chain. The most important aspect of the existing chain is the gradual disappearance of the independent preprocessing sector, which has been an important stakeholder of the seafood value chain. The preprocessing node of the value chain is getting integrated to the processing sector causing a major restructuring of the existing value chain. The dominant response to the imposition of stricter food safety standards for seafood exports in Kerala has been reactive, loyal and defensive, both by the government and the private sector. Thus, hygiene and antibiotic controls have been upgraded largely in response to regulatory change in EU and US, or on demand from major customers. In Kerala, substantial drive to upgrade hygiene controls occurred as a sudden response when market access to EU was threatened or curtailed.

I have initiated the study by formulating two hypotheses, 1) The evolving stringent food safety standards imposed by the developing country export markets are trade restrictive to the Indian seafood export, 2) such a rise in standard will not only affect the export firms alone but also the entire supply chain will have to adjust accordingly, in other words there would be a possible re-shuffling and restructuring of the entire supply chain. As far as hypothesis 1 is concerned it was found that food safety regulations imposed by developing countries is trade restrictive for the Indian seafood sector. But at disaggregated commodity level, the stringent regulations can be trade augmenting as well. This emphasizes the need to look at more disaggregated level analysis of commodities for better insights and interpretations. Regarding hypothesis 2, the study shows that the pre-processing node of the seafood value chain is getting integrated to the processing sector causing a major restructuring of the existing value chain. India would have to upgrade the national system for testing, certification and laboratory accreditation so as to be at par with the prevailing international trade regulatory and safety parameters.

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ENDNOTES

ⁱ A broad definition of standard includes mandatory technical regulations as well as voluntary agreements on the quality characteristics of goods and services.

ⁱⁱ In this article the terms seafood, marine products and fishery products are used interchangeably.

ⁱⁱⁱ Mandatory standards are also termed as technical regulations, are standards set by public institutions (in particular regulatory agencies) with which compliance is obligatory.

^{iv} The Agreement on the application of Sanitary and Phytosanitary measures entered into force with establishment of WTO on January 1st 1995. The SPS Agreement establishes international rules on how to apply SPS measures. The purpose of the Agreement is to allow the legitimate protection of life and health to take place, while avoiding giving rise to illegitimate protectionism. Protectionism in this regard is defined as trade barriers over and above what is required to meet desired protection levels.

^v Aflatoxins are a group of toxic substances that contaminate certain foods and have been associated with acute liver carcinogens in humans and animals.

^{vi} The Codex Alimentarius Commission was created in 1963 by FAO and WHO to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme.

^{vii} EC Directives (91/493/EEC) for Fish and Shellfish quality

^{viii} Kerala is a state in India and one of the major contributors in the marine products export from the country.

^{ix} There are overlapping member countries in EU and OECD. EU has more stringent standards regime compared to general OECD policy on food safety, though EU members are included in OECD.

^x The Harmonized Commodity Description and Coding System (Harmonized System, or HS), is adopted for fish and fishery products, frozen shrimp, squids and cuttle fish respectively. Fish and fishery products (HS 92 Code: 03) Frozen shrimp (HS 92) Code 030613, Squids (HS92) Code 30741 and Cuttle fish (HS 92) Code 30749. Squids and cuttle fish added/grouped together and hereafter referred to cephalopods. Fish and fishery products form the aggregate of all marine products while shrimp and cephalopods are disaggregated level marine products. The Harmonized Commodity Description and Coding System (HS) is an internationally standardized system of names and numbers for classifying traded products developed and maintained by the World Customs Organization (WCO). HS is a six-digit nomenclature.

^{xi} *Cadmium (Cd)* is a heavy metal, which has no known essential function in human life and is toxic even at low concentration when ingested over a long period. In our pursuit to select a regulatory variable as a proxy of the stringency of food safety standards, I found that at least in case of sea foods this is a difficult task. Because, mostly the prohibited contaminants of the seafoods are expressed in 'zero tolerance'. In such cases it is impossible to take the contaminant as an independent variable. But later, it was found that *cadmium* could be used as a proxy variable for two reasons, 1) the emerging importance of *cadmium* standards and 2) *cadmium* is expressed as a numerical value and it varies across countries. The toughest part was to extract the maximum residual limits of *cadmium* across various countries. For this I have relied on multiple sources which include USFDA, Codex reports, Commission Regulation (EC) No 466/2001 EU, Country specific food safety and health related websites and published research articles on cadmium and food safety.

^{xii} Maximum permissible level can also be mentioned as maximum residue level (MRL).

^{xiii} INR is the abbreviation used for Indian Rupees

^{xiv} *Aroor-Chandiroor* belt is the area where majority of pre processing units in Kerala are located.