The Static Economic Effects of the UK joining the EEC: A General Equilibrium Approach

MARCUS H. MILLER
London School of Economics

and

JOHN E. SPENCER
The New University of Ulster

1. INTRODUCTION

In his treatise on International Trade, Professor Pearce has concluded that no general principles enable us to predict on *a priori* grounds what the individual gains or losses accruing to the participants on forming a customs union may be (Pearce [14, p. 223]). Yet it is just such a calculation of the gains or losses which constitute the economic rationale for such a union. " In these circumstances ", Pearce argues, " there is little point in producing more and more complicated algebra . . . empirical studies are urgently awaited " (Pearce, *op. cit.*). In a similar vein, Professor Swann has written, " whether they (i.e. customs unions) are good or bad depends upon the particular circumstances " and ". . . there is no substitute for measurement in deciding the actual results of a union " (Swann [20, p. 35]).

To see what light neoclassical trade theory may throw on the issue, this paper presents calculations of such gains and losses in a static trade model designed with particular reference to the accession of the United Kingdom to the European Economic Community (referred to as EC for short). As set out in detail in the next section, the model consists of four " countries ", UK, EC, the Commonwealth (CW) and the rest of the world (RW), eight final commodities (two per country) and two factors per country. Fixed factor endowments are assumed, consumers maximize utility and producers maximize profits. While factors are mobile within a country, they are not mobile between countries, even when the UK joins the EC, and it is assumed that UK accession to the EC has no effects on the technology in any country.

General equilibrium methods are used in the study, so relative prices are endogenous to the model. We have attempted to relax some of the drastic simplifications with respect to the number of goods or factors, and in respect of the structure of demand and supply, characteristic of such general equilibrium models as are surveyed in Lipsey [11].

The reason for the importance of changes in relative prices is related to the structure of the EC agricultural policy. This violates the assumption commonly made in customs union theory to the effect that tariffs are returned as a " lump sum " to the *consumers* who pay them. In particular, the Common Agricultural Policy of the EC distributes tariff revenues principally to producers of food, and a country like the UK, which is a large net food importer, is thus liable to transfer tariff revenue to other member countries. Such international transfers generally require changes in the terms of trade (i.e. in relative prices).

The exercise constitutes an application of a computational algorithm developed by Professor Scarf of Yale University for the solution, *inter alia*, of general equilibrium systems. The nature of the algorithm is sketched in Section 3. The principal modifications required for our purposes were to allow for a smooth technology and for tariff distortions and income transfers. A termination procedure which greatly improved the accuracy of the results was provided by Professor Hansen of the Norwegian School of Economics and Business Administration.

The " welfare " implications of the model as specified and solved in Sections 2, 3 and 4 are discussed in Section 5, together with an examination of the links between balance of payments and welfare effects. Conclusions and qualifications end the paper in Section 6.

2. THE STRUCTURE OF THE MODEL

The basic model under consideration consists of four " countries ", namely the UK, EC (of 6 members), Australia together with New Zealand (representing the Commonwealth), and the rest of the world. These are labelled as UK, EC, CW and RW in the text and tables, and this ordering is maintained in the subscripts 1 to 4 throughout. Each country produces two goods, non-agriculture and agriculture labelled X and Z respectively, and consumes output of all countries. It is assumed that X produced in the UK and X produced in the EC, e.g. are close, but not perfect, substitutes, however. As X and Z are thus differentiated by country of origin, we have eight final goods in the model. Furthermore, each country has two factors of production, capital and labour, which are assumed to be immobile between countries. Perfect mobility within countries is assumed, however. It could be argued that factors should be mobile between the UK and the EC after the UK joins the customs union (cf. the Treaty of Rome). Within the confines of a general equilibrium model, however, this could well lead to unrealistic movements of factors, so immobility was assumed. We have ignored transport costs in the work, as is usual, but they could in principle be incorporated.

Notationally, we have

X_{ij} = demand by the jth country for the non-agricultural product (referred to as " manufacturing " below) of country i; $i, j = 1, ..., 4$.

Z_{ij} = demand by the jth country for the agriculture produced in i; $i, j = 1, ..., 4$.

K_i = capital endowment in country i; $i = 1, ..., 4$.

L_i = labour endowment in country i; $i = 1, ..., 4$.

P_{x_i} = world price of the non-agriculture good produced by country i; $i = 1, ..., 4$.

P_{z_i} = world price of agriculture produced by country i; $i = 1, ..., 4$.

The endowments K_i and L_i were estimated as explained in the data appendix, available from the authors on request. Production was represented by eight Cobb-Douglas functions of the form AK^cL^d, the c's and d's being taken from various statistical studies, and the A's were evaluated following principles suggested by Denison [3]. The values of the factor endowments and the A's, c's and d's chosen are given in Table I.

The justification for these parameter values and further detail is contained in the appendix.

The Cobb-Douglas production functions enable us to write supply functions for X and Z in any country.

For the UK, say, we have the production function

$$X_1 = aK_1^{\alpha}L_1^{1-\alpha}$$

$$Z_1 = b(K-K_1)^{\beta}(L-L_1)^{1-\beta},$$

TABLE I

Production parameters

	K	L	X			Z		
			A	c	d	A	c	d
UK	16·2	35·3	1·358	0·36	0·64	0·7824	0·65	0·35
EC	40·8	91·3	1·453	0·36	0·64	0·4342	0·55	0·45
CW	6·5	7·2	1·025	0·40	0·60	1·025	0·68	0·32
RW	100·0	100·0	2·061	0·35	0·65	1·171	0·59	0·41

where K_1 and L_1 are capital and labour inputs in the first industry and K and L are total endowments; defining g as

$$\left[\frac{a}{b}\,\frac{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}{\beta^{\beta}(1-\beta)^{1-\beta}}\right]^{1/(\beta-\alpha)}$$

the Z_1 supply function is calculated to be $(0<\alpha,\ \beta<1,\ \alpha\neq\beta)$:

$$Z_1=\frac{bg^{\beta-1}\beta^{\beta}(1-\beta)^{1-\beta}}{\alpha-\beta}\left[\alpha\Pi^{\beta/(\alpha-\beta)}gL-K(1-\alpha)\Pi^{(\beta-1)/(\alpha-\beta)}\right],$$

where $\Pi = P_{z_1}/P_{x_1}$. The supply function for X_1 can be written down at once by symmetry.

The aggregate demand functions for each country are derived from " two-stage " CES utility functions (Sato [15]). It is thus assumed that aggregate consumer preferences in any country can be represented by an ordinal utility function of the form:

$$U=(c_xX^{-e}+c_zZ^{-e})^{-(1/e)},$$

where

$$X=(\Sigma a_iX_i^{-e_x})^{-1/e_x}$$

$$Z=(\Sigma b_jZ_j^{-e_z})^{-1/e_z}.$$

Thus U is of CES form in X and Z, where X and Z are CES functions of the X_i (manufactured goods) and the Z_j (agricultural goods), respectively. The constant elasticities of the lower level functions are $\sigma_x = 1/(1+e_x)$, $\sigma_z = 1/(1+e_z)$, and at the higher level, $\sigma = 1/(1+e)$.

Defining $\phi_x=\Sigma_i a_i^{\sigma_x}P_{x_i}^{1-\sigma_x}$, $\phi_z=\Sigma_j b_j^{\sigma_z}P_{z_j}^{1-\sigma_z}$ and Y as factor income, the implied demand functions are given by

$$X_i=\left(\frac{a_i}{P_{x_i}}\right)^{\sigma_x}\frac{c_x^{\sigma}\phi_x^{\frac{\sigma_x-\sigma}{1-\sigma_x}}Y}{c_x^{\sigma}\phi_x^{\frac{1-\sigma}{1-\sigma_x}}+c_z^{\sigma}\phi_z^{\frac{1-\sigma}{1-\sigma_z}}}$$

with an analogous expression for Z_j.

The utility function is weakly separable with respect to the partitioning of the goods into the X and Z categories as the marginal rate of substitution between two goods in one category is independent of the quantities of goods in the other category. In fact, the marginal rate of substitution between X_i and X_j, say, is

$$\frac{\partial U}{\partial X_i}\div\frac{\partial U}{\partial X_j}=\frac{a_i}{a_j}\left(\frac{X_j}{X_i}\right)^{1+e_x},$$

which is independent of *all* other goods, so the utility function is Pearce separable. (On the concepts of separability, see, for example, Goldman and Uzawa [4].)

In addition to separability, there is another property of our utility function which will be useful in what follows. It is shown in Blackorby, Lady, Nissen and Russell [2] that if the utility function is weakly separable and if each of the category satisfaction functions is homothetic, then there will exist aggregate price indices for each of the categories. In our case X and Z are linearly homogeneous in X_i and Z_j respectively and hence homothetic, so group price indices exist, say P_x and P_z.

In fact,

$$P_x = P_{x_i}/\partial X/\partial X_i, \quad \text{all } i,$$
$$= [\Sigma a_i^{\sigma_x} P_{x_i}^{1-\sigma_x}]^{1/(1-\sigma_x)}.$$

The quantity index is, $X = [\Sigma a_i X_i^{-e_x}]^{-1/e_x}$, so that $P_x X = \Sigma P_{xi} X_i$, the amount of income spent on the X's.

Similarly,

$$P_z = P_{z_i}/\partial Z/\partial Z_i = [\Sigma b_j^{\sigma_z} P_{z_j}^{1-\sigma_z}]^{1/(1-\sigma_z)},$$
$$Z = [\Sigma b_j Z_j^{-e_z}]^{-1/e_z}.$$

P_x can be interpreted as the marginal utility of X per unit marginal utility of income allocated to the X's; a similar interpretation holds for P_z.

While the solution of the various competitive equilibria considered in this paper does not depend in any essential way upon separability and the existence of such aggregates, nevertheless the latter make possible the simplified treatment of the welfare changes presented at the end of Section 5 below.

The demand functions used in the computations were as described above, with allowance for tariffs and subsidies and international transfers of spending power. Thus, for example, the demand for X_i in the UK can be written

$$X_i = \left(\frac{a_i}{P_{x_i}(1+t_{x_i})}\right)^{\sigma_x} \frac{c_x^{\sigma} \phi_x^{\frac{\sigma_x-\sigma}{1-\sigma_x}}(Y+\overline{T}_x+\overline{T}_z)}{c_x^{\sigma}\phi_x^{\frac{1-\sigma}{1-\sigma_x}} + c_z^{\sigma}\phi_z^{\frac{1-\sigma}{1-\sigma_z}}},$$

where

Y = factor income,

$\overline{T}_x$ = tariffs and subsidies on X-goods retained at home,

$= \Sigma f_{x_i} p_{x_i} t_{x_i} X_i$, where f_{x_i} is the retention proportion on good X_i (it being assumed that the UK as a member of the EC will transfer to the EC 30 per cent of tariff revenues on X-imports and 90 per cent on Z-imports—see Section 5 below for further detail),

$\overline{T}_z = \Sigma f_{z_j} P_{z_j} t_{z_j} Z_j$,

$\phi_x = \Sigma a_i^{\sigma_x} P_{x_i}^{1-\sigma_x}(1+t_{x_i})^{1-\sigma_x}$.

Hence, after manipulation,

$$X_i = \left(\frac{a_i}{P_{x_i}(1+t_{x_i})}\right)^{\sigma_x} \frac{c_x^{\sigma}\phi_x^{\frac{\sigma_x-\sigma}{1-\sigma_x}} Y}{(c_x^{\sigma}\phi_x^{\frac{1-\sigma}{1-\sigma_x}} + c_z^{\sigma}\phi_z^{\frac{1-\sigma}{1-\sigma_z}})(1-\theta)}$$

where $\theta = (\overline{T}_x + \overline{T}_z)/(Y + \overline{T}_x + \overline{T}_z)$

$$= \{c_x^{\sigma}\phi_x^{\frac{\sigma_x-\sigma}{1-\sigma_x}} \Sigma f_{x_i} P_{x_i}^{1-\sigma_x} a_i^{\sigma_x} t_{x_i}(1+t_{x_i})^{-\sigma_x} + c_z^{\sigma}\phi_z^{\frac{\sigma_z-\sigma}{1-\sigma_z}} \Sigma f_{z_j} P_{z_j}^{1-\sigma_z} b_j^{\sigma_z} t_{z_j}(1+t_{z_j})^{-\sigma_z}\}$$
$$\div \{c_x^{\sigma}\phi_x^{\frac{1-\sigma}{1-\sigma_x}} + c_z^{\sigma}\phi_z^{\frac{1-\sigma}{1-\sigma_z}}\}.$$

The values of tariffs are discussed in the appendix and are as given in Table II.

TABLE II

Tariffs

Imposing country	X	Z
UK	0·15 (0·00 on RW)	0·00
EC	0·15	0·20
CW	0·20 (0·05 on UK)	0·00
RW	0·125	0·20

The numbers in parentheses represent the Commonwealth preference system. After the formation of the Customs Union between the UK and the EC, the UK tariff array becomes identical with that of the EC, and Commonwealth preference ends.

The subsidy on UK agriculture was taken to be 20 per cent prior to entry.

The parameters σ_x and σ_z were each set at 3·0 for the main computations, this fairly high value indicating considerable ease of substitution between different kinds of goods in the same category. The value for σ was chosen to reflect a low elasticity of demand for agriculture as a whole. In terms of aggregate agriculture, we can write

$$-(\partial Z/\partial P_z)/(P_z/Z) = \sigma + (1-\sigma)S_z,$$

where S_z is the share of spending on Z-goods in all spending. For the UK, $S_z \simeq 0{\cdot}08$, so $\sigma = 0{\cdot}1$ was chosen to give rise to an elasticity of demand of just over 0·1 (see Miller [13] for estimates of this demand elasticity). The same parameter values were used for the other countries. (For convenience, Z is often referred to as food in what follows.)

3. METHOD OF SOLUTION

Although gradient solution methods are successful on the production side of the economy, they need not be stable in a model involving consumers unless some relatively strict assumptions, such as " gross substitutability ", are placed on the market demand functions (Scarf [16]). At first sight it might appear that our demand functions exhibit weak gross substitutability, but this is not necessarily the case due to tariffs and tariff transfers. This can be seen by differentiating the UK demand functions for any X with respect to Pz_2 (the price of EC agriculture), and noting that the result is difficult to sign as it depends upon various factors including $1-\sigma_z$. In order, therefore, to retain flexibility in our parameter choice we decided to use the recent algorithm of Scarf [16], [17] which does not require gross substitutability and which goes through under very general conditions.

Application of the algorithm will lead to a price vector which is arbitrarily close to equilibrium, but the level of accuracy needed would have required excessive computer time. Hence, recourse was had to a termination routine due to T. Hansen (see Hansen [7]), who helped us substantially with the problem of improving the accuracy of the final prices. The method requires an initial price vector $\pi^{(0)}$ (found from Scarf's algorithm) appropriately close to π^*, the equilibrium vector. To sketch Hansen's method, let $B^{(0)}$ = the matrix of first derivatives of the excess supply functions evaluated at $\pi^{(0)}$. Then choose $d\pi$ to minimize ε subject to $|\Sigma_j b_{ij}^{(0)} d\pi_j + Z_i^{(0)}| \leqq \varepsilon$, for each i, where $Z_i^{(0)}$ is the excess supply of the ith good evaluated at $\pi^{(0)}$. For sufficiently small $d\pi$, $B^{(0)}d\pi \simeq dz$, and the constraints involve $|z_i^{(1)}| \equiv |z_i^{(0)} + dz| \leqq \varepsilon$. Since ε is minimized, this ensures that the maximum of the absolute value of the excess supplies is minimized. $\pi^{(0)}$ needs to be sufficiently close to π^* such that none of the $d\pi$'s is large enough to give rise to negative prices. The procedure is then repeated, evaluating the derivatives, etc., at the new prices and continues until a sufficiently close approximation is achieved.

The basic programme to compute the initial price vector $\pi^{(0)}$ was kindly made available to us by Scarf. Three aspects of our use of the algorithm which necessitated some modification of the basic programme may be commented upon here.

(i) In the computation of world demand at any set of world prices, the prices at which each country maximized its utility were world prices *after* distortion by tariffs or subsidies; utility was maximized subject to the income available from factors, augmented (reduced) by any such tariff (subsidy) revenue, together with any international transfers. (See Shoven and Whalley [19]).

(ii) The algorithm (as originally devised) works with an activity analysis model of production, and computes factor prices together with product prices. Since we wished to use a continuous Cobb-Douglas technology we initially modified the algorithm so as to choose the cost minimizing activity from the continuum available from the production function at any given factor price ratio. It was pointed out by Hansen that this was inefficient since for this model with continuous production functions the supplies of final commodities are uniquely determined by final product prices (which would not be the case were the technology to be defined by a set of activities). Factor prices were therefore not calculated explicitly, and the algorithm was applied to excess demands for final goods. The factor prices reported in Section 3 are, of course, computed from the final commodity prices by using the standard first-order conditions.

(iii) As explained in greater detail in the appendix, a preliminary run was made with Cobb-Douglas utility functions, $U = \Pi X_i^{a_i} \Pi Z_j^{b_j}$. The demand functions in this case imply

$$\frac{P_{x_i} X_i}{P_{x_j} X_j} = \frac{a_i}{a_j} \frac{(1+t_{x_j})}{(1+t_{x_i})}, \quad \text{all} \quad i, j.$$

Since the value of the trade components are known in the pre-entry case (using data for 1968) and the tariffs or subsidies are also known, these equations determine the ratio of the a's. Normalizing so that $\Sigma a_i = 1$ enables us to derive the a_i and an analogous procedure yields the b's.

A general equilibrium with these functions on the demand side was found, i.e. a set of prices, say p^*, which represents the economy prior to entry. This was replicated using the demand functions above for any σ_x, σ_z and σ as follows. Clearly,

$$\frac{a_i^{\sigma_x}}{a_j^{\sigma_x}} = \frac{(1+t_{x_i})^{\sigma_x} P_{x_i}^{\sigma_x} X_i}{(1+t_{x_j})^{\sigma_x} P_{x_j}^{\sigma_x} X_j} \quad \text{all} \quad i, j.$$

For the same pre-entry solution to be replicated, prices must remain at p^* (thus leaving supplies unchanged) and since the right-hand sides are known as before, normalization of the a_i so that, say $\Sigma a_i^{\sigma_x} = 1$, is sufficient to derive the $a_i^{\sigma_x}$ separately. The $b_j^{\sigma_x}$ were found similarly. Setting $c_x^{\sigma} = S_x P_x^{\sigma-1}$, $c_z^{\sigma} = S_z P_z^{\sigma-1}$, where the shares and aggregate prices were taken from the Cobb-Douglas equilibrium, ensured that the latter (and hence the desired trade flows) would be obtained as the full general equilibrium solution of the double CES case.

4. RESULTS

The principal results from solving the model are presented below. The various solution runs differed only in respect of the tariff levels and transfer payments, and are distinguished as follows:

1. " PRE "	Tariff and subsidy levels as they were prior to UK entry to Common Market.
2. " POST " = " Post with Transfer "	UK/EC impose no tariffs on each other's trade but impose the Common External Tariff. UK/CW abolish Commonwealth Preference. UK transfers 90 per cent of tariff revenue to EC.[1]

3. " POST (NT) " = " Post without Transfer " Tariffs as for Post with Transfer. No transfer of UK tariff revenue.

The units of measurement are determined by the assumptions on the supply side of the economies. As explained in detail in the appendix, inputs and outputs are defined relative to the USA (whose inputs and total output is set equal to 100) following a procedure of Denison [3]. Division of output by total inputs, the latter being combined (as for Cobb Douglas) using US income shares as weights, yields efficiency factors for each country. The overall efficiency factors were then disaggregated into efficiency factors for each industry using knowledge of proportional labour inputs and proportional national income per head in each industry. This gave the two production functions for each economy,

$$q_1 = A_1 K_1^{c_1} L_1^{d_1},\ q_2 = A_2(K-K_1)^{c_2}(L-L_1)^{d_2},$$

the c's and d's (as above) being taken from econometric sources. After preliminary computer runs, the A's were slightly modified to ensure that the value of the outputs of the various countries stood in the right proportions.

TABLE III

Prices

Prices	PRE	POST (NT)	POST
X_1	3·301	3·297	3·266
X_2	5·661	5·644	5·667
X_3	7·064	7·138	7·132
X_4	6·367	6·349	6·351
Z_1	6·117	6·106	6·050
Z_2	20·740	20·677	20·759
Z_3	6·436	6·498	6·492
Z_4	10·020	9·993	9·996
K_1	2·730	2·723	2·699
K_2	5·165	5·149	5·169
K_3	3·340	3·369	3·366
K_4	4·685	4·672	4·674
L_1	2·135	2·134	2·113
L_2	3·850	3·839	3·854
L_3	3·950	3·997	3·994
L_4	8·438	8·415	8·417
Total	$\Sigma = 100$	$\Sigma = 100$	$\Sigma = 100$

Note. Final product prices are " at factor cost ".

First we tabulate the factor cost prices relevant to production and factor incomes, normalized in each case to sum to 100. These are assumed to be the prices at which goods are traded internationally—except for the export of food from the EC to the UK in the PRE-entry case where these exports are assumed to be made at a 20 per cent discount on EC producer prices. This subsidization of exports to the UK is assumed to stop when Britain joins the Common Market, and the consequent rise in the cost of EC food is largely responsible for an adverse shift of $\frac{3}{4}$ of 1 per cent in the " terms of trade " on entry without transfer (see Table IV). This shift in UK terms of trade does not correspond to the change in producer prices. In fact, as shown in Table IV, the shift in producer prices themselves is slightly favourable to the UK. When the transfer of tariff is effected, both the terms of trade and producer prices move adversely to the UK by about 1 per cent.

TABLE IV

UK terms of trade

	A (traded prices)	B (producer prices)
PRE	100·00	100·00
POST (NT)	99·33	100·09
POST	98·30	99·06

Notes

1. The terms of trade are measured by the ratio of the value of a fixed bundle of exports to that of a bundle of imports at various prices. The quantities used are from the PRE entry run.
2. In Column A the prices used to construct the index are those at which trade is conducted (f.o.b. prices), while in Column B those used are producer prices (ex-factory prices). The two sets of prices differ if exports are subsidized.
3. Both columns are scaled to be 100 in the PRE case.

The prices relevant to consumers are, of course, producer prices subject to tariffs and subsidies. The next table lists the consumer price and quantity aggregates in each country. The only significant aggregate price change comes in the price of agriculture in the UK which rises by about 22½ per cent relative to manufactures on entry, a result which stems from the assumption that a 20 per cent subsidy on UK, EC agriculture has been removed and a 20 per cent tariff imposed on imports of CW, RW agriculture. Such an estimate is consistent with the 1970 White Paper [21] which predicted that " the maximum increase in retail food prices which would be likely to occur if we joined the Community would be in the range of 18 to 26 per cent involving a corresponding increase of 4 per cent to 5 per cent in the cost-of-living index " (p. 42). The rise in the cost of living is not, of course, a measure of the welfare loss, as subsequent discussion will show.

TABLE V

Consumer price and quantity aggregates

Prices		PRE	POST (NT)	POST
UK	X	4·376	4·338	4·308
	Z	9·360	11·379	11·357
EC	X	5·828	5·800	5·820
	Z	18·524	18·455	18·507
CW	X	7·021	7·112	7·106
	Z	7·593	7·645	7·640
RW	X	6·335	6·318	6·320
	Z	12·419	12·403	12·407
Quantities		**PRE**	**POST (NT)**	**POST**
UK	X	25·6268	25·6694	25·2054
	Z	1·0418	1·0225	1·0035
EC	X	88·3656	88·4137	88·7582
	Z	3·0891	3·0904	3·1027
CW	X	7·0959	7·1072	7·1074
	Z	0·2029	0·2034	0·2034
RW	X	204·6546	204·6381	204·6363
	Z	2·1306	2·1301	2·1300

The demand and supply forthcoming for each good at the prices reported above is given next in Table VI.

TABLE VI

Demand and supply

Production	PRE	POST (NT)	POST
X_1	35·0046	35·0472	35·0350
X_2	91·5746	91·5997	91·6077
X_3	6·2657	6·2852	6·2853
X_4	200·1278	200·0961	200·0936
Z_1	0·6579	0·6349	0·6415
Z_2	2·1124	2·1056	2·1034
Z_3	0·9156	0·8942	0·8941
Z_4	3·8087	3·8288	3·8304

The fact that the model shows agricultural output to fall by about 3 per cent on entry is probably the result of assuming that a subsidy of 20 per cent of costs has been removed and replaced by a level of protection of only 20 per cent on other food imports, which will, at given factor costs, not bring market prices up to the level established by the producer subsidy. A small change in the subsidy level would change this prediction as the elasticity of supply implied by the production assumptions is very high. This theoretical elasticity can be obtained from the supply function

$$Z_1 = \frac{bg^{\beta-1}\beta^{\beta}(1-\beta)^{1-\beta}}{\alpha-\beta}\left[\alpha\pi^{\beta/(\alpha-\beta)}gL - K(1-\alpha)\pi^{(\beta-1)/(\alpha-\beta)}\right]$$

as specified above in Section 2.

Differentiation yields:

$$\frac{dZ_1}{d\pi}\frac{\pi}{Z_1} = \frac{\alpha\beta g\pi^{1/(\alpha-\beta)}L+(1-\alpha)(1-\beta)K}{(\alpha-\beta)[\alpha g\pi^{1/(\alpha-\beta)}L-K(1-\alpha)]}$$
$$= 81{\cdot}1,$$

on the values of the parameters used in this paper.[2] This theoretical measure should overestimate the supply response for a finite change in $\pi = P_{z_1}/P_{x_1}$ and we find that calculating $(\Delta Z_1/\Delta\pi)/(\pi/Z_1)$ from the Tables III and VI yields a figure of 60. This is still enormously greater than the sort of supply elasticities discussed in the 1970 White Paper [21], for example. The difference must presumably largely stem from different assumptions as to factor mobility.

The structure of demand, disaggregated by country and by commodity, follows in Tables VIIa and VIIb which also show the changes on entry without transfer, and on effecting the transfer. The tables are interpreted as follows:

	UK	EC	CW	RW	Total
UK	d_{11}	d_{12}	d_{13}	d_{14}	Σd_{1j}
EC	d_{21}	d_{22}	d_{23}	d_{24}	Σd_{2j}
CW	d_{31}	d_{32}	d_{33}	d_{34}	Σd_{3j}
RW	d_{41}	d_{42}	d_{43}	d_{44}	Σd_{4j}

d_{11} = demand by UK for UK good

d_{12} = demand by EC for UK good etc.

TABLE VIIa

The demand for manufactures

			Exports				
			UK	EC	CW	RW	Total
PRE	I M	UK	26·9811	1·5601	0·5619	5·9015	35·0046
	P O	EC	0·8046	80·9840	0·1577	9·6285	91·5746
	R T	CW	0·0461	0·0127	5·8316	0·3753	6·2657
	S	RW	2·3914	6·9002	0·7337	190·1027	200·1278
POST (NT) *less* PRE	I M	UK	−0·5516	+0·7887	−0·1685	−0·0260	+0·0426
	P O	EC	+0·4004	−0·3915	+0·0079	+0·0081	+0·0251
	P T	CW	−0·0175	−0·0005	+0·0521	−0·0128	+0·0195
	S	RW	−0·0384	−0·0406	+0·0383	+0·0090	−0·0317
POST *less* POST (NT)	I M	UK	−0·2973	+0·1015	+0·0102	+0·1734	−0·0122
	P O	EC	−0·0604	+0·1766	−0·0023	−0·1058	+0·0080
	R T	CW	−0·0010	+0·0002	−0·0003	+0·0013	+0·0001
	S	RW	−0·0932	+0·0914	−0·0027	+0·0018	−0·0025

Note. Rows do not sum to totals because of rounding. The units of measurement are as in the utility and production functions.

TABLE VIIb

The demand for agriculture

		Exports				
		UK	EC	CW	RW	Total
PRE						
Imports	UK	0·5354	0·0367	0·0028	0·0829	0·6579
	EC	0·0494	1·9401	0·0008	0·1221	2·1124
	CW	0·1782	0·1586	0·1856	0·3932	0·9156
	RW	0·5156	1·2882	0·0311	1·9737	3·8086
POST (NT) *less* PRE						
Imports	UK	−0·0495	+0·0264	+0·0001	0	−0·0230
	EC	−0·0044	−0·0030	+0·0001	+0·0006	−0·0068
	CW	−0·0015	−0·0062	−0·0011	−0·0127	−0·0214
	RW	+0·0148	−0·0033	+0·0010	+0·0077	+0·0202
POST *less* POST (NT)						
Imports	UK	+0·0015	+0·0026	+0·0001	+0·0025	+0·0066
	EC	−0·0016	+0·0008	−0·0001	−0·0014	−0·0022
	CW	−0·0039	+0·0023	+0·0001	+0·0014	−0·0001
	RW	−0·0134	+0·0147	+0·0001	+0·0004	+0·0016

Note as for Table VIIa.

Table VIII gives the predictions of an analysis of the effects of the tariff and transfer changes, which follows Armington [1] in assuming constant producer prices. Results of this type are denoted henceforth by the mnemonic CP (constant prices). Clearly the income and substitution effects arising from the changes in producer prices above must be absent from this analysis, which constitutes the main limitation of such an approach, especially in dealing with the case of a transfer.

TABLE VIII

Effects of tariff changes at constant prices

	Exports				
	UK	EC	CW	RW	Total
Manufactures—POST (NT) CP *less* PRE					
UK	−0·5343	+0·8009	−0·1807	0	+0·0860
EC	0·3949	−0·3971	+0·0020	0	−0·0002
CW	−0·0164	0	+0·0745	0	+0·0581
RW	−0·0474	—0.0339	+0.0093	0	−0·0718
Agriculture—POST (NT) CP *less* PRE					
UK	−0·0506	+0·0266	0	0	−0·0241
EC	−0·0047	−0·0049	0	0	−0·0096
CW	+0·0042	−0·0004	−0·0001	0	+0·0036
RW	+0·0120	−0·0033	0	0	+0·0087

Note as for Table VIIa.

Although the CP analysis assumes *producer* prices are constant, it allows for the cost of food to rise sharply to UK consumers, and, since these goods are imported, this constitutes a terms of trade loss to UK consumers. What the CP analysis fails to do, however, is to ensure that producer prices adjust to equate world demand and supply for the various products when the various tariff changes consequent upon UK entry have been effected. Indeed, in the POST (NT) case the surplus on the UK balance of trade at CP (producer) prices exceeds the extra cost of EC food by a small margin. The rise of UK prices relative to those elsewhere required to eliminate this balance of trade surplus constitutes some small offset to the terms of trade loss on food.

5. WELFARE

Since the results reported in the previous section are obtained from a model in which each country maximizes an explicit utility function, subject to its endowments and the varying tariff distortions, these utility functions can of course be used to assess the desirability of the various outcomes. The linear homogeneity of the utility function means that a rise of x per cent in this index between two such outcomes is a welfare improvement equivalent to what would be achieved by a rise of x per cent of expenditure at constant prices. The utility function will of course settle any index number problems arising from the change in prices between the outcomes examined.

Table IX shows the values attained by these utility functions in each country for four different outcomes, expressed as a percentage of the value obtained in the first case. The nature of the first three cases has already been described; the last column, labelled FT for free trade, gives the results of eliminating *all* tariffs and transfers from the model. The values of the indices using constant (PRE) producer prices—the so-called constant price analysis—are also given in order to see how much, if anything, is lost by ignoring changes in these producer prices.

TABLE IX

Welfare indices (utility functions)

		PRE	POST (NT)	POST	FT
UK	GE	100 (1·21895)	99·988	98·175	100·696
	CP	100 (1·21895)	99·961	98·443	100·423
	GE : CD	100 (11·44580)	100·573	98·102	100·652
	CP : CD	100 (11·44580)	99·885	98·518	100·064
EC	GE	100 (5·72218)	100·053	100·444	100·250
	CP	100 (5·72218)	100·063	100·386	100·409
	GE : CD	100 (42·22067)	100·048	100·593	99·906
	CP : CD	100 (42·22067)	100·044	100·336	100·159
CW	GE	100 (0·51361)	100·162	100·164	100·450
	CP	100 (0·51361)	99·889	99·889	100·586
	GE : CD	100 (3·50978)	99·864	99·878	100·106
	CP : CD	100 (3·50978)	99·957	99·957	100·180
RW	GE	100 (13·22946)	99·992	99·991	100·195
	CP	100 (13·22946)	100	100	100·150
	GE : CD	100 (139·05198)	99·938	99·931	100·103
	CP : CD	100 (139·05198)	100	100	100·048

Note. Values of the utility index for each country in any row are deflated by the value of the index for the PRE customs union case. This deflator is shown in parentheses in the first column. The values of the elasticities are $\sigma = 0{\cdot}1$, σ_x, $\sigma_z = 3{\cdot}0$ except in the rows labelled CD for Cobb Douglas, where both are 1·0. GE indicates General Equilibrium solution, CP indicates Constant Price, and FT Free Trade.

While the detailed results of the last section were obtained by taking the elasticity of substitution between the aggregates of manufactures and food to be 0·1 and the elasticity of substitution between manufactures and food from different countries to be 3·0, all the runs were repeated setting both substitution elasticities equal to unity—yielding Cobb-Douglas utility functions.

The welfare changes corresponding to the results reported in the last section for the UK are of virtually no change on entry without transfer of tariff revenues, but a loss of 1·8 per cent when such transfers are effected. The EC shows a small gain (0·05 per cent) on Britain's accession without transfer, and this gain rises to almost $\frac{1}{2}$ per cent as transfers are paid. Interestingly enough, the CW shows a gain of about $\frac{1}{6}$ of 1 per cent as a result of the enlargement of the EC, while the RW shows virtually no change. Under free trade all countries show an improvement.

With Cobb-Douglas utility functions, however, the UK shows a gain of about $\frac{1}{2}$ per cent on entry without transfer, and the Commonwealth shows a loss of about $\frac{1}{10}$ per cent as a result of Britain's accession. When the transfer has been paid, the net outcome for the UK, the EC and RW is broadly as for the principal case (where $\sigma = 0{\cdot}1$, $\sigma_x = \sigma_z = 3$). Thus the UK loses 1·9 per cent, the EC gains 0·6 per cent and the RW shows a small percentage loss of less than $\frac{1}{10}$ of 1 per cent. In the free trade run, all countries showed an increase in welfare except for the CW.

A better understanding of these welfare outcomes can be obtained by comparing them with the CP figures as shown for the UK in Table X. Although the CP runs do allow for the higher price paid by UK consumers for EC food, they ignore the terms of trade effects of any changes in producer prices required to clear world markets after tariff changes, so the difference between the CP and general equilibrium results are measures of the welfare costs of these producer price changes.

TABLE X

UK: Change of utility as percentage of pre-existing level

	ENTRY ONLY PRE/POST (NT)	TRANSFER POST (NT)/POST	ENTRY PLUS TRANSFER PRE/POST
(1) GE	−0·012	−1·813	−1·825
(2) CP	−0·039	−1·518	−1·557
(1) *less* (2)	0·027	−0·295	−0·268

N.B. GE indicates General Equilibrium solution.

As can be confirmed from the table, the elimination of a small favourable balance of trade shift on entry without transfer requires a shift of producer prices in favour of the UK (the gain being only 0·027 per cent however), but this favourable effect is overwhelmed by the adverse shift in prices needed to effect the transfer of tariff revenues to the EC. It is more convenient to analyse the welfare costs of the transfer first before examining in detail the various costs and benefits of entry without transfer.

The transfer as a fraction of national income is shown by the CP analysis of Table X to be 1·52 per cent in this model. This transfer is built up of the components (using POST shares) given in Table XI.

TABLE XI

Composition of transfer

	Tariff rate		Share of expenditure at factor cost		Transfer rate		Transfer as percentage of national income
Transfer of tariffs on food from CW	20%	×	0·95%	×	90%	=	0·17
Transfer of tariffs on food from RW	20%	×	4·37%	×	90%	=	0·79
Transfer of tariffs on Manufactures from CW	15%	×	0·17%	×	30%	=	0·01
Transfer of tariffs on Manufactures from RW	15%	×	12·13%	×	30%	=	0·55
					Total transfer		1·52

Member countries are bound to transfer 90 per cent of tariff and duty revenue. The figure of only 30 per cent applied to tariffs on " manufactured " goods is to correct for the fact that many non-food imports are not manufactured goods and attract very low tariffs. No account is taken of other liabilities to the community in the form of VAT on the rough assumption that such payments will be approximately offset by receipts from the Community budget (for some justification of this last step reference may be made to Miller [13, p. 74]).

The terms of trade cost, the so-called added burden of the transfer, as measured by the difference between general equilibrium and CP runs, is about 0·3 per cent, an addition of about one-fifth of the cost of the transfer. The added burden depends critically on the price elasticities of demand for UK exports and of UK demand for imports, as these elasticities determine the price changes required to eliminate the trade deficit remaining after the income transfer. In a two-country, two-good model the relationship between the change in the balance of trade (expressed as a percentage of initially balanced trade flows) and the change in the terms of trade is

$$dB/pI = (\eta_m + \eta_x - 1)dp/p,$$

where

- B is the balance of trade surplus (expressed in terms of home good),
- p is the price of imports (relative to the price of the home goods),
- I is the quantity of imports,
- η_m is the price elasticity of demand for imports by the home country,
- η_x is the price elasticity of demand for imports by the foreign country.

We can calculate a value for the equivalent of the " sum of the elasticities " in this four-country model from the figures in Table X together with an estimate of the income effects of the transfer as follows.

Since

$$dB/Y = (1-\Sigma m)T/Y = (\eta_m + \eta_x - 1)dP(I/Y),$$

then

$$(\eta_m + \eta_x - 1) = [(1-\Sigma m)T/Y]/[IdP/Y]$$

where

- Y is the level of national income (expressed in terms of home goods),
- T is the transfer,
- Σm denotes the sum of the marginal propensities to import in the two countries involved in the transfer.

Thus the " sum of the elasticities less one " is given by the ratio of effects of the transfer on the balance of trade at constant prices to the terms of trade cost. Given an estimate of 0·77 for $(1-\Sigma m)$ from the CP run, and figures of 1·52 per cent for T/Y and 0·295 for IdP/Y above, this implies a figure of 4 for $\Sigma\eta - 1$, so the terms of trade cost of curing a deficit is about a quarter.

Confirmation of this figure can be gained from consideration of the substitution elasticities assumed in constructing the model. First we note that while the elasticities of demand for imports in the above formula take account of changes in the domestic supply of the imported commodity as well as that in demand, there is no domestic production of the import good in the model. Thus the high elasticity of substitution in production between the two UK produced goods will not reduce the demand for imports if all foreign prices rise relative to the UK price. Thus the " price elasticity of demand for imports " may be expected to be determined principally by demand elasticities.

The " elasticity of UK demand for imports " as a whole given a proportionate increase in all import prices can therefore be computed from the elasticities of substitution in demand and the figures for expenditure shares. The calculation yields an estimate of $2\frac{1}{4}$ for η_m. It would appear that the elasticity of demand for imports in other countries (certainly in RW) is higher, as imports are a smaller share of their expenditure, so that η_x should be closer to 3. These figures are consistent with the sum of the elasticities calculated from the transfer burden above.

Since the loss due to the transfer is shown separately, the effect on the outcome of UK entry of varying the size of the transfer can be easily gauged. Indeed, given that there is virtually no gain or loss for the UK on entry without transfer, varying the estimated transfer varies the overall welfare loss in the same proportion.

A Marshallian Analysis of the Effects of Entry without a Tariff Transfer

The change in UK welfare associated with entry without transfer can be analysed, market by market, by using the concepts of consumers' and producers' surplus as in Johnson [8]. Using a weighted average of UK prices as numeraire, changes in consumers' surplus, CS, are measured as

$$\Delta CS = \Sigma(t_i P_i \Delta C_i + \tfrac{1}{2}\Delta(P_i t_i)\Delta C_i - \tfrac{1}{2}\Delta P_i \Delta C_i - C_i \Delta P_i),$$

where

C_i is the initial level of consumption of good i in the country whose benefits are being estimated,

t_i is the initial tariff/subsidy of good i in that country,

P_i is the initial producer price of good i, wherever produced, and the summation is over the eight goods consumed.

Changes in producers' surplus, PS, are similarly measured as

$$\Delta PS = \Sigma(\tfrac{1}{2}\Delta P_j \Delta O_j + O_j \Delta P_j),$$

where O_j is the initial level of output of the good j and summation is over the two goods produced in the country whose benefits are being estimated.

The outcome of calculating these measures from the data presented in Section 4 above is shown in Table XII, where the benefits are also shown as a percentage of national income. The diagrammatic presentation of these measures described in the Johnson article cited is also given in Figure 1, which shows for each market in turn the areas measured by the formulae above.

The welfare costs and benefits measured in this way net out to practically zero, as would be expected from the general equilibrium results. Considering manufacturing first, we note that there is a gain of 0·13 per cent on manufacturing consumption and production, a number which can be broken down into trade creation gains, losses from trade diversion, and terms of trade effects. There is a 50 per cent expansion of imports of manufactures from the EC, on which a tariff of 15 per cent has been removed, and given that about 4 per cent of income was spent on EC manufactures prior to entry, the trade creation gains on this account are about $\frac{1}{6}$ of 1 per cent. Some trade in manufactures from the CW is "destroyed" by the imposition of a 15 per cent tariff, which entails a 0·01 per cent loss of consumer surplus. There is also a contraction of imports of manufactures from RW which continue to bear a 15 per cent tariff, and this contraction of about $1\frac{1}{2}$ per cent in an element constituting 14 per cent of expenditure generates a trade diversion loss of 0·03 per cent. Thus the reallocative gains just described amount to only 0·10 per cent of national income. The gain on the terms of trade in manufactured products, a benefit derived largely from the tariff concessions made by the EC in favour of the UK, is shown to amount to only 0·03 per cent. The small size of these conventional measures of the benefits and costs of forming a customs union is perhaps surprising; and that they are so small is important when these benefits are to be set against the costs of the straight income transfers which may be associated with economic integration.

While trade in manufactures is freed of some tariffs, UK trade in food is subjected to additional tariffs and levies, and the costs associated with these changes offset the net gain of 0·13 per cent on manufactures. Since all food prices are assumed in this paper to rise together, either because subsidies are removed in the UK and the EC or tariffs are imposed on CW and RW, there is no large switching in the source of supply. If there are no tariff transfers overseas, then the tariff levied on overseas output will accrue as income to UK residents and the rise in UK prices will be offset by a reduction of taxes, so these price rises do not *per se* constitute welfare losses. This is not true of the rise in the price of EC food which, it is assumed, is now bought at EC price levels while it was bought before at lower " world " price levels (an operation which is only made possible by subsidization by the European Community). In this case, entry involves loss of a subsidy paid by foreign residents, and there is a welfare loss of 0·16 per cent associated with the price rise on EC food. This is offset in small part by gains of 0·03 per cent in consumer surplus due to changes in consumption levels, but there is little change in producer price levels.

It is clear from the above description that the extra price paid for EC food is largely responsible for cancelling out any gains on entry without transfer. To show this more clearly and also to allow for some variation of assumptions we explicitly divide the changes

TABLE XII

Partial equilibrium analysis

Change in consumers' surplus		$t_i P_i \Delta C_i + \frac{1}{2}\Delta(P_i t_i) \Delta Ci$		$-\frac{1}{2}\Delta P_i \Delta C_i - C_i \Delta P_i$		Row sum	
From consumption of manufactures from	EC	+0·1700	0·14%	0·0100	0·01%	+0·1800	0·15%
	CW	−0·0093	−0·01%	−0·0031	—	−0·0124	−0·01%
	RW	−0·0367	−0·03%	0·0237	0·02%	−0·0130	−0·01%
	Sub total[1]	+0·1240	0·10%	0·0306	0·03%	+0·1546	0·13%
From consumption of food from	UK	+0·0303	0·03%	0·0020	—	+0·0323	0·03%
	EC	—	—	−0·1940	−0·16%	−0·1940	−0·16%
	CW	−0·0010	—	−0·0124	−0·01%	−0·0134	−0·01%
	RW	+0·0148	0·01%	0·0078	0·01%	+0·0226	0·02%
	Sub total[2]	+0·0441	0·03%	−0·1966	−0·16%	−0·1525	−0·13%
Change in producers' surplus				$\frac{1}{2}\Delta P \Delta O + O \Delta P$			
	Sub total[3]	—	—	−0·0026	—	−0·0026	—
Change in welfare	Total[4]	+0·1681	Approx. 0·13%	−0·1686	−0·13%	+0·0005	0%

Notes. 1. For formulae used see text.
2. $\Delta (P_i t_i)$ is approximated by $P_i \Delta t_i$.
3. Valuation is in terms of UK output (see text).
4. Values are also shown as a percentage of UK National Income.

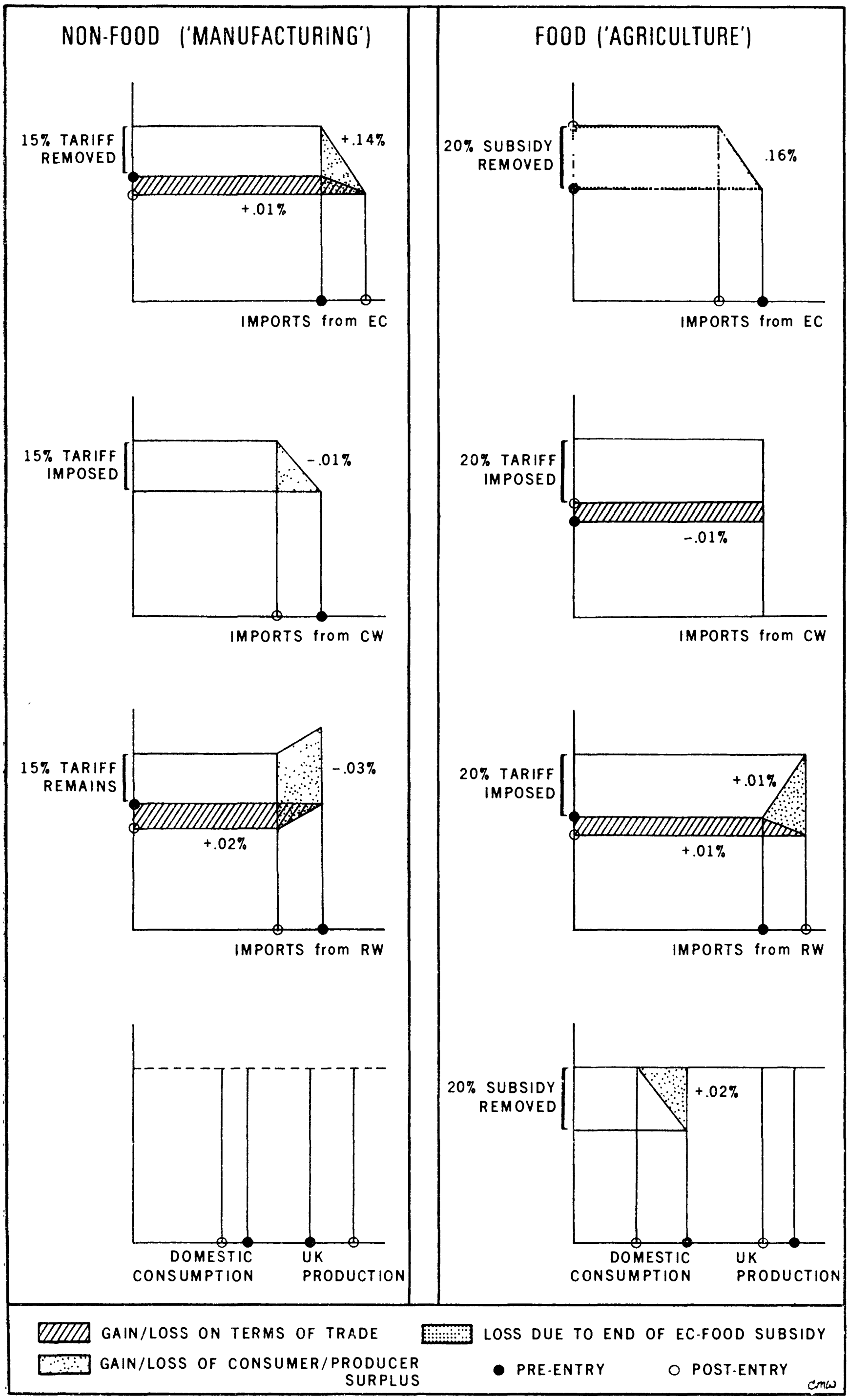
NON-FOOD ('MANUFACTURING')
FOOD ('AGRICULTURE')
15% TARIFF REMOVED
+.14%
+.01%
IMPORTS from EC
20% SUBSIDY REMOVED
.16%
IMPORTS from EC
15% TARIFF IMPOSED
-.01%
IMPORTS from CW
20% TARIFF IMPOSED
-.01%
IMPORTS from CW
15% TARIFF REMAINS
-.03%
+.02%
IMPORTS from RW
20% TARIFF IMPOSED
+.01%
+.01%
IMPORTS from RW
DOMESTIC CONSUMPTION
UK PRODUCTION
20% SUBSIDY REMOVED
+.02%
DOMESTIC CONSUMPTION
UK PRODUCTION
GAIN/LOSS ON TERMS OF TRADE
LOSS DUE TO END OF EC-FOOD SUBSIDY
GAIN/LOSS OF CONSUMER/PRODUCER SURPLUS
● PRE-ENTRY
O POST-ENTRY
cmw

FIGURE 1

on entry into two parts, the losses due to the end of the EC food " subsidy ", and the gains due to the tariff changes, as shown in Table XIII. From the general equilibrium result, confirmed by other approaches, it is apparent that the EC food subsidy is worth about $\frac{1}{6}$ of 1 per cent of national income in this model, so the loss of this subsidy on entry (without transfer) cancels out gains of the same magnitude. Thus even if there were no subsidization of food exports by the EC to the UK prior to entry, so that UK consumers paid the full EC producer price both before and after entry, there would still only be a gain of $\frac{1}{6}$ of 1 per cent of national income on entry without transfer of tariff revenues.

TABLE XIII

Division of welfare effects on entry without transfer to show value of EC food " subsidy "

	PRE to POST (NT)	End of subsidy	All others
(1) GE	−0·012	—0·150	+0·138
(2) CP	−0·039	−0·150	+0·111
(1) *less* (2)	0·027	0·0	0·027
Marshallian calculations			
Terms of trade gains	0·02	0·0	0·02
Cost of the rise in UK consumer price of EC food	−0·16	−0·13	−0·03
$\Delta CS+\Delta PS$	+0·14	−0·02	+0·16

N.B. Figures show changes as a percentage of national income.

Against benefits of entry of these orders of magnitude, gains of $\frac{1}{6}$ per cent if there is no change in EC food prices in the UK, it is clear that unrequited transfers of tariff revenues must be fairly limited if the UK is to make a net gain from joining.

Aggregates

The existence of the aggregates, food and manufactures, with the associated aggregate prices permits a two dimensional representation of the welfare results for any country, and also simplifies the use of the usual indices of welfare change.

As explained above, utility is a CES function of aggregate food and manufacturing consumption, so that indifference curves in the space of the aggregates can readily be drawn. Figure 2 shows the " consumption points " A, B, C, for the three outcomes (PRE, POST (NT), POST, respectively) examined in this paper. The co-ordinates for these points are as given in Table V above and the slopes of the consumer valuation functions passing through them are also from Table V. Consumers are assumed to maximize utility at those prices and the appropriate indifference curves are shown in Figure 2 with the index numbers being from Table IX and discussed above.

The point labelled B lies below and to the right of the point labelled A largely because of the substitution in consumption towards manufactures and away from food as UK relative prices shift into line with EC relative prices. The effect of the tariff transfer is to shift the " budget line " in approximately parallel fashion towards the origin as it is UK/foreign relative prices which change in this case, but not the relative price of food and manufactures. The POST consumption point (C) lies below and to the left of PRE consumption.

The outcomes for the Cobb-Douglas case (i.e. $\sigma = \sigma_x = \sigma_z = 1$) are also shown in Figure 2. Each of these points lies below its counterpart in the main solution. This is because of the higher elasticity between food and manufactures, which, given the sharp rise in the relative price of food, means a substantially reduced demand.

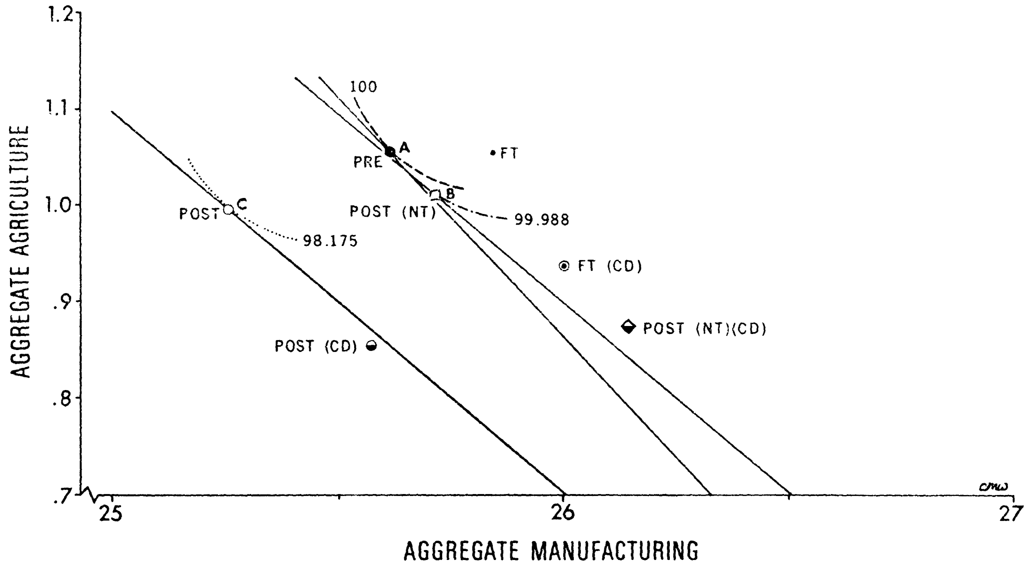

FIGURE 2

The valuations put upon points A, B, and C by consumers (using all three sets of relative prices) are shown in Table XIV.

TABLE XIV

Welfare indices (valuation functions)

		PRE		POST (NT)		POST	
		X	Z	X	Z	X	Z
P_x	P_z	25·6268	1·0418	25·6694	1·0225	25·2054	1·0035
PRE							
4·376	9·360	100	*(27·855)*	100·006	(27·857)	98·194	(27·352)
POST (NT)							
4·338	11·379	100	(28·360)	99·972	*(28·352)*	98·159	(27·838)
POST							
4·308	11·357	100	(28·373)	99·972	(28·365)	98·160	*(27.851)*

Using superscripts 0 and 1 to indicate PRE, and POST, the Laspeyres Index of the quantity changes is $[(X^1+Z^1\pi_0)/(X^0+Z^0\pi^0)]\times 100$, where $\pi^0 = P_z^0/P_x^0$. This is the number written in the second row and fifth column of the table. The numerator is given in the second row and sixth column, while the denominator is given in the second row and second column. The derivation and meaning of the other numbers should be clear.

Using PRE prices as weights, consumption rises by 0·006 per cent as between A and B, while using POST (NT) prices it falls by 0·028 per cent. Taking the geometric mean of the two indices gives a figure of 99·989. This, the Fisher Ideal index, gives a measure of a fall in the " quantity " of consumption which is very close to the fall of 0·012 per cent shown by the utility function.

Comparing A and C using PRE and POST prices shows that A is " revealed preferred " to C and the Fisher Ideal index falls from 100 to 98·177, which is close to the value of 98·175 shown by the utility function.

6. SUMMARY AND CONCLUSIONS

Since a central feature of UK entry into the Common Market is the harmonization of tariff levels and the redistribution of tariff revenues, this exercise has computed the effects of such tariff changes and transfers in an illustrative four-country neoclassical trade model. The elasticities of substitution in production and consumption are not estimated in the study, but were chosen in the light of empirical research. On the supply side it transpired, however, that the Cobb-Douglas production function estimates used, together with the assumption of domestic factor mobility, gave rise to very high elasticities of substitution (cf. Johnson [9]). On the demand side, the approach follows Armington in distinguishing each commodity by type of product and country of origin. While the elasticity of substitution between the same product from different countries of origin was assumed to be 3, the elasticity of substitution between product groups was taken to be very low, 0·1. The consequences of setting both elasticities equal to 1 were briefly examined.

The tariff levels chosen embodied the assumption that the Common Agricultural Policy would act as a tariff in keeping EC food prices above world levels. Despite the rise in the world food prices relative to those in the EC subsequent to the accession of the UK in January 1973, long-run predictions by the European Commission appear to assume that prices will revert to something like their earlier relationship.

The literature on customs unions is generally not optimistic as to the size of the gains from trade creation accruing to partner countries—although the gain on the *terms of trade* may be considerable. Thus Verdoorn estimated that the trade creation gains for the members of a West European Customs union would only amount to about $\frac{1}{20}$ per cent of annual income, see Lipsey [12]. Although there were almost no trade diversion costs to be set against this, Verdoorn reckoned that the terms of trade gains might be seven times as large (Scitovsky [18, p. 66]). Regarding the expansion of intra-European trade, which was the basis of the estimated gains of trade creation, Scitovsky [18, p. 67], commented as follows: " Verdoorn's figures are probably underestimates; but if, by way of correction, we should raise them by five- or even twenty-five-fold, that would still leave unchanged our basic conclusion that the gain from increased intra-European specialization is likely to be insignificant."

The neoclassical model specified here confirms Scitovsky's conclusions in that, despite the large changes in trade flows, the gains from trade creation are small. Thus although UK entry into the Common Market led to an estimated 50 per cent increase in imports of manufactured goods from the EC, this gave rise to a gain of only $\frac{1}{6}$ per cent of income for the UK. Against the gain from trade creation—the principal benefit accruing to the UK on the assumptions of the model—were to be set losses of trade diversion, of higher prices paid for EC food and the costs of transferring tariff revenue to other EC members. (The terms of trade effects of the tariff changes were not important for the UK.) This study has drawn attention to the fact that the conventional assumption in customs union theory, that tariffs are redistributed as a lump sum to consumers who pay them, is not appropriate in this case. Indeed, since the costs and benefits for the UK measured in this paper are evenly balanced in the absence of tariff transfers, it is the burden of the transfer which constitutes the main " costs of entry ".

As presently constituted, the Common Agricultural Policy (CAP) involves redistribution from consumers of food to producers of food. For an open economy which is not a large food producer, like the UK, this leads to an outward transfer. The size of the outward transfer from the UK assumed in the paper amounts to $1\frac{1}{2}$ per cent of national income.

For reasons explained below, this is probably more than the UK authorities anticipate paying, but even if the transfer were nearer to the $\frac{4}{5}$ per cent, which is what the authorities may have been anticipating in the 1971 White Paper [22], it is clear that such a transfer, with its associated terms of trade cost, must bulk large against the trade creation gains just described.[3]

If the rise in world price levels is not matched by a rise in CAP support levels then clearly the support given to producers of food will fall. Since the sum of tariff revenues on all products will not presumably change as much, the principal determinant of the transfer required of the UK will be the new use to which these funds are applied. It seems likely that other uses of these funds will be more advantageous to the UK than the CAP (although they may nevertheless promote inefficiency if they are used to subsidize excess production of chosen commodities), so that a rise in world food price levels should lead to some mitigation of the transfer burden as between the UK and the rest of the community.

The overall loss for the UK on entry with a transfer of $1\frac{1}{2}$ per cent of national income was estimated to be 1·8 per cent of national income, but this figure should be varied in proportion with the best estimate of the transfer. The overall loss assuming Cobb-Douglas utility functions (and a somewhat smaller transfer) was shown to be only slightly larger; but for entry without transfer there was in this case a positive gain to the UK of over half a per cent. The lower demand elasticities increase the added burden of the transfer sufficiently to offset this gain in the final income, however. Nevertheless the lower the demand elasticities the more worth while it is for the UK to secure a reduction in the size of the transfer, given the harmonization of tariffs.

The illustrative calculations in this paper take no account of the EFTA or of the effects of others joining the EC with the UK. It would appear that the loss of EFTA privileges (vis-à-vis those EFTA members who do not join) and having to share free trade arrangements (vis-à-vis those EFTA countries who do join) with other EC members, will lower the gains to entry with no transfer. Increasing the amount of trade not subject to tariffs, however, lowers the level of tariffs collected and leads to a lower estimate of the transfer. It is these considerations which appeared to underlie the official pessimism as to the impact effects of tariff changes on the industrial trade balance, and also explained why the official estimate of tariff revenue collected is probably less than 1 per cent of national income.

It is important to note that the assumptions made for the purpose of the calculations of this paper do not allow account to be taken of any gains through increasing returns to scale, increased " *X*-efficiency " (cf. Leibenstein [10]) and increased capital formation. Substantial gains of this kind are confidently expected by many supporters of UK entry to the EC, however, and they should not be ignored in any overall assessment of the costs and benefits of UK entry to the EC. The estimates of such gains are, however, generally based more on the historical experience of the original Common Market members than on explicit models of UK development. The idea that relatively slow growth, as in Britain, may be due to a failure to import capital goods embodying the latest technology is examined by Gomulka [5], however. This approach suggests that distinguishing between different vintages of capital may be a necessary step for an adequate treatment of these growth arguments.

Since those gains predictable on the basis of customs unions theory (even assuming no costs to reallocating factors in any country) appear to be small, and since the large gains just mentioned are uncertain, it would seem sensible to relate the size of the transfer to the emergence of the (uncertain) gain. Failure to do so could, as the exercise shows, result in a substantial loss of welfare to the UK. However, UK pressure on the Commission to set up a substantial Regional Fund can be viewed as an attempt to convert a relatively fixed liability into one which is contingent on UK development, since *receipts* from such a fund by the UK should increase in the event that the " dynamic " benefits are not realized. With the failure to secure a Regional Fund adequate to fulfil this purpose, however, the UK has proposed that gross *contributions* should be limited so that no country pays an amount much in excess of its share of Community GNP, and some steps in this direction were agreed in early 1975. While it may be politically difficult to implement such proposals, it is easy to understand their role in allocating the non-zero sum gains of customs union amongst the partner countries in a manner which is contingent upon future events.

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NOTES

1. As stated above and explained in Section 5 below, this is replicated by a 30 per cent transfer of tariff revenue on X and 90 per cent on Z.
2. The elasticity is given equivalently by

$$\left[\frac{\alpha\left(\frac{K_1}{K}\right)+(1-\alpha)\left(\frac{L_1}{L}\right)}{\beta\left(\frac{K_1}{K}\right)+(1-\beta)\left(\frac{L_1}{L}\right)}-1\right]^{-1} \quad \text{in Gorman [6, formula (2)].}$$

3. The progressive downward float of sterling vis-a-vis other Common Market currencies in the recent past has produced an anomolous result for the CAP since the fall in the value of spot sterling has not been matched by a fall in the " green pound " (the rate used to convert Common Market agricultural support prices into sterling under the CAP). As a result of the " overvalued " green pound the price of food in the UK is being kept below the level which the CAP is basically designed to achieve, so levies on UK imports from ROW are presently quite low and substantial subsidies are paid on UK imports from partner countries! The present position thus lies somewhere between the pre- and post-entry situations described in our paper (where no allowance is made for an overvalued green pound). How long the UK will continue to avoid the full application of the CAP by refusing to devalue the green pound is an open question.

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