

A STATISTICAL STUDY OF THE FOREIGN DEMAND FOR RAW JUTE

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INTRODUCTION

The importance of statistical studies on demand is now being increasingly felt in this country. The Bengal Jute Enquiry Committee, 1939, stressed the need for undertaking such studies with the following observations:—"Much of our present talks about the effects of price movements on consumption—a vitally important matter for the jute trade—is of a somewhat 'woolly' character, as they lack statistical background." (Page 25 of the Report).

In view of the practical usefulness of this class of studies, it may be of interest to study the demand for raw jute in the light of available statistics on the subject. In the present paper, however, we propose to deal only with a part of the problem, viz., the foreign demand for raw jute.

The demand for a commodity depends not only on its price but also on various other factors, such as, purchasing power of money, business conditions, prices of related goods etc. Theoretically, all factors, important or unimportant, which affect the demand should be included in the analysis. But it is not necessary in practice to do so. For, owing to inter-correlations amongst the different factors, little advantage is gained by the inclusion of any but the first few highly associated factors in the situation.¹ For the purpose of our present study, the important factors which deserve consideration seem to be (1) prices of raw jute, (2) business conditions and (3) prices of related goods. As our object is to investigate foreign demand, the appropriate prices to be used in the analysis should be those to which foreign buyers respond. It is also necessary to express prices in terms of a common measure, i.e. gold, and to work with such gold prices.

NATURE AND SOURCES OF DATA

The relevant data for 19 years from 1920 to 1938, on which the present analysis is based, are shown in Table 1. The quantity series shown in col. (2) represents exports of raw jute from India and has been compiled from the official Blue Book relating to the Seaborne Trade and Navigation in India. The series shown in col. (3) represents gold prices of raw jute (First Marks) in Lohulun—the chief world market²—which have been derived from the corresponding sterling prices³ compiled by the Board of Trade, London. As regards world business conditions, the indices of industrial production and of world trade compiled and published by the League of Nations would naturally claim attention. But in view of the

1. Moore, H. L.: *Forecasting the Yield and Price of Cotton*, 1917, p. 162, and Schultz, H.: *Theory and Measurement of Demand*, 1938, p. 71.

2. *Id.* the following extract from the "Commodity Year Book, 1939" compiled and published by Commodity Research Bureau Inc, 82 Bowser St., New York (first edition, page 265.):—

"The world market place for jute is an over-the-counter affair in Mining Lane in London. Very little actual jute finds its way to London, but merchants and brokers buy and sell the recognized descriptions and grades. World prices are arrived at there, and dealers have an international reputation as arbitrators for the trade."

3. Three prices for a series of years are given in a convenient form in the Statistical Abstract of the United Kingdom—vide Table No. 192 (pp. 260-1)—83rd number, July 1940 (cmd. 6232).—

fact that these two series do not cover the entire period⁴ under consideration they cannot be used for the purpose of our investigation. A graphical analysis (on a logarithmic scale), however, reveals a very close correspondence⁵ of these two series with that relating to industrial production in the U. S. A. as compiled and published by the Federal Reserve

TABLE I. PRIMARY DATA

Year	Export of Raw jute (Apr.-Mar) ^a (000 Tons)	Gold price of First Marks (London) (£ per ton)	Index no. of Industrial production (1935-39 = 100) (U. S. A.) No.	Gold price of Burlap (U. S. A.) (Cents. per yd.)	Link Relative of figs. in			
					Col (2) y	Col (3) x ₁	Col (4) x ₂	Col (5) x ₃
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1920	472	42.31	75	11.8				
21	468	25.34	58	9.8				
22	578	28.37	73	7.8	-.992	-.599	-.773	-.467
23	660	25.76	88	7.9	1.235 ₂	1.159	1.259	1.625
24	696	26.03	82	8.9	1.142 ₃	-.908	1.203	1.013
					1.055	1.112	-.932	1.127
25	647	47.84	91	10.4	-.930	1.070	1.110	1.169
26	708	40.56	96	9.2	1.094	-.848	1.055	-.895
27	892	31.44	95	9.8	1.560	-.775	-.990	1.065
28	898	32.78	99	10.0	1.007	1.042	1.042	1.020
29	807	30.98	110	8.6	-.809	-.946	1.111	-.860
30	620	21.37	91	6.1	-.768	-.690	-.827	-.709
31	587	15.65	75	6.2	-.947	-.732	-.824	-.832
32	583	12.10	58	4.4	-.959	-.779	-.773	-.846
33	748	10.65	69	4.4	1.329	-.874	1.100	1.000
34	732	9.56	75	3.7	1.093	-.898	1.087	-.841
35	771	11.10	87	3.6	1.025	1.161	1.160	-.973
36	821	11.09	103	3.2	1.043	-.999	1.184	-.889
37	747	12.33	113	3.2	-.910	1.112	1.097	1.000
38	691	11.09	88	2.9	-.925	-.899	-.779	-.906

^aFigures under this column relate to fiscal year, being shown against the calendar year which covers the nine months of fiscal year (i.e., figure shown against 1920 refers to fiscal year 1920-21 and so on.)

Bank of that country. Accordingly, the index numbers of industrial production⁶ in the U. S. A. have been taken to represent world business conditions for the purpose of the present study and are tabulated in col. 4 of Table 1. As regards prices of related goods, those of jute manufactures seem to be very important. It is well known that the demand for raw jute is a derived one, being dependent on that for the jute fabrics. The manufacturers' demand for raw jute, accordingly, finds expression in terms of prices of jute goods which would, therefore, be an important factor for the purpose of our study. We have accordingly taken the prices of burlap (40" x 10½ oz) in New York to represent world prices of jute manufactures. The relevant figures in this connexion, which have been taken

4. The series of index numbers relating to world industrial production published by the League of Nations runs from 1925, while that relating to world trade from 1924.

5. The degree of correspondence may be judged by the following correlation coefficients (based on the figures for the 14 years from 1925 to 1938).

$$r_{1925, 1928} = 0.85; r_{1928, 1928} = 0.97; r_{1928, 1928} = 0.84$$

where y₁ = Index of Quantum of World Trade (League of Nations)
 y₂ = " " Industrial Production of the World (League of Nations)
 x = " " " " " " in the U. S. A.

6. The Federal Reserve Bank of the U. S. A. has recently revised their series, vide Monthly Bulletin for August, 1940. We have taken the revised series.

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from the data compiled and published by the Bureau of Labour¹, U. S. A. are shown in col. 6 of the Table, with the necessary adjustment for the devaluation of the dollar since 1933. As foreign purchases are likely to be reflected in the official statistics with a time lag, the export figures shown in col. 2 of the Table refer to official years (April-March), while those relating to the other three series shown in cols. 3, 4 and 5 refer to calendar years.

ANALYSIS & FINDINGS—LINK-RELATIVE METHOD—(a) ARITHMETIC FORM

As *relative* rather than *absolute* changes form the basis of relationship in economic series, it has been deemed expedient to employ the link-relative method for the purpose of our analysis. Denoting the relative changes in exports as compared with the preceding year by y and similar changes in respect of prices of raw jute, business conditions and prices of *burlap* by x_1 , x_2 and x_3 respectively—as tabulated in the last four columns of Table 1—we obtain the following equation by the method of multiple correlation (taken as linear as a first approximation) —

$$y = 0.6132 - 0.3748(\pm 0.1386) x_1 + 0.4496(\pm 0.1987) x_2 + 0.3299(\pm 0.1477) x_3 \quad (1)$$

with a value of $R=0.743$ which is slightly greater than the value 0.738 at one per cent level of significance with $n=14$ (or $n'=18$). The standard error of the estimates (S) works out at 0.093. But as both R and S have been derived from small samples, they require an adjustment and the adjusted values work out¹⁰ at $\bar{R}=0.675$ and $\bar{S}=0.104$ respectively.

Equation (1) which may be regarded as an approximation to the generalised law of demand in the ratio form, leads to the following conclusions:—

(1) On the assumption of other things remaining the same, a rise (or fall) of one point (about 1 per cent) in the gold price of raw jute will, on the average, cause a decrease (or increase) of 0.37 point (about 0.35 per cent) in the exports of raw jute as compared with the preceding year.

(2) The net effect of an improvement in the world business conditions by one point (about 1 per cent) is likely to result in an increase of foreign demand for raw jute by 0.45 point (about 0.45 per cent) as compared with the preceding year; and

7. These prices are collected by the Bureau in connexion with their index numbers of wholesale prices in the U. S. A. and are given in the Annual Bulletin published by the Bureau on the subject.

8. The figures with \pm sign within brackets in the equation represent the standard errors of the respective regression coefficients.

9. The adjustment is for the number of observations in the sample and for the number of constants on the regression equation.

10. Denoting by y the value of the dependant variable as estimated from the regression equation

$$y = a + b_1 x_1 + b_2 x_2 + \dots + b_{m-1} x_{m-1}$$

The standard error (S) of the estimate is given by

$$S^2 = \frac{1}{n} \sum (y - \hat{y})^2$$

where n is the number of sets of observations.

The adjusted value of the standard error (\bar{S}) is then given by

$$\bar{S}^2 = \frac{n}{n-m} S^2 = \frac{1}{n-m} \sum (y - \hat{y})^2$$

where m is the number of parameters in the regression equation. The corrected or adjusted value of *i.e.*, \bar{R} , is given by

$$\bar{R}^2 = 1 - (1 - R^2) \left(\frac{n-1}{n-m} \right)$$

(3) An increase of one point (about 1 per cent) in the relative price (gold) of jute goods will, on the assumption of other things remaining unchanged, improve the foreign demand for raw jute by 3 points (i.e. about 0.3 per cent) as compared with the preceding year.

To obtain the usual demand curve on the assumption of other factors (here world business conditions and price of jute goods) remaining unchanged, we put the mean value of x_1 and x_2 in equation (1) above and get

$$y = 1.3877 - 0.3748 x_1 \tag{1A}$$

which, though in relative form, can easily be transformed into absolute terms. Writing

$$y = Q / Q_{-1} \text{ and } x_1 = P / P_{-1}$$

and making the necessary substitutions from Table 1, equation (1A) is reduced to

$$Q = 930.3 - 10.14 P \tag{1B}$$

where Q is the quantity of exports expressed in *thousand tons* and P the gold price of raw jute per ton. The coefficient of elasticity of demand (η) at the average level of price during the period of study (i.e. £ 23.0 gold per ton) works out at -0.35. The values of elasticity of demand at certain other selected levels of price as deduced from equation (1B) or (1A)¹¹ above are shown in Table 2.

TABLE 2. ELASTICITY OF FOREIGN DEMAND FOR RAW JUTE

Change in Price (gold price of raw jute as compared with the average price during the period 1920-38, i.e., £. 23.0 gold per ton)				Values of the elasticity of demand	
50	per cent	above	the average	$x_1 =$	$\eta =$
40	"	"	"	1.5	-0.68
	"	"	"	1.4	-0.61
30	"	"	"	1.3	-0.54
20	"	"	"	1.2	-0.48
10	"	"	"	1.1	-0.42
10	"	below	"	0.9	-0.32
20	"	"	"	0.8	-0.28
30	"	"	"	0.7	-0.23

The results shown above are in agreement with the general proposition of the economic theory that elasticity is greater for high than for low prices¹². The values shown in the last column of the table illustrate how the foreign demand tends to be more and more elastic as prices become higher and higher.

As already remarked, equation (1A) or (1B) was derived on the assumption of "other factors remaining the same" As a matter of fact, however, "other factors" (viz. world business conditions and prices of jute goods) did not remain unchanged throughout the period of study but varied from year to year, producing shifts in the demand curve. An

11. The coefficient of elasticity of demand can be worked out from the demand equation in the ratio form as shown below. Thus writing Q/Q_{-1} for y and P/P_{-1} for x_1 , equation (1A) becomes

$$Q = 1.3877 Q_{-1} - 0.3748 \left(\frac{Q_{-1}}{P_{-1}} \right) P$$

from which

$$\eta = \frac{dQ}{dP} \cdot \frac{P}{Q} = -0.3748 \left(\frac{Q_{-1}}{P_{-1}} \right) \frac{P}{Q} = -0.3748 \frac{x_1}{y}$$

12. Marshall: *Principles of Economics* (6th edition) 10]0, Book III Chapter IV, p. 103.

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examination of the position shows that a pronounced shift of the demand curve to the right occurred in 1925, the law of demand for which year may be written as

$$Q=1042.6-9.11 P \quad (1C)$$

Equation (1C) shows that if the price in 1925 were equal to the average of those ruling during 1920-38 (i.e. £ 23.6 gold per ton), the quantity demanded for export in that year would have been approximately 827,000 tons, as compared with 601,000 tons derived on the basis of the unchanging demand curve, (equation 1B). To give some idea of the shift of the demand curve during the period of study, the quantities demanded for export at each of certain selected levels of prices in 1928 and 1934 (two extreme years)¹³ are shown in Table 3 below, along with the corresponding quantities derived on the basis of the unchanging demand curve during the whole period:—

TABLE 3. SHIFT OF THE DEMAND CURVE

Year	Export demand (in thousand tons) at certain selected levels of price (gold) as deduced from the law of demand for particular years shown in col.1				
	£. 18.00 per ton	£. 21.27 per ton	£. 23.63 per ton	£. 25.99 per ton	£. 28.36 per ton
(1)	(2)	(3)	(4)	(5)	(6)
1928	1064	1039	1014	989	964
1934	634	472	410	348	285
Average 1920-38	739	715	691	667	643

ANALYSIS & FINDINGS—LINK-RELATIVE METHOD—(b) LOGARITHMIC FORM

The results stated above have all been derived on the basis of the arithmetic law expressed by equation (1). But instead of assuming an arithmetic form of relationship, we may as well work on the basis of the alternative hypothesis, viz., geometric form of relationship. This may be done by working with the logarithms of the link-relatives (shown in the last four columns of Table 1) and deducing the demand curve on that basis. Adopting this alternative procedure and denoting the logarithm of y , x_1 , x_2 and x_3 by z_1 , z_2 , z_3 and z_4 respectively, we get the following equation.

$$z_1 = 1.2891 - 0.4023(\pm 0.1638) z_2 + 0.4863(\pm 0.2013) z_3 + 0.2732(\pm 0.1409) z_4 \quad (2)$$

with a value of the multiple correlation coefficient $R=0.706$, which, though significant on the 5 per cent level, is not so on the one per cent level.¹⁴ The values of the adjusted coefficient of multiple correlation and standard error of the equation work out as

$$\bar{R}=0.620 \text{ and } \bar{S}=0.0457$$

Equation (2) shows that on the usual assumption of other things remaining the same, a rise of 10 per cent in the price (gold) of raw jute will, on the average, reduce the foreign demand for raw jute by 4 per cent—a result agreeing closely with that (viz. 3.5 per cent)

¹³ The greatest shift of the demand curve to the right seems to have occurred in 1928 and that to the left in 1934

¹⁴ The value of R is 0.640 at 5% level of significance and 0.738 at one per cent level with $n=14$ (or $n'=18$)

obtained previously on the basis of the arithmetic law. Similarly the net effects of the other two factors as deduced from equation (2) above are in substantial agreement with the corresponding results obtained from equation (1), as may be seen from the following:—

(a) An improvement of 10 per cent in the world business conditions will, on the average, lead to an increase of foreign demand of raw jute by 4.8 per cent as against 4.5 per cent indicated by the arithmetic law.

(b) An increase of 10 per cent in the price (gold) of jute goods is likely to improve, on the average, the foreign demand of raw jute by 2.7 per cent as against 3.3 per cent suggested by the arithmetic law.

CONCLUSIONS

We have investigated the law of foreign demand for raw jute under two hypotheses—(a) arithmetic and (b) logarithmic relationships; and though the general conclusions reached are practically the same in both the cases, it is of interest to know which of the two forms of relationship has a greater claim to validity. This is because of the fact that the economic significance differs in the two cases, the logarithmic form implying constant elasticity for all levels of prices, while the arithmetic form presupposing varying elasticity. When several forms of relationship are available, we should clearly choose that particular form which fits the data with the greatest degree of precision. The values of the adjusted multiple correlation coefficient and standard error are serviceable in this connexion. Comparing the values of these statistical constants in the two cases, we find that the arithmetic form gives a slightly better fit than the logarithmic form. The assumption of varying elasticity would thus appear to be more appropriate in the present case than that of constant elasticity—a finding to which *a priori* considerations also lend support. Accordingly the results derived from equation (1) should be taken in preference to those indicated by equation (2).

The main conclusions reached in the present study may now be summarised as follows:—

(a) Of the three factors *viz.* (1) price of raw jute, (2) world business conditions and (3) price of jute manufactures, which affect the foreign demand for raw jute, the second factor seems to be the most important.

(b) When world business conditions and prices (gold) of jute manufactures remain unchanged, a rise of 10 per cent in the price (gold) of raw jute will, on the average, cause a reduction of approximately 4 per cent in the foreign demand for raw jute. In other words, the foreign demand for raw jute is inelastic, the average elasticity being approximately equal to -0.4 . The elasticity, however, varies with prices and its value at certain selected levels of prices, as deduced from the average experience during the period 1920-33, is given in Table 2 *ante*.

(c) On the assumption of prices of raw and manufactured jute remaining unchanged, an improvement of 10 per cent in world business conditions will lead to an increase of foreign demand for raw jute by about 5 per cent on the average; and

(d) When world business conditions and prices of raw jute remain the same as before, an increase of 10 per cent in the price (gold) of jute manufactures will, on the average, improve the foreign demand for raw jute by about 3 per cent.

15. Moore, H. L. "Economic Cycles: Their Law and Causes", 1914, p. 84.

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