ΟΙΚΟΝΟΜΙΚΑΙ ΚΟΙΝΩΝΙΚΑΙ ΤΕΧΝΙΚΑΙ ΣΠΟΥΔΑΙ ΤΡΙΜΗΝΙΑΙΑ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΠΙΘΕΩΡΗΣΙΣ
ΕΚΔΟΣΙΣ ΤΗΣ ΕΝ ΠΕΙΡΑΙΕΙ ΑΝΩΤΑΤΗΣ ΒΙΟΜΗΧΑΝΙΚΗΣ ΣΧΟΛΗΣ

ΟΙΚΟΝΟΜΙΚΟΝ ΕΤΟΣ 1978	ΟΚΤΩΒΡΙΟΣ - ΔΕΚΕΜΒΡΙΟΣ 1978	ΚΗ' ΤΟΜΟΣ	ΑΡΙΘΜ. ΤΕΥΧΟΥΣ 4

A NOTE ON THE EFFECTS OF TARIFF REDUCTIONS ON THE VOLUME OF IMPORTS

By T. HITIRIS and E. PETOUSSIS,
University of York

It has been suggested that the effects of tariff reductions on the volume of trade, e.g. following the formation of a customs union, should be estimated by the use of tariff rather than price elasticities [1]. This is justified by the fact that tariff elasticities have been found invariably higher than price elasticities by the few empirical studies that introduced tariff variables together with prices into the import functions. The above divergence between the two elasticities has been attributed to the possibility «that importers regard tariff changes as permanent and reallocate purchases accordingly while changes in import prices are often considered transitory» [2]. Further research in support of this argument, however, does not seem to be forthcoming : few commodities have been subjected to tariff changes frequent enough to allow estimation by econometric techniques [3]. Nevertheless, economic association of a number of countries with the E.E.C. has given rise to gradual reductions of tariffs, and there is now considerable data for the

1. Kreinin, M. E., «Effects of Tarif Changes on the Price and Volume of Imports», American Economic Review, 51, 1961; Wemelsfelder, J., «The Short - Run Effect of the Lowering of Import Duties in Germany», Economic Journal, 70, 1960.

2. Balassa, B., Trade Liberalization Among Industrial Countries, Atlantic Policy Studies of the Council on Foreign Relations, McGraw - Hill, New York, 1967, p. 187. Kreinin has attributed this difference in the elasticities to the possibility of divergence between nominal and effective tariff rates : Kreinin, M. E., «Price v. Tariff Elasticities in International Trade - A suggested Reconciliation», American Economic Review, 57, 1967.

3. Leamer, E. E., «The Effects of Tariffs on a Trade Dependence Model», in Quantitative Studies of International Economic Relations, H. Glejser ed., North - Holland Publishing Co., Amsterdam, 1976.

study of tariff reductions at certain levels of aggregation. Such a study we attempt in the following with the use of data for Greece.

Greece became an associate member of the E.E.C. in 1962. The relevant Agreement distinguishes in the case of imports from partner countries two broad categories of importables. The first category includes commodities which are of a lesser importance for Greece because either their demand is not large enough to justify protection of the home market, or domestic production of substitutes seems to be competitive and capable of satisfying the domestic demand. The pre-association tariff on commodities belonging to this category of importables has been eliminated gradually in the first 12 years of association. The second category of importables includes all those industrial products which are most important for the Greek economy and thus are imported in considerable quantities. The Association Agreement [4] specifies that the pre-association tariff on this category of importables was to be eliminated gradually over a 22 year period before Greece became a full member of the Community. It had then to be subjected to four reductions of 5 percent each followed by ten reductions of 8 percent each. The Common External Tariff had also to be adopted by Greece in four stages during the period of association for its imports coming from non - EEC countries.

For the first set of estimates the import function is specified as

$$M_i = a + b_1 Y + b_2 P_i + b_3 T_i + u \qquad (1)$$

where M_i is the import volume of the i class of importables, Y is real domestic income, P_i is the relative price of imports, T_i is the tariff level of the i class of importables, and u is the error term. The specification of equation (1) is based on the assumption of distinct behavioural patterns to tariff and price changes. It can be argued, however, that the tariff effects on imports are in fact indistinguishable from the price effects, and therefore they should be dealt with by appropriate adjustments of the price variable. Consequently, we estimated a second set of import functions of the form

$$M_i = a + b_i Y + b_2 P_i^* + u \qquad (2)$$

where $P^* = P(1 + T)$, i.e. the tariff-inclusive price of imports. The full forward shifting of the tariff is sufficiently justified by the smallness of the importing country.

We have studied imports of industrial products only, that is the SITC classes 5 (Chemicals), 6 (Manufactures), and 7 (Machinery and Transport Equipment), on quarterly bases for the period 1957 I to 1975 IV, i.e. a sample of 76 observa-

---

4. Agreement Establishing Association Between Greece and the European Economic Community, signed in Athens on 9 July 1961.

tions. We assumed that the tariff reductions under consideration applied to all Greek imports of industrial products. This is not an unrealistic assumption : as a result of proximity and special trade relations certain European countries, such as Germany, were the main suppliers of industrial goods to Greece in the past. The association of Greece with the E.E.C. has further enhanced this trend by diverting Greek imports from non-members to members of the E.E.C. The variables and data used in the estimation are described in the following :

Income, Y Quarterly data for income is not available for Greece. Instead we constructed a proxy variable, S, from the available figures of domestic money supply in real terms [5], which is highly correlated with the real income data at the level of yearly observations. Derivation of quarterly data from the annual income data using the method described by Boot, Feibes, and Lisman [6] did not provide better estimates of import functions.

Relative Price, P_i Import price indices for SITC 5, 6, and 7 are available on a monthly basis [7]. We estimated quarterly indices as the arithmetic averages of the relevant monthly figures. Assuming the absence of money illusion, import prices are usually deflated by a price index of domestically produced import competing products to yield a relative price variable. In a broader sense, imports are competing with the total domestic production and the appropriate price deflator for the derivation of relative prices is in this case the wholesale domestic price index, which is available for Greece on a quarterly basis [8].

Tariffs, T_i For the estimation of the average tariff levels before association we applied the method of unweighted averages. By this method significant and less significant commodities have the same weight, but the large numbers of individual tariffs employed in the calculation afford a balancing rate representing the mean more accurately than any averages of arbitrary weights. Thus, we estimated the required tariff rates by averaging 605 individual tariffs of SITC 5, 949 individual tariffs of SITC 6, and 408 individual tariffs of SITC 7 [9]. Table 1 presents the pre - association level of tariffs and the levels resulting from the Agreement's cuts during the period under consideration.

---

5. International Financial Statistics, various issues I.M.F., Washington, D.C.

6. Boot, J. C. G., Feibes, W., and Lisman, J., «Further Methods of Derivation of Quarterly Figures from Annual Data», Applied Statistics, 16, 1967.

7. Monthly Bulletin of External Trade Statistics, various issues, National Statistical Service of Greece, Athens.

8. Monthly Bulletin of Statistics, various issues, National Statistical Service of Greece, Athens.

9. Hitiris, T., Trade Effects of Economic Association with the Common Market: The Case of Greece, Praeger Publishers, New York, 1972.

TABLE 1

TARIFF LEVELS

Time Period	Agreed cut	SITC 5	SITC 6	SITC 7
Pre - association	—	23.96	37.96	18.89
1 July 1962	5 %	22.75	36.06	17.95
1 January 1965	5 %	21.55	34.16	17.01
1 July 1967	5 %	20.35	32.26	16.07
1 January 1970	5 %	19.15	30.36	15.13
1 July 1972	8 %	17.23	27.32	13.77
1 January 1974	8 %	15.31	24.28	12.41
1 July 1975	8 %	13.39	21.24	11.05

Import Volume, M_i Volume indices for each SITC class are available on a monthly basis [10]. We calculated from these quarterly data by averaging the relevant monthly figures.

Seasonal Variables, Q_j In order to take into account seasonal variations we introduced seasonal dummy variables Q_j , $j = 1, 2, 3$, the constant giving the intercept for the 4th quarter of the year. Hence, Q_j takes the value 1 for the j the quarter of the year and 0 for all other periods. The intercept of the function, therefore, is $a + a_j Q_j$ j in the first three quarters, and a only in the fourth quarter.

Evidence provided by other relevant studies suggests that time lags between imports and their determinants are short. This has been explained by the possibility that importers take into consideration the lags of the effects of changes in the causal variables in their import decisions. Following the precedence of other successful studies [11] we have adopted the assumption that there is no lag between imports and their determinants.

In estimating the import equations we encountered autoregression. This was not unexpected, since factors influencing the demand for imports in one period would be expected to carry over, at least in part, to the following period, so that their effect on the volume of imports would not stop immediately but linger on for some time. The shorter the period between successive observations the more likely will be for autoregression to occur. The use of quarterly data can probably be the cause of autoregression in our estimations. For autoregressive disturbances we have $E(e_t \cdot e_{t-s}) \neq$ for $t > s$; that is, the disturbance occuring at time t

10. Monthly Bulletin of External Trade Statistics, op. cit.

11. Kwack, S. Y., «The Determination of U.S. Imports and Exports : A Disaggregated Quarterly Model», Southern Economic Journal, 39, 1972.

is related to the disturbance occuring at time (t - s). Consequently, the least squares estimators are not the best linear unbiased estimators, i.e. they are not asymptotically efficient although consistent. We had then to use an alternative procedure for autoregressive disturbances, the iterative method [12]. Thus, we estimate first the parameters of the assumed first - order autoregressive scheme generating the error terms $u_t = \rho u_{t-1} + e_t$ for $|\rho| \geqq 1$. Then, we use the resulting estimate of ρ to transform the original variables, e.g. $Y_t' = Y_t - \rho Y_{t-1}$, $X_t' = X_t - \rho X_{t-1}$, etc., and apply simple least squares to estimate the relationship between the transformed variables. If the residuals from the second relationship are still autocorrelated, other rounds of transformations follow until the values of the estimators converge and a random set of residuals results by this method.

The estimated equations for the three SITC classes of importables are presented in the following, along with the relevant goodness of fit statistics and t values in parentheses.

Imports of Chemicals, SITC 5.

(1) $M_5 = 555.602 + 0.815\,S - 2.266\,P - 12.842\,T_5 - 5.329\,Q_1 + 1.171\,Q_2 - 13.982\,Q_3$
(3.775) (4.031) (— 3.819) (— 2.811) (— 0.640) (0.139) (— 1.890)

$\bar{R}^2 = 0.948$, $F = 225.202$, $DW = 2.242$, $\rho = 0.556$ (3 iterations)
(5.797)

(2) $M_5 = 242.613 + 1.166\,S - 2.030\,P_5^* + 2.758\,Q_1 + 6.149\,Q_2 - 9.346\,Q_3$
(3.486) (7.535) (—4.057) (0.369) (0.762) (—1.347)

$\bar{R}^2 = 0.949$, $F = 256.942$, $DW = 2.255$, $\rho = 0.703$ (3 iterations)
(8.562)

Imports of Manufactures, SITC 6.

(1) $M_6 = 466.999 + 0.432\,S - 2.495\,P_6 - 4.084\,T_6 - 9.040\,Q_1 + 4.167\,Q_2 - 7.052\,Q_3$
(4.455) (2.962) (—4.377) (—1.857) (—1.719) (0.795) (—1.582)

$\bar{R}^2 = 0.927$, $F = 157.972$, $DW = 2.290$, $\rho = 0.771$ (7 iterations)
(10.474)

(2) $M_6 = 353.653 + 0.463\,S - 2.083\,P_6^* - 8.101\,Q_1 + 4.624\,Q_2 - 6.237\,Q_3$
(5.570) (3.515) (—4.693) (—1.655) (0.907) (—1.487)

$\bar{R}^2 = 0.931$, $F = 187.455$, $DW = 2.317$, $\rho = 0.836$ (4 iterations)
(13.179)

12. Cochrane, D., and Orcutt, G. H., «Application of Least Squares Regressions to Relationships Containing Autocorrelated Error Terms», Journal of the American Statistical Association, 14, 1949.

Imports of Machinery and Transport Equipment, SITC 7.

$$(1)\ M_7 = 585.684 + 0.984\,S - 2.285\,P_7 - 19.142\,T_7 + 6.601\,Q_1 + 36.802\,Q_2 + 6.452\,Q_3$$
$$(4.203)\quad (5.211)\quad (-3.035)\quad (-2.816)\quad (0.738)\quad (3.975)\quad (0.753)$$

$$\bar{R}^2 = 0.954,\ F = 253.832,\ DW = 2.002,\ p = 0.492\ (2\ \text{iterations})$$
$$(4.899)$$

$$(2)\ M_7 = 279.948 + 1.349S - 2.617\,P_7^* + 15.285\,Q_1 + 42.206\,Q_2 + 13.353\,Q_3$$
$$(3.246)\quad (10.841)\quad (-4.250)\quad (1.808)\quad (4.559)\quad (1.612)$$

$$\bar{R}^2 = 0.953,\ F = 280.753,\ DW = 2.009,\ \rho = 0.519\ (2\ \text{iterations})$$
$$(5.265)$$

The coefficients of the explanatory variables are highly significant and possess the theoretically expected sign. The seasonal dummy variables do not display any uniform pattern of seasonal variation and most of their coefficients are non - significant.

For the functional forms (1) and (2) short-term elasticities of the import demand with respect to price and tariff, calculated at the point of sample means, are presented in Table 2. The lower and upper limits have been estimated from the confidence intervals for $t_{0.95,76} = 1.995$ and the standard errors of the relevant coefficients. Although both the price and the tariff variables are statistically significant and the estimated elasticities possess the correct sign, no discernible pattern emerges about the relative size of the relevant elasticities. Thus, the point estimates of the tariff elasticity is greater than the price elasticity for SITC 5 and 7, while the price elasticity is greater than the tariff elasticity for SITC 6. The combined price - tariff variable has provided elasticities of the expected size which are based on firm economic reasoning and therefore they are preferable than the other estimates.

TABLE 2

IMPORT DEMAND ELASTICITIES

		Lower Limit	Point Estimate	Upper Limit
SITC 5	Price Elasticity	— 0.41	— 0.85	— 1.29
	Tariff Elasticity	— 0.34	— 1.18	— 2.02
	Price - Tariff	— 0.64	— 0.92	— 1.37
SITC 6	Price Elasticity	— 0.78	— 1.43	— 2.08
	Tariff Elasticity	— 0.06	— 0.81	— 1.69
	Price - Tariff	— 0.91	— 1.59	— 2.26
SITC 7	Price Elasticity	— 0.35	— 1.02	— 1.68
	Tariff Elasticity	— 0.41	— 1.42	— 2.42
	Price - Tariff	— 0.72	— 1.36	— 1.99

Nevertheless, the estimated import functions confirm that tariff reductions raise significantly the volume of imports. Thus using the definition of price elasticity, e_p, and the point elasticity estimates of the form (2) functions, we calculated from the formula

$$\frac{\Delta M}{M} = e_p \frac{T}{1+T} \tag{4}$$

that complete elimination of the tariff would have increased imports of Chemicals by 17.78 % imports of Manufactures by 43.74 % and imports of Machinery and Transport Equipment by 21.61 %. Undoubtedly, tariff changes have a significant effect on the balance of trade.