# MODELLING JAPANESE IMPORT DEMAND FUNCTION FOR INDIAN SEAFOOD PRODUCTS

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## ABSTRACT

Using a partial adjustment modelling (PAM) approach, this paper examines the behaviour of Japanese import demand for Indian seafood products during the period January 1995 -March 2000. It is found that lag demand, income, seasonality and time trend significantly influencing the import demand behaviour of Japan for the Indian seafood products. The Indian seafood industry, as well as the fishing industry, may wish to consider the findings to formulate appropriate marketing strategies to sustain export market returns and maintain long term sustainability of the resource.

**Keywords:** Seafood, import demand; Japan

## INTRODUCTION

India's export dependent seafood industry is the fourth largest earner of foreign exchange and the marine products account for 3.32% of the country's export in the years 1998-99 [1]. In value terms, Japan has continued to be the largest market for Indian seafood products during the period of 1995-2001 [2, 3]. During the last four decades or so, Japan's position in the international seafood market has been changed due to a series of national and international events and Japan has become the net importer of seafood products in the world seafood market [4, 5, 6, 7]. This change in market position of one of the highest seafood consuming countries in the world has created opportunities for the other major seafood exporting countries, like India. According to a report, the Indian seafood industry has the surplus capacity to meet increased export market demand. Thus the dependence of Japan on seafood imports to meet the domestic demand and the capacity of the Indian seafood industry to meet the export market demand, to a certain degree has created a mutually beneficial situation for both countries. The fulfilment of this challenge by the Indian seafood industry would certainly meet one of the important objectives of maximizing foreign exchange earnings that can be used for the development of the national economy. The contribution of the Indian seafood export to Japan for the period 1995-2000 is presented in Table I.

**Table I: Descriptive Statistics of Indian Seafood Exports to Japan**

| Marine Products | | | | | Export quantity to Japan as % of total seafood export quantity |
|---|---|---|---|---|---|
| Year | Export quantity (tonnes) | Value (Rs. Lakhs) | Quantity index (1995=100) | Value index (1995=100) | |
| 1995 | 49889 | 158183 | 100.00 | 100.00 | 17.23 |
| 1996 | 64698 | 185967 | 129.68 | 117.56 | 18.29 |
| 1997 | 71948 | 226195 | 144.22 | 142.10 | 18.03 |
| 1998 | 65568 | 237456 | 131.43 | 150.11 | 20.91 |
| 1999 | 65202 | 217892 | 130.69 | 137.75 | 19.93 |
| 2000 | 71060 | 262477 | 142.44 | 165.93 | 16.88 |
| **Mean** | 64727.50 | 214695 | | | |
| **S. D.** | 7916.43 | 37316.37 | | | |
| **Sample size:** | 63 | | | | |

Source: Statistics of Marine Products Exports, The Marine Products Export Development Authority (MPEDA), India, 1999 and 2000.

Realising the economic importance of the seafood trade relationships between Japan and India, this paper empirically examines the factors that affect the Japanese import demand for Indian seafood products. More specifically, from a marketing point of view, it is important for the Indian seafood industry to identify the potential factors such as relative prices, income, time trend and deterministic seasonality that may affect the import demand behaviour of a major foreign market. It is hoped that the identification of significant factors would contribute to the formulation of a successful export market strategy for India. Moreover, to the best of the authors' knowledge, information on the import demand parameters for Indian seafood products is limited. Consequently, it is also expected that the empirical results from this paper would provide a sound statistical basis for formulating export-oriented strategies applicable to the Japanese market.

## DATA SOURCES

Data on monthly export quantity and the value of the Indian seafood products to Japan were obtained from the Marine Products Export Development Authority (MPEDA), covering the period January 1995 to March 2000. The unit price of import (in Japanese Yen) is calculated using quantity, value and exchange rate data and finally converting to an index (1995=100). The monthly data for Japanese consumer price index (1990=100) was obtained from the various issues of the Reserve Bank of Australia Bulletin and was used as a proxy for the domestic price. The monthly data for industrial production index (1990=100) for Japan was obtained from Main Economic Indicators published by the Organisation for Economic Co-operation and Development (OECD).

## MODEL SPECIFICATION

A simple functional form reflecting the characteristics of Japanese import demand function for Indian seafood products can be represented as follows:

$$\left(Q_{Japan}^{India}\right) = f\,(RP\,, Y\,, SD\,, T\,) \qquad \text{(Eq. 1)}$$

where the dependent variable 'Q' represents the Japanese import demand of Indian seafood products and 'RP' represents the relative price, which is defined as the ratio of import price to domestic price. The industrial production variable was used as a proxy for the income (Y) to capture the effects of income on the import demand. Finally, the monthly seasonal dummy variables, 'SD', and the trend variable 'T' are included in the model to capture the deterministic seasonality and trend in the seafood import demand.

To allow the adjustment process between the actual and desired level of import demand, the following partial adjustment model (PAM) specification is considered to be appropriate [8].

$$\left(Q_{Japan}^{India}\right)_t = \beta X_t - (1-\delta)\left(Q_{Japan}^{India}\right)_{t-1} + \mu_t \qquad \text{(Eq. 2)}$$

Where, '$X_t$' denotes a vector of explanatory variables defined above and a constant term and '$\beta$' is the coefficient vector. The symbol '$\delta$', the partial adjustment coefficient represents the share of the desired adjustment completed in the single period and the symbol'$\mu_t$' is the random disturbance term. All the variables (except binary variables like monthly seasonal dummy variables) were transformed into logarithmic form. The purpose of logarithmic transformation is to minimise the variability in the data set. Furthermore, it helps obtain the elasticity estimates from the coefficient estimates.

## DISCUSSION OF RESULTS

Table II presents the results of the PAM specification of equation 2 as model 1. A 'general-to-specific' modelling strategy is followed to obtain preferred specification of the model. The estimated coefficient of lag relative price variable is negative and statistically insignificant at the 5% level. It should be mentioned that the inclusion of current relative price failed to produce theoretically consistent results. This is not surprising as it is found that in the case of Japan, price transmission of domestic to Indian market for frozen shrimp is not instantaneous [9]. The negative sign of the estimated coefficient reflects the fact that the import demand function for Japan for Indian seafood products is negatively sloped thereby consistent with the economic theory of demand. The coefficient measures the short-run elasticity of import demand with respect to relative price. In the case of Japan, it was found that seafood has a very low own-price and cross-price elasticity with substitutes, especially meat [6].

**Table II: Estimated Results of the Model in Equation (2)**

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| **Independent variables** | **Coefficient estimate** | **T-ratio** | **Coefficient estimate** | **T-ratio** |
| Constant | -0.24 | -0.10 | 0.68 | 0.29 |
| $Q_{t-1}$ | 0.27 | 2.16 | 0.43 | 3.37 |
| $RP_{t-2}$ | -0.05 | -0.30 | -0.01 | -0.39 |
| $RP_{t-3}$ | | | 0.32 | 0.99 |
| $RP_{t-4}$ | | | -0.06 | -0.22 |
| Y | 1.36 | 2.82 | 0.92 | 1.81 |
| **Seasonal variables:** | | | | |
| $SD_8$ | 0.31 | 3.06 | | |
| $SD_9$ | 0.19 | 1.95 | | |
| $SD_{10}$ | 0.23 | 2.39 | | |
| $SD_{11}$ | 0.32 | 3.36 | | |
| $SD_{12}$ | 0.16 | 1.56 | | |
| **Trend variable:** | | | | |
| T | 0.004 | 2.36 | 0.002 | 1.03 |
| **Summary Statistics** | | | | |
| $R^2$ | 0.58 | | 0.37 | |
| **Diagnostics:** | | | | |
| **Normality Test** | | | | |
| J-B LM | 2.16(2) | | 0.29(2) | |
| **Heteroscedasticity Test:** | | | | |
| B-P-G test | 7.43(9) | | 5.12(6) | |
| ARCH test | 0.22(1) | | 1.15(1) | |
| **Autocorrelation Test:** | | | | |
| LM(2) | 0.64 | | 1.37 | |
| LM(4) | 0.88 | | 2.22 | |
| LM(10) | 0.18 | | 0.98 | |
| **Specification Test** | | | | |
| RESET (2) | 0.93(1,49) | | 0.05(1,50) | |
| RESET (3) | 0.50(2,48) | | 0.60(2,49) | |
| RESET (4) | 0.45(3,47) | | 3.48(3,48) | |
| **Forecast Performance:** | | | | |
| MSE | 0.03 | | 0.04 | |
| MAE | 0.15 | | 0.16 | |
| RMSE | 0.17 | | 0.20 | |

Note: The symbols $Q_{t-1}$ , RP and Y represent the lag of the dependent variable (import quantity), the relative price variable and the income variable respectively. The variable RP is defined as the ratio of unit import value index to Japanese consumer price index. The J-B LM (Lagrange Multiplier) test is used to examine the normality of the residuals [10]. The B-P-G test is used to test the null hypothesis of homoscedasticity of the residuals [11, 12]. The autoregressive conditional heteroscedasticity (ARCH) test is used to test whether the disturbances do in fact follow an (ARCH (q)) process as suggested in [13]. The Lagrange Multiplier (LM) test statistic at different lags is used to test the null hypothesis of no autocorrelation. Finally, the regression specification error test (RESET), which is an F-test is used to test for functional misspecification of the model. The values of mean square error (MSE), mean absolute deviation (MAD) and root mean square error (RMSE) were used to measure the forecast performance of the model. For definitions of the diagnostics see [14, 15].

The estimated coefficient of income variable carries a positive sign and is significant at the 5% level. The coefficient measures the short-run elasticity of import demand with respect to income. It is found that the estimated coefficient is greater that unity and implies that a 1% increase in income, other things being equal, will increase the import demand of Japan by 1.36%, in the short run. This finding is also consistent with the existing literature (see Tada, 2000).

The lag dependent variable is found to be significant at the 5% level. The coefficient of adjustment ($\delta$) is 0.73, which is positive and less than one, thereby indicates the fact that the adjustment is not instantaneous. It other words, only 73% of the gap between the actual and the desired import is covered in each period.

It should be noted that there is a significant seasonal variation in the Japanese import demand, particularly at the second half of the year. This result is in line with the findings of the export review report by the MPEDA. The seafood marketing authorities in India should take this advantage of this seasonality in import demand so as to maximise the export market revenue. Furthermore, Japanese import demand exhibits a significant positive trend. This provides further statistical support to the descriptive results presented in Table I.

To investigate whether the seasonal dummy variables are interfering with the performance of the relative price variable the model (as described in Eq. 2) was also estimated by excluding the seasonal dummy variables.  The results are reported in Table II as model 2. It should be noted that model 2 seems to have no clear advantages over model 1. Also, model 2 failed to produce similar results in relation to the relative price variables. In this particular case more lag variables needed to be included in the model to obtain theoretically consistent results. Furthermore, not only the performances of the income and trend variables are quite different but also the explanatory power (as measured by the $R^2$ value) of the model 2 was decreased as compared to model 1. Finally, the forecast performance (as measured by the values of mean square error (MSE), mean absolute deviation (MAD) and root mean square error (RMSE)) of model 1 is lower than that of Model 2. Therefore from both a theoretical and statistical standpoint model 1 appears to perform better than its counterparts.

Finally, to justify the statistical validity of the model a series of diagnostic checking has been applied and the results of this diagnostic checking are presented in Table II. It can be seen that in all cases, the results from the econometric diagnostics do not exhibit any deviations from the classical linear regression properties. The J-B LM test is used to examine the normality of the residuals at the 5% level [10]. The test statistic follows a $\chi^2(2)$ distribution and the value of the test statistic indicates that the null hypothesis of normality cannot be rejected. The B-P-G test is used to test the null hypothesis of homoscedastcity of the residuals at the 5% level [11, 12]. The test statistic follows a $\chi^2(2)$ distribution and the test value is insignificant at the 5% level thereby the null hypothesis of homoscedastic error variances cannot be rejected. To test whether the disturbances do in fact follow an autoregressive conditional heteroscedasticity (ARCH (q)) process, a simplification of the Lagrange Multiplier (LM) test represented by ARCH(1) test (at the 5% level) [13]. The ARCH test statistic has an asymptotic $\chi^2(q)$ distribution under the null hypothesis of homoscedastic error variances. The test result supports the null hypothesis. The Lagrange Multiplier (LM) test statistic at different lags is used to test the null hypothesis of no autocorrelation at the 5% level. The LM test is appropriate when a lagged value of the dependent variable serves as a regressor. The test result favours the null hypothesis of no autocorrelation. Finally, the regression specification error test (RESET), which is an F-test is used to test for functional misspecification and the test result failed to detect any specification error in the model.

## CONCLUDING REMARKS

This study empirically investigated the basic import demand function of Japan for Indian seafood products. It was found that lag demand, income, seasonality and time trend significantly influence the import demand behaviour of Japan for the Indian seafood products. This baseline study has produced some theoretically and practically consistent results, which may be useful to devise appropriate marketing strategies to sustain and/or maximise export market revenue. It should be recognized that the existence of an economically viable market for fish and seafood products at the domestic, regional, international level is fundamental to the success of commercial fishing enterprise. This is because economic viability of a commercial fishing enterprise, among other things, depends on market performance, resource status and costs of production. In addition, from an Indian seafood perspective, investigations of export market behaviour for an export-dependent fishery may help predict investment decisions of fishing firms. It should also be noted that this study identifies the import demand behaviour for all the Indian seafood products collectively. However, further research should be carried out for analysing import demand behaviour for each seafood products (or species) separately to understand the strength and weaknesses of individual products, as this type of information is lost in the case of aggregated data.

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