Foreign Trade Parameters Reconsidered Disaggregative vs Aggregative Model

Narayan K. Nargund*

I. Introduction

There have been a number of studies since early post-war years (see for instance Cheng (1959), Leamer and Stern (1970, Chapters 2 and 3) which have been stressed in the effort to provide an explanation of stagnant exports of many of the developing countries, the low price elasticities of demand and supply for traditional products on world markets have received considerable attention. Economists have tried to find answers to questions as to why such low price elasticities were estimated. Robert Stern (1973, p. 149) declared that "meaningful results may also be obtained by using data specifications that avoid lumping together commodities with widely varying elasticities and by making explicit allowances for lags in the adjustment process." Cohen (1964, p. 610) observed that "further research into India's relative export prices and market shares in her other important markets - such as the United States, Japan, and Africa - would be illuminating for policy makers; the Indian government has recently begun to collect such data for some Indian exports." The present paper is an attempt in that direction.

The purpose of this paper is to re-examine the foreign trade elasticities of developing countries and to reassess the policy implications. More specifically, the present study offers some empirical results on simultaneous disaggregation of trade by commodity class and by trading partner using data for Indo-U.S. exports over the period of 18 years, 1951-1969. While the model specified and tested

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is in the general spirit of those previously employed, several new variables are incorporated and tested. Moreover, an attempt is made to measure the role of non-traditional products or "new manufactures" like engineering commodities in the Indo-U.S. foreign sector as they have experienced a significant growth during the 1960's.

Section II of the paper dicusses the model; section III presents the empirical results; and section IV gives the measures of elasticity with respect to various explanatory variables. The final section discusses policy implications of the results and summarizes the conclusions.

II. The Model

The basic export demand equation, based upon the pioneering works of Polak (1954), Neisser and Modigliani (1953), Ball and Marwah (1962), Kreinin (1967), and Houthakker and Magee (1969), can be written as

$$(X_i)_t = A_0 + A_1 (Y_j)_t + A_2 (P_j)_t + A_3 (P_j)_t + e_{it} \quad (1)$$

dividing equation (1) through by P_i yields

$$(x_i)_t = A'_0 + A'_1 (y_j)_t + A'_2 (P_j/P_i)_t + e'_{it} \quad (2)$$

where

$(x_i P_i)_t \equiv (X_i)_t =$ Export earnings of country i in year t

$(y_j P_i)_t \equiv (Y_j)_t =$ Income or economic activity of the world

$(P_j)_t =$ Price of world exports

$(P_i)_t =$ Export price of country i

$e_{it}, e'_{it} =$ Error terms

$A_0, A_1, A_2, A_3, A'_0, A'_1, A'_2 =$ Trade parameters estimated by the ordinary least squares method. A'_1 and $A'_2 \geqslant 0$; $A'_0 \gtreqless 0$.

The simple justification for equation (2) would be in terms of the theory of demand according to which the volume of exports would, *ceteris paribus*, be determined by the world economic activity and the relative prices. Other influencing factors are trading blocks, commercial policies, tastes, the availability of credit, delivery delays, and so on. The selection of the explanatory variables is dictated by the availability of data and the inclusion of all explanatory variables would create problems associated with estimation method - multicollinearity, limited degrees of freedom and goodness of fit. Thus the choice among these variables would depend, to a great extent, upon theoretical as well as practical considerations (see Ball (1973, Chapter 8)).

The export demand in a two-country disaggregative model is further influenced by the exporting country's competitor's price and by the importing country's price of either similar products or modern substitute goods like synthetic goods. Thus, equation (2) may be rewritten as

$$(x_{ijk})_t = B_0 + B_1 \ (y_{jk})_t + B_2 \ (P_{jk}/P_{ik})_t + B_3 \ (P_{lk}/P_{ik})_t + B_4 \ (P_{jm}/P_{ik})_t + u_{it} \tag{3}$$

where,

$(x_{ijk}P_{ik})_t = (X_{ijk})_t$ = Export earnings of country i from country j

$(y_{jk}P_{ik})_t = (Y_{jk})_t$ = j^{th} country's economic activity in the production of k^{th} commodity

$(P_{jk})_t$ = j^{th} country's domestic price of k^{th} product

$(P_{ik})_t$ = Country i's export price of k^{th} commodity

$(P_{lk})_t$ = i^{th} country's major competitor's (i.e. l^{th}) export price of k^{th} product

$(P_{jm})_t$ = Price of m^{th} (i.e. k^{th} substitute) commodity in country j

u_{it} = Error term

B_0, B_1, B_2, B_3, and B_4 = Trade parameters estimated by the ordinary least squares method. $B_1, B_2, B_3, B_4 \geqslant 0; B_0 \gtrless 0$

For brevity, let

$$(P_{jk}/P_{ik})_t = (P_1)_t; \ (P_{lk}/P_{ik})_t = (P_2)_t; \text{ and } (P_{jm}/P_{ik})_t = (P_3)_t \quad (4)$$

Substituting equation (4) into equation (3), we obtain a testable hypothesis

$$(x_{ijk})_t = B_0 + B_1\ (y_{jk})_t + B_2\ (P_1)_t + B_3\ (P_2)_t + B_4\ (P_3)_t + u_{it} \quad (5)$$

The choice of activity variable depends upon the nature of a commodity or group of commodities being studied. B_2, B_3, and B_4 reflect the strength of substitution between the ith country's products and similar products produced in the jth country on the one hand and the competitors' products on the other. They are expected to be positive since the ith country's export price is in the denominator. The magnitude of variation in the volume of exports depends on the size of the elasticities of substitution and of the activity of elasticity.

III. Empirical Results

The most important commodities in India's exports to the United States are (1) jute manufactures, (2) tea, (3) cashew nuts, (4) spices, (5) hides and skins, and (6) shellac and gum. Together, they constitute about 80 per cent of India's total exports to the United States. During the sixties, engineering products tended to acquire increasing importance and their share of total exports, though smaller, was more than doubled by 1968. This section presents the estimated export demand equations for these commodities.

The equations are estimated by the method of ordinary least squares (OLS) in spite of the classic criticisms of Orcutt (1950) and others (1958) since in estimating the foreign trade equations of a small country like India against a world market or a gigantic country's market, the problem of single equation bias is unimportant and does not even exist. Klein (1960, p. 871) aptly remarked that "international trading relationships pitting a small country's demand or supply against an overwhelming world market may also properly be estimated by the ordinary method of least squares." To evaluate the equation standard statistical measures such as $\bar{R}^2$, DW, and t-ratios are given. The empirical results are presented in Table 1.

When two equations are given for a commodity, the first (a) is the linear estimated equation while the second (b) is the log-linear estimated equation. The equation with the prime symbol (') for the same commodity incorporate additional variables.

Jute Manufactures

Jute products contribute a major portion of dollar earnings. Their share in India's total exports to the United States was between 30 and 55 per cent during the period 1951-1968. The U.S. farm crop production and the industrial production are the appropriate activity variables as jute manufactures are used in packaging agricultural produce, floor coverings, upholstery, and in twine.

Jute products face severe competition from paper bags and sacks. The high price of jute during 1946-1950 due to World War II encouraged the substitution process. The use of paper bags and sacks increased considerably as they carry more visible printed advertising information to customers. Therefore, we should introduce the price of paper as an explanatory varible into the jute export equation. The estimated equations are 3.1a and 3.1b in Table 1.

The regression coefficients have theoretically expected signs. It appears that both equations provide a good explanation of the variation in the volume of jute exports to the United States. However, judged from statistical significance point of view, equation (3.1a) is preferable.

Tea

The United States is predominantly a coffee-drinking country and therefore, the demand for tea is mainly a matter of habit and custom.

The U.S. demand for tea has, almost entirely, been met by imported tea. Thus, the amount of tea consumption in the United States could be used as a specific demand indicator for India's tea exports. For the past fifteen years, India's tea has been facing intense competition from Asian and African countries. The sharp fall in tea prices during 1951-1953 owing to the large scale production of inferior quality tea affected India's tea exports adversely. Her major competitors in the U.S. tea market are Ceylon and Kenya (during the sixties). It is appropriate to include Ceylonese tea export price in our equation. The estimated relationship is shown as equation 3.2 in Table 1.

The negative coefficient of Y is puzzling, for normally one would expect the activity variable to have a positive impact on the demand for tea. The negative sign could be due to a declining trend.[1] It appears that a market rise in real income would lead to some reduction in the amount of tea consumed in favor of other beverages, (see FAO (1960), p. 13). The F.A.O. study (1960) based on the household survey in 1953 found the negative coefficient of tea as regards both quantity of tea consumed and expenditure.

India's relative share of the U.S. tea market tended to decline during the period under study. Presented as 3.3 in Table 2 is the estimated share equation.

The price of coffee may have some influence on India's relative share. Therefore, we have reestimated equation (3.3) incorporating the U.S. import price of coffee as an explanatory variable and presented as equation 3.3 in Table 1.

The coefficient of (P_3) appears to be statistically insignificant which indicates that tea and coffee are not good substitutes in a coffee drinking nation like the United States.

The value of $\bar{R}^2$ shows a substantial improvement over equation (3.3). We recommended both equations (3.2) and (3.3) at this stage as the former analyzes the level of U.S. demand for Indian tea and the latter India's share.

Cashew Nuts

The United States is the largest buyer of India's cashew nuts accounting for more than 60 per cent of India's total exports of cashew nuts. At present, there are no major competitors. Brazil and Mozambique have, in recent times, exported small quantities of cashew nuts to the United States.

The estimated equation of India's exports of cashew nuts to the United States is derived from the straightforward *a priori* analysis that is, the U.S. demand for Indian cashew nuts depends on the U.S. income and on its own price, and is shown as equation 3.4 in Table 1.

Spices

1 The inclusion of a time trend variable in our trial equations produced unacceptable price coefficient (wrong sign and statistically insignificants to multi-collinearity between the two).

The demand for spices in the United States has, almost entirely, been met by imports. Pepper, black and white, is the dominant item among the U.S. imports of spices.

In analyzing the U.S. demand for Indian spices, one would expect the expenditures on spices to be the prime demand indicator. Indian spices face competition from Indonesian spices. Before 1958, the United States took the bulk of its need from India and since then Indonesia has taken a major portion of the U.S. market away from India. To measure the price competitiveness between the two, the export price of Indonesian pepper was introduced into our export equation of spices. A time trend variable has also been included. The estimated equation is shown as equation 3.5 in Table 1.

Shellac and Gums

The demand for shellac and gums in the United States has been continuously declining during the period 1951-1968. This is so because synthetic products have captured a great portion of the U.S. gramophone record market which was once dominated by shellac. Therefore, the demand for Indian shellac and gums depends on the production of synthetic products such as plastic resins with an expected negative coefficient. The U.S. price of plastic resins relative to India's export price of shellac is another explanatory variable which measures the substitution effect. The estimated relationship is shown as equation 3.6 in Table 1.

Hides and Skins

The demand for hides and skins depends on consumer demand for leather products such as shoes, hand-bags, and belts. Therefore, the U.S. production of leather goods has been selected to represent the activity variable in our estimated equation. The U.S. price of hides and skins relative on the price of India's hides and skins seems to be relevent as there is a substantial production of hides and skins in the United States. The lagged exports of hides and skins variable has been included in the function implying a geometrically declining lag pattern. The estimated equation is presented as equation 3.7 in Table 1.

Engineering Goods

India's exports of "new manufactures" consisting of engineering goods experienced a tremendous growth during the 1960's. Their share of total Indian exports rose from 1.3 per cent in 1970 to 7.7 per cent in 1969. Although their share is low compared with that of traditional commodities, engineering goods emerged as the most dynamic group and began to gain more importance in India's export trade structure. The term "engineering goods" covers (1) machinery and transport equipment (SITC 7), (2) scientific, optical, medical, measuring and controlling instruments (SITC 861), (3) watches and clocks (SITC 864), and (4) miscellaneous manufactures of metals (SITC 69).

The estimating equation is fairly simple. It expresses India's exports of engineering goods to the United States as a functions of the level of personal disposable income in the United States. The relative price variable or, for that matter, other explanatory variables have not been included. This is so because we are dealing with very limited degrees of freedom.

The estimated equation based on nine annual observations from 1961 to 1969 is shown as equation 3.8 in Table 2.

The regression fit is quite satisfactory. The income variable, by itself, seems to explain 92 per cent of the variation in India's exports of engineering goods to the United States. Its coefficient is highly significant judged from the statistical point of view.

To stress the importance of disaggregation, equations relating to Indo-U.S. export and Indo-world export trade are presented as equation 3.9 and 3.10 respectively. Equation 3.9 shows that India's exports to the United States is a function of U.S. income or industrial production. The relative price variable based on a ratio of U.S. prices to India's export prices is irrelevant as most of the commodities imported from India are not produced in the United States. Equation 3.10 points out that the index of world gross domestic product is the prime demand indicator. The relative price variable defined as export price index of low income countries[2] relative to India's export price is another chief explanatory variable.

Professor Harry G. Johnson suggested that exports of a country must be roughly equal to imports minus capital inflows, and their total growth must be related to the growth of the exporting country. We have reestimated equation 3.10 by incorporating the capital inflows variable as a regressor. The results are as follows:

2 In estimating a low-income country's export equation, the developing area's export price instead of World export price is an appropriate variable as the latter is dominated by advanced countries' export price.

$$X_W = -0.27 + 0.0043Y + 0.0086P + 0.020K$$
$$(-0.66) \quad (1.74) \quad (2.66)^1 \quad (1.95)$$

$$\bar{R}^2 = 0.81, \quad DW = 1.44, \quad S = 0.80$$

Where K is the capital inflows into India and other variables are explained in the List of Variables Section.

The goodness of fit as measured by R^2 increased whereas the statistical significance of the activity variable declined.

IV. Measurement of Elasticity

One of the primary purposes of any empirical analysis of international trade is to measure the trade elasticities with respect to various explanatory variables as to the policy implications and applications depend, *ceteris paribus,* on their size and sign. Some measures of elasticity of U.S. demand for India's commodities in terms of the regressors have been estimated and are presented in Table 2.

V. Policy Implications and Conclusions

In summary, the estimates of the model support the hypothesis that U.S. economic activity, U.S. price competitiveness (P_1), and India's price competitiveness (P_2) are the major determinants of India's export performance in the U.S. market. They appear to (1) carry signs suggested by economic theory except in Tea and Hides and Skins equations where the activity variable sign reversals occur but are not unusual, given the nature of these products, and (2) satisfy tests prescribed by statistical methods in terms of R^2, significance of the coefficients, and the Durbin-Watson test.

The results of this study indicate that disaggregation of trade by commodity class and by trading partner is essential to derive meaningful foreign trade demand functions. To emphasize the significance of disaggregation, equations relating to Indo-U.S. export and Indo-World export trade were also estimated. The aggregate equations (3.9 and 3.10) exhibit an inelastic demand for India's exports, whereas the disaggregate equations (3.1a, 3.4, and 3.8) reveal that India's products are income elastic. The following implications and conclusions may be drawn from this study.

Jute, cashew nuts, and engineering goods have income elasticity greater than unity which shows that the U.S. demand for these products will probably rise. It is interesting to note that the U.S. demand for Indian jute manufactures is somewhat more elastic with respect to industrial production than with respect to agricultural production as was expected. In recent years, the consumption of jute in the United States advanced considerably due to increased production of carpets and upholstery. It appears that cashew nuts are luxury items for the U.S. consumers. India's engineering goods are highly income elastic and are fairly new in the U.S. market and may compete well with those of other countries like Japan. On the other hand, India's traditional commodities such as spices are income inelastic and thus indicate that the demand for these products appears to rise slowly. Our serious concern is with the negative activity elasticity for Indian tea which is one of the most important items in the export basket. As was pointed out earlier, a marked rise in real income would lead to some reduction in the amount of tea consumed in favor of other beverages. One way to increase the demand for Indian tea is to introduce product differentiation such as instant tea, iced tea, tea candy, tea ice cream, and tea liquor.

One of the main findings of this study is the discovery that the price variable contributes substantially to the explanation of export behavior of a low income country and its role is measurable. The estimates of competitive price elasticity indicate that there exists an effective price competition between Indian products and her competitor's products (Ceylon and Indonesia) and to a lesser extent between Indian products and synthetic products. The price competition is also significant in other markets. Cohen (1964) estimated the elasticity of substitution between Indian and Ceylonese tea in the U.K. market to be -1.05. DaCosta (1964), Dutta (1965), and Cohen (1964) obtained the elasticity of substitution between the two countries's tea in the world market of -1.17, -1.22, and -0.81, respectively. Thus, contrary to the conclusion reached by Peera (1971), the price sensitivity is measured and it is statistically significant (see also Dutta and Nargund (1972)). It appears that there is no widespread substitution of paper bags for jute. Chaudhary (1958) reported the elasticity of substitution between jute and paper during 1930-1940 of 0.74. In the remaining period of 1919-29 and 1941-53, it was -0.306 and -0.26 respectively. Maizels (1961) found it to be 0.01. Our estimate for the contemporary period is 0.24.[3] Similarly, the elasticity of substitution between shellac and synthetic resins is also less than unity but greater than the substitution effect between paper bags and jute.

3 The export price of jute is in the denominator, and thus the elasticity coefficient is positive.

The foreign demand for India's traditional exports can be increased by reducing the cost of production and by adopting techniques of proper product differentiation and promotion. One way to reduce cost is to eliminate inefficiency in the production of goods such as textiles, jute, and tea.

The effects of income on the Indo-U.S. export trade appear to be weaker than those on the Indo-U.S. import trade.[4] Therefore, our analysis shows that, other things being equal, India's trade balance with the United States may deteriorate over time and it supports the conclusions reached by Houthakker and Magee (1969). Thus, special attention must be given to the advancement of export trade. Efforts must be made to meet the production targets for exports, internal factors affecting the mobility of resources must be removed, and a favorable atmosphere must be created for external demand conditions. If external imbalance is to be avoided, India should become an "export-minded" nation like Japan and increase the supply of exportable goods, improve her competitive position, and diversify the composition of exports.

Further research on the invisible items of current account and on the capital account of the balance of payments is essential to formulate effective policy measures.

4 India's activity elasticity estimated for her imports from the United States is approximately 1.20 Nargund (1976), whereas the U.S. activity elasticity for India's exports is approximately 0.58 (Table 1).

Table 1

STATISTICAL ESTIMATES FOR DISAGGREGATED EXPORT TRADE*
1951-1968

Equation No.	Endogenous Variable*	Constant	Exogenous Variables*						$\bar{R}^2$	S	DW
			Y	P_1	P_2	P_3	X_{-1}	t			
3.1a	X_j	-394.83 (-2.20)	4.67, 6.93 (1.89), (5.98)			1.11 (2.14)	-0.68 (-3.10)		0.92	31.55	-17.70@
3.1b[a]	X_j	-0.73 (-0.45)	0.77, 1.39 (1.55), (5.96)			0.28 (2.38)	-0.67 (-3.42)		0.92	0.06	-9.54@
3.2	X_T	3.12 (0.23)	-0.145 (-2.78)		0.41 (4.50)				0.77	2.96	1.60
3.3	$(X/M_{rw})_T$	0.12 (0.60)	-0.0052 (-6.68)		0.008 (5.97)				0.91	0.044	1.97
3.3	$(X/M_{rw})_T$	0.22 (1.08)	-0.0050 (-6.56)		0.006 (2.97)	0.007 (1.42)			0.92	0.042	1.98
3.4	X_c	-17.22 (-1.74)	0.0016 (7.41)	-134.01[b] (-5.29)					0.78	4.76	2.57

Table 1 (Continued)

Equation No.	Endogenous Variable*	Constant	Y	P₁ Exogenous Variables*							
				P_1	P_2	P_3	X_{-1}	t	$\bar{R}^2$	S	DW
3.5	X_s	0.35	0.11		0.041			−0.35	0.84	1.29	2.79
		(0.24)	(2.56)		(6.86)			(−4.38)			
3.6	X_{sh}	2.82	−0.0017		0.068				0.76	1.23	1.72
		(1.21)	(− 2.59)		(4.27)						
3.7	X_{hs}	18.04	−0.20	0.042			0.403		0.90	1.0	−4.59@
		(2.31)	(−2.50)	(2.42)			(2.73)				
3.8[c]	X_{eg}	−8.98	0.0242						0.92	0.51	1.56
		(−7.48)	(9.40)								
3.9	X_{us}	0.0148	1.083						0.55	0.28	1.90
		(4.53)	(3.47)								
3.10	X_w	−0.338	0.0096	0.0084					0.78	0.084	1.20
		(−0.703)	(6.954)	(2.318)							

Notes: (1) Numbers in parentheses are *t-ratios*.
(2) R^2 is the coefficient of determination adjusted for degrees of freedom.
(3) *S* is the standard error of estimate for each equation.
(4) *DW* is the Durbin-Watson statistic for serial correlation; the DW marked by the symbol @ is the Durbin's "h" test (in equations 3.1a, 3.1b, and 3.7)

a Equation (3.1b) is in the log-linear form
b Own price coefficient
c Equation (3.8) is based on annual observations from 1961 to 1969
* A complete data appendix may be obtained from the author.

Table 2

MEASURES OF ELASTICITY*

Equation No.	Dependent Variable	Exogenous Variables Y	P_1	P_2	P_3
3.1a	Jute	0.90, 1.32			0.24[a]
3.1b	Jute	0.77, 1.39			0.28[a]
3.2	Tea	-0.58		1.48	
3.3	Tea (share)	-1.73		2.39	
3.3'	Tea (share)	-1.66		1.79	0.29
3.4	Cashew Nuts	2.47	-0.74[b]		
3.5	Spices	0.77		0.89	
3.6	Shellac and Gums	-0.32		0.94[c]	
3.7	Hides and Skins	-2.80	0.81		
3.8	Engineering goods	4.73			
3.9	Total Exports to USA	0.58			
3.10	Total Exports to World	0.61	0.62		

a elasticity of substitution between burlap and paper
b own price elasticity
c elasticity of substitution between shellac and synthetic resins
* computed at the sample means

List of Variables

Endogenous Variables:

X_j = volume of India's jute exports to the United States in millions of pounds;

X_T = India's exports of tea to the United States in millions of pounds;

M_{rw} = U.S. imports of tea from the rest of the world in millions of pounds;

X_c = exports of cashew nuts to the United States in millions of pounds;

X_s = exports of spices to the United States in millions of $ deflated by Indian export price index of spices;

X_{sh} = exports of shellac and gums to the United States in millions of $ deflated by India's export price of shellac;

X_{hs} = exports of hides and skins to the United States in millions of $ deflated by Indian hides and skins price;

X_{eg} = exports of engineering goods to the United States in millions of U.S. dollars deflated by India's export price of engineering goods;

X_{us} = India's total exports to the United States in millions of dollars deflated by India's export price index;

X_w = India's exports to the World in millions of U.S. dollars deflated by Indian export price.

Exogenous Variables:

1) Activity Variables

There are two activity variables in equations (3.1a) and (3.1b) namely the index of farm crop production of the United States and the index of industrial production of the U.S. respectively (1963: 100). The *Y* variable in: (3.2), (3.3), (3.3') is the U.S. consumption of tea in millions of pounds; the activity variable in

(3.4) is the U.S. personal consumption expenditure on food items in million of U.S. $;

(3.5) is the U.S. consumption of spices in millions of 1963 dollars;

(3.6) is the value of shipment of synthetic resins in the United States in millions of 1963 dollars;

(3.7) is the U.S. industrial production of leather goods (1963:100);

(3.8) is the U.S. disposable personal income in billions of 1963 dollars;

(3.9) is the U.S. industrial production index (1963:100);

(3.10) is the World gross domestic product index.

2) Price Variables

$P_1 = P_{jk}/P_{ik}$ = the ratio of the j^{th} country's domestic price of k^{th} product to the i^{th} country's export price of k^{th} product;

$P_2 = P_{lk}/P_{ik}$ = j^{th} country's price of k^{th} product divided by the i^{th} country export price of k^{th} product;

$P_3 = P_{jm}/P_{ik}$ = Price of m^{th} commodity (i.e. k^{th} substitute) in the country j divided by the i^{th} country's export price of k^{th} product;

i refers to India; j refers to the United States; l refers to India's major competitor.

3) Other Variables

t = time trend.

Appendix
Adjustment for Autocorrelation

An examination of the commodity equations (see Table 1) revealed that in equations for cashew nuts and spices the residuals are serially correlated, implying that the specification did not fully capture certain dynamic effects of demand. Therefore, these two equations were re-estimated subject to the first-order Cochrane-Orcutt iterative process.

$$u_t = \rho u_{t-1} + v_t \qquad (1)$$

where ρ is the serial correlation coefficient, and v_t is a random variable which satisfies all the assumptions of the OLS method: ~ NINV $(0, \sigma_v^2)$. The reestimated equations and income and price elasticities are presented below:

$$X_c = -16.007 + 0.0016Y - 131.943P_1 \qquad (2)$$
$$(-1.78) \quad (8.005) \quad (06.028)$$

$\bar{R}^2 = 0.82$ $\quad$ DW $= 1.725$

S $= 4.694$ $\quad$ $\hat{\rho} = -0.344$

income elasticity = 2.00 $\quad$ price elasticity = -0.731

$$X_s = 0.6581 + 0.0997Y + 0.04008P - 0.3376t \qquad (3)$$
$$(0.646) \quad (3.2815) \quad (8.7172)^2 \quad (-6.0347)$$

$\bar{R}^2 = 0.90$ $\quad$ DW $= 2.34$

S $= 1.203$ $\quad$ $\hat{\rho} = -0.437$

income elasticity = 0.74 $\quad$ price elasticity = 0.868

Note that there is a considerable improvement in the fit as measured by $\bar{R}^2$ and in the statistical significance as measured by *t* ratios.

Although the income elasticity in the case of cashew nuts dropped from 2.47 to 2.00, the Cochrane-Orcutt iterative process did not substantially change the price elasticities in either equation or the income elasticity in equation (3.5).

Note that the traditional *DW* test is not applicable to equations (3.1a), (3.1b), and to (3.7) where the lagged dependent variable appeared as a regressor. The *h* test proposed by Durbin was performed and the results indicate that there is no serial correlation among the residuals.

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