ECONOMIC PAPERS

COMMISSION OF THE EUROPEAN COMMUNITIES • DIRECTORATE-GENERAL FOR ECONOMIC AND FINANCIAL AFFAIRS

No. 6 January 1982

The bilateral trade linkages of the Eurolink Model: An analysis of foreign trade and competitiveness

by P. RANUZZI*

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ABSTRACT:

Following the basic philosophical approach of the LINK Project, which links various national econometric models built in different countries, the Commission of the European Communities has succeeded in linking the full size quarterly econometric models of the four major European countries. The Eurolink Project is under extension to cover the other EEC countries plus the United States, Canada and Japan. The results reported in this paper are part of this larger project, which tries to link together the EEC member economies in a trade and capital flows econometric model and explain the transmission of interdependent economic fluctuations from country to country. In the present study, the interconnection between the various economies is represented by bilateral trade flows only. Flows of invisibles and of financial capital are not completely studied and are not yet ready to be included in this report.

The theoretical structural model with its bilateral trade supply and demand functions and the technique employed for the construction of bilateral import and export price indices are presented. Estimation results are shown and commented with emphasis on their use for the analysis of international trade and for policy decision making.

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I INTRODUCTION

The EuroLink model is a system of structural econometric models of the different countries of the European Economic Community. The models are linked through bilateral trade flows and bilateral import-export prices. In the near future, capital flows and exchange rate linkages will be added. The national models are built, maintained and operated by resident economists in each EEC country, familiar with local institutional behavioural characteristics and well informed as to the economic prospects and economic policies in their own country. The individual models vary considerably in size and specification from about a hundred behavioural equations for the Italian model to about eight hundred for the French one, and overall they produce a system which cannot be compared with a centrally structured multinational model which has a uniform structure across countries[1].

There exist different methods of linking national econometric models by the international trade sector. A first one, the Bilateral Direct Linkage, assumed that all countries linked together form one market. Bilateral trade flows are, then, directly determined by domestic demand and price competitiveness among all suppliers, the domestic market included (Resnick and Truman, 1975; Berner et alii, 1977). A different approach is followed by the Trade Allocation Model where the problem to explain bilateral trade flows is separated into two steps. The first is the allocation of expenditure between domestic goods and imports. The second step is the distribution of commodities according to their geographical origin. This method allows one to abstract from the simultaneous explanation of the volume of trade and its origin and to concentrate only on the latter (Barten, 1971; Hickman, 1973).

[1]L.R. Klein, since 1968 a pioneer in this field, has provided the basic philosophical approach in his Link Project.

Finally, the World Trade Approach is largely used when information about bilateral trade flows is not very important for the model in hand, so that a satisfactory and more direct picture of the mechanism which links countries together is not required. This linkage system determines the volume of world trade from the weighted import volume of each country. The volume of each country's exports is, then, a function of the global volume of world trade, relative export prices and other domestic factors (Klein and Van Peeterssen, 1973).

The Eurolink system has adopted the Trade Allocation linkage model through bilateral merchandise flows and bilateral trade prices in order to cover the special relationships between very closely interdependent economies which are characteristic of the EEC countries.

For policy making, this approach allows the possibility to measure the direct impact and feed-backs of any economic policy taken by an EEC country or partner countries and, implicitly, show clear advantages for policy coordination at EEC level[2].

At present, four major EEC countries - France, Germany, Italy and the United Kingdom - are part of the Eurolink system with full size national models. A Rest of the World model would close the system. The project is very soon to be extended to cover all the other EEC countries plus the United States, Canada and Japan.

The remainder of this report is organised in five sections. Section II outlines the basic trade linkage model; section III reports on sources and disaggregation of bilateral data. Section IV introduces the construction of bilateral import-export price indices. Section V sketches dynamic bilateral linkages. Section VI presents and discusses the empirical results.

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[2]To enable the model builders living in their country of origin to operate their model at the Eurolink Centre in Brussels, each model, together with its own solution programme, is regularly updated: this makes it easier for each national team to use its own model directly at the Centre without having to cope with the differences in software. The procedure has called for a main software programme which can run all the various national solution programmes in parallel. The Eurolink Centre is, therefore, really responsible for the linkage model only.

II THE BILATERAL LINKAGE MODEL

Import and export elasticities differ by type of commodity and trading partner. An ideal bilateral linkage model based on trade flows should therefore involve the estimation of a set of bilateral import equation (demand side) for every traded commodity for each trading partner, as well as a bilateral export function (supply side) for each commodity traded, according to origin and destination. Ideally, the commodity classes chosen should be as homogenous as possible.

This ideal solution cannot, however, be realised. The number of commodities to be distinguished would be so large in this case that the calculation problems would be insurmountable. Considerable aggregation and other economic assumptions to keep the model within manageable proportions are therefore inevitable.

This paper reports on the estimation of a system of bilateral trade functions, while total imports and total export prices are produced by national models and therefore are exogenous for the linkage submodel. Thus the system can be seen as an allocation model which explains changes in bilateral trade flows as a function of given export prices and total demand for imports.

This procedure leaves out of the linkage system the home markets with their demand and price variables. The approach, based on the separability hypothesis, limits the number of variables on the right-hand side of the bilateral import demand and bilateral export supply equations[3].

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[3]In the terminology introduced by Strotz (1957), a utility tree approach to the specification fo demand functions in foreign trade first determines total import demand for any good and then independently allocates demand among competing sources of supply. Thus, it is assumed for present purposes that total import demand and total export prices in each country have already been determined in the national models, and only the allocation decision will be considered here.

The basic model

The basic model of the demand for imports into country j from each partner country i, the supply of exports from country i to each partner country j and the bilateral market-clearing equilibrium can be written formally as follows:

1) $m^d_{ij} = f^d_{ij}\ (m_j;\ Pm_{ij};\ Pmc_{ij};\ v_{ij})$

2) $x^s_{ij} = f^s_{ij}\ (Px_{ij};\ Px_i;\ u_{ij})$

3) $x^s_{ij} = m^d_{ij}$

The following identities hold:

4) $x_i = \sum_j m_{ij}$ total real exports of country i

5) $Pm_{ij} = Px_{ji}$

6) $Pm_j = \sum_i w_{ij}\ Pm_{ij}$

Recording discrepancies between export and import values and actual observed import and export prices due to the fob (free-on-board) and cif (cost-insurance-freight) margins are ignored.

The endogenous variables are:

m_{ij} = Imports demanded by country j from country i at constant prices.

x_{ij} = Exports supplied by country i to country j at constant prices.

Pm_{ij} = The price of bilateral imports from country i facing demanders in country j.

Px_{ij} = The bilateral export price received by suppliers in country i for their exports to country j.

Pmc_{ij} = Average import price of the competitors of i in the market of country j. Pmc is exogenous, when only one pair of equations (demand and supply) is considered, endogenous when the whole linkage model is used.

The exogenous variables are:

m_j = Total real imports of country j (variable supplied by national models).

Px_i = Total export price index of country i (variable supplied by national models).

v_{ij} and u_{ij} = non-price variables which include a random disturbance term.

This bilateral trade model describes the allocation of all imports of goods as between countries of origin. Therefore the sum of the values of all bilateral imports by a country is equal to the value of its total imports:

$$7)\ M_j = \sum_i M_{ij}$$

which could be rewritten as

$$8)\ m_j\ Pm_j = \sum_i m_{ij}\ Pm_{ij}$$

Pm_j is required to satisfy the relation

$$9)\ Pm_j = \sum_i (m_{ij}/m_j)\ Pm_{ij}$$

Bilateral import demands are specified below in logarithmic form: as shown in equation 1), the value at constant prices of the demand for bilateral import flows is related to total demand for imports (constant prices) and to the bilateral import price index relative to the price index of the competitors in the same market.

For the kth commodity:

$$10)\ \ln m^d_{ijk} = a_{ijk} + b_{ijk} \ln m_{jk} + c_{ijk} \ln Pm_{ijk}/Pmc_{ijk} + u_{ijk}$$

The variable u_{ijk} is the stochastic disturbance term assumed to be independently and normally distributed with zero mean and constant variance.

As the function is stated in logarithmic terms, a_{ijk}, b_{ijk} and c_{ijk} represent respectively a constant, the allocation elasticity and the substitution elasticity. A priori one would expect $b>0$ and $c<0$. This specification is valid since the separability assumption recalled above is applicable at any desired level of aggregation of the kth commodity sector.

The equation is specified in logarithmic terms also as a matter of convenience, because the formulation in logarithms enables us to obtain constant elasticities directly, which avoids also the problems connected with large changes in the elasticities determined by differences in the times at which they are evaluated. Also, the logarithmic formulation is suitable because it avoids heteroscedasticity problems for estimation of the parameters (Theil, 1971).

The logarithmic form of equation 2, for the kth commodity is

$$11)\ \ln x^{s}_{jik} = a'_{jik} + b'_{jik} \ln Px_{jic} + c'_{jik} \ln Px_{ik} + w_{jik}$$

The bilateral export supply in constant dollars is determined by positive price elasticities of the bilateral export price index and negative price elasticities of the price index of total exports of country i ($b' > 0$ and $c' < 0$), where one can expect $|b'| = |c'|$ for reasons of homogeneity.

Shifts in export patterns occur when some markets offer more profitable prices. Variations between the bilateral export price and the average total export price could condition the exporter's choice between supplying country j, and supplying other markets of destination.
Each supplier's export allocation function will include only the exporter's offer price Px_{ji} in the market under consideration and the average offer price Px_i of the same seller in all j markets where that exporter can supply the same bundle of goods.

The inclusion of a single relative price variable ($|b'| = |c'|$ homogeneity of degree zero in prices) is justified by postulating that the elasticity of substitution has the same value for each pair of destinations of tradeable goods, i.e. the market under consideration and its competitors. To fulfil this condition, each market must be receiving (supply function) a similar mix of tradeable goods. The same, mutatis mutandis, is true for the demand function, where each pair of sources has the same value for the elasticity of substitution. Thus, an important step in empirical implementation of the model, as will be shown later, is to disaggregate by the same types of commodity and to price the same whole set of tradeable products. This requirement is the basis for the construction of bilateral and total import and export price indices.

Although a cursory glance at the basic model above might suggest that total exports of country i have been accidentally excluded as an independent variable, the specification of the bilateral export supply function above is justified in several ways.

One of the independent variables in the demand allocation function for bilateral trade flows is the total amount of imports, which is predetermined in each national model. But a similar approach for the export supply function, with the total supply of exports predetermined in the national models, could well create more problems than it can solve.

In the national models, export prices are generally estimated as a function of domestic costs and other relevant variables. Total commodity exports could be derived either by an identity from the linkage model as an aggregation over the bilateral imports of the partner countries, or as a function of a total world trade variable.

On the other hand, the specification of the bilateral export supply function, as written above, is based on the assumption that the elasticity of supply of total exports is infinite for total export price Px_i, predetermined in the national models. Any reduction in domestic capacity utilisation increases the potential export supply and lowers total export prices. Higher levels of Px_i reflect a higher domestic demand which is competing with the demand for exports.

At the same time, Px_i could be considered as an average competitors' price. At that price, the exporter (supplier) is willing to sell his products to any foreign buyer (importer). And, other things being equal, he is willing to switch supplies to wherever the relative bilateral prices are higher.

Finally, Px_i should be considered as the link between the supply side of the national models and the linkage trade model. In theory, we are free to choose as a link for the supply side of the national models either x_i (total exports) or Px_i (total export price), but not both, because export suppliers cannot set prices and quantities at the same time.

In practice, however, domestic models provide endogenously only the total export price Px_i, so that there is no choice.

Considering the whole linkage model, as outlined above, it is easy to to see that the system is exactly identified:

there is a pair of endogenous variables (m_{ij}, Pm_{ij}),

where Pm_{ij} is equal to Px_{ji} (see identity 5 above),

for each pair of exogenous variables (m_j, Px_i).

III THE DATA

For the estimation of the demand and supply equations 10) and 11), the bilateral import-export price indices are needed. However, they are not available, even at the most aggregate level.

This problem is usually solved at the aggregate level by replacing Pm_{ij} (bilateral import price of country j from country i) by Px_i (bilateral export price index of country i). However, the use of the published series for M_{ij} (bilateral import flows), M_j (total import flow), Px_i (total export price), Pm_j (total import price) raises a few important problems for the construction of the bilateral trade model. First of all, the use of aggregates might give undue weight to goods with relatively low elasticities, like imports of fuels and raw materials.

Second, if the published series are used as proxies for the bilateral prices, the identity 7)

$$\sum_i M_{ij} = M_j$$

will not be satisfied.

Last, but not least, acceptable estimates for the coefficients are not obtained, unless constraints on the coefficients are imposed as in Barten (1971).

Thus, to produce reliable results, disaggregated equations are needed and <u>ad hoc</u> bilateral trade price indices should be used.

In view of all these problems, the ideal level of commodity aggregation should involve a degree of detail fine enough to allow identification of goods which are perfectly homogeneous, regardless of origin of production. In such a breakdown, all components of the same set could be regarded as perfect substitutes. With this kind of data, bilateral price indices can be constructed and disaggregated equations estimated.

For this purpose, OECD bilateral trade data were used. The OECD provides quarterly import and export data in both quantity and value terms based on the Standard International Trade Classification (SITC) Revised (UN, 1975), for the 24 OECD countries.

A complete classification by trading partner country (204 countries) is given. The data cover the years 1963 to the most recent year available: at present 1980. In the SITC, data cover 1696 items. Import values are cif and export values are fob, all in dollars. Quantities are expressed in metric units. The data used to construct bilateral price indices are, then, unit values, i.e. values per unit of quantity within the Standard International Trade Classification of imports and exports.

IV BILATERAL IMPORT-EXPORT PRICE INDICES

As Frisch (1936) pointed out, the problem of how to construct a price index number is a much one of economic theory as of statistical technique. From the economic point of view, there is no ideal price index. The best index should be constructed in the context of a given model and its use. For the linkage model outlined above, the first requirement for bilateral trade price indices is that the different commodities should be weighted on the basis of the country's geographical trade composition. Otherwise, it would be impossible to determine whether a price change is the result of price movements or variations in the weights of goods whose price movements are identical. These are well-known problems of the choice between weighting according to a base period (time-to-time indices) and weighting according to a regional trade pattern at a given moment (place-to-place indices).

This problem does not arise in the case of the Eurolink linkage model. Weights are for each period in terms of the importing (exporting) country, that is in terms of a third region which is independent of the countries involved in the comparisons. Bilateral price indices for each particular partner country in each different market are determined by an averaging process in which each commodity has a weight proportionate to its share in the total trade market of the importing or exporting country for each year. In practice, as we shall see below, the construction of the bilateral unit value indices involves building indices using the current period as weight, which is the Paasche Index formula. But instead of each partner country using its own commodity weight for each bilateral index, a common weight (total share of the item in the reporting country's total volume of trade) is used.

When a country does not export a particular item (for example, because it could be produced only at higher prices), the requirement for all international goods to be priced was satisfied by taking the marginal bilateral import price, that is the highest bilateral import price. Where there is only one exporter (perhaps because of natural resources) and competition is then ruled out, attribution of the same single price to all partner countries should produce a fair comparison.

Mutatis mutandis, the same is true for the construction of bilateral export price indices to be used for the supply equation of the linkage model. Import data on a cif basis were used to compute the bilateral price indices for import demand equations; for supply equations, export data must be expressed fob. In the import demand function, the buyer should compare net expenditures. In the supply function, the seller (supplier) is interested in determining which market yields the highest net proceeds for the same basket of export products. Net proceeds to the seller are best measured by fob data, since insurance and freight costs (cif) differ according to destination. The requirement for all international goods to be priced has been satisfied by attributing the lowest bilateral export price to the partner country of destination when exports were nil: the supplier tries to shift his export goods where he is paid the higher prices for the same set of commodities. When demand is restricted to a single importer, the exporter has no choice, and competition among markets of destination is ruled out. In this case, the same, single price is attributed to every partner country.

To build import-export price indices, import-export unit values have to be calculated at the finest level of disaggregation. The elementary unit value is the ratio between the value V_k and the quantity Q_k of each kth flow at period t.

$$12)\quad \frac{V_{kt}}{Q_{kt}} = u_{kt}$$

The price index (unit value index) is obtained by

$$13)\quad \frac{u_{kt}}{u_{k70}} = P_{kt}$$

where u_{kt} is the unit value of the current period for item k and u_{k70} is the unit value for the same item in the base year, 1970. For the period 1963-1969, items at the four digit level of the SITC are used, for the period 1970-1980, the five digit level, covering approximately 1699 items, is employed.

Commodities are aggregated by using current weights in volume terms. If X is the trade flow (import-export) in value and x the trade flow in volume, weights are defined as

$$14)\quad w_{kt} = (X_{kt}/P_{kt})/\sum_k (X_{kt}/P_{kt}) = x_{kt}/\sum_k x_{kt}$$

Total aggregate price indices thus take the form

$$15)\quad P_t = \sum_k w_{kt}\, P_{kt}$$

which are current weighted Paasche Index numbers. Paasche Index numbers are currently written as

$$16)\quad \frac{\sum_k q_{kt}\, p_{kt}}{\sum_k q_{kt}\, p_{k70}}$$

Formula 15) is in fact the same as formula 16), where the q's are current trade flows in volume. To show that this is the case, definition 13) should be substituted in 15):

$$17)\quad P_t = \sum_k w_{kt}\, P_{kt} =$$

$$= \sum_k (X_{kt}/P_{kt})/(\sum_k (X_{kt}/P_{kt}))\quad P_{kt}$$

$$= \sum_k (X_{kt}/(u_{kt}/u_{k70})/\sum_k (X_{kt}/(u_{kt}/u_{k70}))\,(u_{kt}/u_{k70})$$

$$= \sum_k (x_{kt} u_{kt})/\sum_k (x_{kt}\, u_{k70})$$

where the quantities q of the Paasche formula are replaced by x, the trade flow in volume terms. Commodities for the bilateral and total unit price indices are aggregated by using formula 15) which is, as shown, equivalent to a Paasche Index number.

V A DYNAMIC LINKAGE MODEL

Price changes could have relatively slow effects on market shares: there may be recognition, decision, delivery and production lags. On the other hand, by its nature there are no lags in the relationship between total import demand m_j and the bilateral flow m_{ij}.

Therefore, if lags are introduced in the model described above, they should refer to the price term only.

The most popular form of lag distribution is a geometric lag distribution, which can be rationalized by the familiar adaptive expectation model (Kmenta, 1971).

The bilateral import demand equation can then be rewritten:

$$18)\quad \ln m_{ijk} = a_{ijk} + b_{ijk} \ln m_{jk} + c_{ijk} \ln (Pm_{ijk}/Pmc_{ijk})^e + u_1$$

where $(Pm_{ijk}/Pmc_{ijk})^e$ is the expected price ratio.

The expected price ratio is determined by:

$$19)\quad \ln (Pm_{ijk}/Pmc_{ijk})^e = \lambda \ln (Pm_{ijk}/Pmc_{ijk})^e_{t-1} + (1-\lambda) \ln (Pm_{ijk}/Pmc_{ijk}) + u_2$$

Current expected price ratios are determined by modifying previous expectations in the light of current experience. Next, the expected price ratio 19) can be incorporated in 18):

$$20)\quad \ln m_{ijk} = a_{ijk} + b_{ijk} \ln m_{jk} + c_{ijk} \lambda \ln (Pm_{ijk}/Pmc_{ijk})^e_{t-1} + c_{ijk}(1-\lambda) \ln(Pm_{ijk}/Pmc_{ijk}) + u$$

which by use of the Koyck transformation (Koyck, 1954) lagging 18) can be rewritten as

$$21)\ \ln m_{ijk} = a_{ijk}(1-\lambda) + b_{ijk} \ln m_{jk} - b_{ijk}\lambda \ln m_{jkt-1}$$

$$+ c_{ijk}\ (1-\lambda) \ln (Pm_{ijk}/Pmc_{ijk}) + \lambda \ln m_{ijk_{t-1}} + u$$

Because of non-linearities, this specification requires non-linear estimation procedures. The supply equation is, on the contrary, linear in the logarithms and, after some rearrangement of terms, takes the form

$$22)\ \ln X_{ijk} = a'_{ijk}\ (1-\lambda) + b'_{ijk}\ (1-\lambda) \ln (Px_{ijk}/Px_{kk})$$

$$+ \lambda \ln X_{ijk_{t-1}} + u$$

VI EMPIRICAL RESULTS

Regression results are not reported in this abridged version of the paper because of lack of space, but can be obtained on request from the author. The following paragraphs and synoptic tables summarise the main conclusions of economic significance for four reporting countries (France, Germany, Italy and the UK). Partner countries are the same four countries plus the Rest of the World.

In general, it has emerged that allocation coefficients (b's) are around one; and substitution elasticities (c's) are negative and show very low values for basic materials (SITC 2-4) and mineral fuels (SITC 3).

Allocation elasticities (b coefficients)[4]

Tables 1, 2, 3 and 4 present the import distribution elasticities by origin for each reporting country (France, Germany, Italy and the UK). The column headings indicate the importing country, and allocation elasticities are given with respect to the partner exporting country appearing in the row entry.

Allocation elasticities larger than one (>1) show growing market shares for the exporting countries (row entries) in the import market of each of the four countries considered.

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[4]Market share time series are a common tool to analyse international trade for policy making. Allocation elasticity estimates should be considered a more refined and subtle approach to the same problem. Being the result of an economic model and of multiple regression techniques, these elasticities can be used to distinguish the effects of changes in demand from the effects of changes in supply as well as of price competitiveness and other factors. On the other hand, the usual market share time series cannot be of much help to the policy maker, who needs a few key and summary figures for action. The bilateral trade model presented here has already been used by the EEC Delegation in Geneva for the assessment of the effects of the various tariff cutting formulas during the Tokyo Round of Trade Negotiations within the framework of the General Agreement on Tariff and Trade (GATT) (P. Ranuzzi, 1978).

Table 1 reports allocation elasticities for food, beverages and tobacco (SITC 0-1). France, with a very low import allocation elasticity vis-à-vis Germany and elasticities lower than one for Italy and the UK, is apparently turning away from the EEC member countries and towards the Rest of the World as a source of this category of imports. The size of the export share of the Rest of the World in the French agricultural importing market is growing at a rate of 5% a year, abstracting from price substitution effects.

Germany also shows low food import allocation elasticities in respect of its EC partners, with an exception for the UK. UK accession to the EEC has probably led to a reduction in German agricultural imports from the EEC founder members in favour of the British agricultural exporting market.

The figures for imports of agricultural goods by Italy are strikingly different from those of France and Germany. Allocation elasticities are substantially higher than unity for the EEC partners, and lower than one for imports form the Rest of the World, which implies a substantial agricultural trade creation effect between Italy and its EEC partners.

The UK import allocation elasticities are not so clear-cut, because to get meaningful results for the bilateral import equations from Germany and Italy, the coefficients have been assumed to be equal to one. But the Rest of the World is probably increasing its share of food exports to the UK market, which shows an import allocation elasticity of 1.14.

Table 2 for basic materials (SITC 2-4) shows an EEC trade creation effect in the French importing market for the three EEC exporting countries (Germany, Italy and UK), while the Rest of the World is losing ground. The same can be said for the Italian import market. The share of French exporters in the German market is increasing, while that of Italian exporters is declining slightly; the UK and the Rest of the World hold their positions in the German market.

The UK, on the other hand, shows a diversion of this type of trade from the three EEC partner exporting countries in favour of the Rest of the World.

Table 3 (SITC 3, mainly oil) is not very interesting because, as expected, allocation elasticities vis-à-vis the Rest of the World are practically one, and the imports of oil from the Rest of the World represent almost 90% of the market share in each importing country. Germany's very high allocation elasticity vis-à-vis the UK, which is an exception, could be explained by the recent discovery and exploitation of the British North Sea oilfields.

Results in Table 4 (manufactured goods, SITC 5-9), are quite interesting. France and Germany have been diverting their import trade since 1970 from the EEC founder members towards the UK, a new member, and the Rest of the World. French and German import allocation elasticities are lower than one vis-à-vis the EEC founder members exporting to their markets and larger than one vis-à-vis the UK and the Rest of the World.

On the other hand, France seems to be increasing its share quite substantially in the Italian and British markets for manufactured goods; elasticities are 1.21 and 1.30 respectively. German exports seem to be losing ground in all three EEC member countries. Italy's share of the market is decreasing in Germany and France, but increasing in the UK.

The UK, most probably because of recent accession to the EEC, is gaining market shares in France and Germany, but not yet in Italy.

Elasticities of substitution (c coefficients)

Tables 5, 6, 7 and 8 show elasticities of substitution, which can be seen as measure of the degree of monopoly of the suppliers (exporters) in each importing market.

Tables 1 - 4

Allocation Elasticities (b coefficients)

Table 1: food, beverages + tobacco SITC 0-1

		Importers			
		FR	GE	IT	UK
Exporters	FR	/	0.78	1.23	0.46
	GE	0.33	/	1.24	1.
	IT	0.83	0.74	/	1.
	UK	0.77	2.60	2.60	/
	RW	1.05	1.04	0.84	1.14

Table 2: basic materials SITC 2-4

		Importers			
		FR	GE	IT	UK
Exporters	FR	/	1.28	1.67	0.15
	GE	1.26	/	1.03	0.19
	IT	1.32	0.94	/	0.58
	UK	1.39	0.98	1.67	/
	RW	0.97	0.98	0.86	1.03

Table 3: mineral fuels SITC 3

		Importers			
		FR	GE	IT	UK
Exporters	FR	/	1.18	1.09	1.31
	GE	0.56	/	1.52	1.48
	IT	0.54	1.0	/	1.52
	UK	0.60	3.17	0.33	/
	RW	1.01	0.94	0.99	0.97

Table 4: manufactured goods SITC 5-9

		Importers			
		FR	GE	IT	UK
Exporters	FR	/	0.97	1.21	1.30
	GE	0.91	/	0.94	0.97
	IT	0.83	0.81	/	1.06
	UK	1.10	1.14	0.92	/
	RW	1.08	1.03	0.97	0.97

Note: reading across the tables, the coefficients give the elasticities of importing country trade in relation to changes in exports of the countries or regions mentioned in the left hand column.

Quarterly regression results, sample 1970-1978
Estimation procedure: Zellner's Seemingly Unrelated Regression Method (Zellner 1962)

Elasticities of substitution of less than one ($C < 1$) show that the importing country cannot easily switch from one supplier to another. If the exporter raises prices by one percent, an inelastic substitution means that the importing country reduces its bilateral import quantity from that supplier by less than one percent. As a consequence, the total amount of money spent on the bilateral import flow increases while the bilateral trade volume of imports decreases.

The exporter's degree of price monopoly in any importing market is absolute when completely inelastic substitution is found. Given the total quantity imported, any price increase decided by the exporter is fully borne by the importer. The importing country, in fact, cannot switch demand to any other supplier with lower prices, because the existing supplier has complete control over the supply in the importing market. Elasticities of substitution go beyond nominal price competitiveness, which refers to higher or lower levels of relative prices only. By measuring each exporter's degree of price monopoly, relative to all other competitors in the same importing market, elasticities of substitution tell us something about the segmentation of the market and the monopolistic control established in the importing market.

Table 5 shows elasticities of substitution for food, beverages and tobacco (SITC 0-1). The row entries show that France still retains a certain degree of monopoly in the Italian and German foods markets, but not in the British market. Germany shows a very small degree of monopoly in all three food importing markets of the EEC: France, Italy and the UK. Italy controls the German market, perhaps because of its traditional role as a fruit and vegetable exporter, but has to fight hard to be price competitive in the French and British food markets. For instance, in the UK, all other things being equal, Italy would have to lower agricultural prices by 2 percent to increase its bilateral trade flow by one percent (the UK's total bill towards Italy will decrease if Italy tries to expand the volume of exports to the British food import market by cutting prices).

The UK shows no degree of monopoly in the importing markets of the other three EEC member countries and its price competitiveness is weakened especially in France and Germany by a high import elasticity of substitution, where to enlarge its export flow by one percent, it would have to lower its price by more than two percent.

For France and Italy, as importing countries, the elasticities of substitution reported in Table 5 are short-run elasticities.

Long run elasticities (see Appendix) can be found by dividing the short run substitution coefficients by $(1-\lambda)$, where λ is the lag operator. In the French agricultural importing market, Germany and the UK as exporters show very high elasticities of substitution with coefficients of 4.18 and 7.31 respectively. Italy presents a long-run coefficient of 2.68 which is much lower than those of Germany and the UK, but still too high to imply any control of the French agricultural market in the long run. Only the Rest of the World, with a long run elasticity of substitution of less than one (0.77), presents some monopolistic power in the French food importing market.

Italy, as a long run food importer, presents a pattern similar to that of France, but with smaller substitution coefficients. The three biggest EEC exporters of agricultural products to Italy have little long run control over the Italian food importing market, but the Rest of the World has a fairly high degree of control.

Table 6 refers to basic materials (SITC 2-4). Member countries have no control over the markets in the other member importing countries. Only France and Germany present some monopoly power in the British importing market. The Rest of the World, on the other hand, shows, as expected, a high degree of monopoly (represented by an elasticity of substitution almost equal to zero) in every importing market of the EEC member countries.

Table 7 (mineral fuels, SITC 3), is not very important for the European countries, because as exporters of mineral oils and other

Tables 5 - 8

Substitution Elasticities (c coefficients)

Table 5: food, beverages + tobacco SITC 0-1

		Importers			
		FR	GE	IT	UK
Exporters	FR	/	-0.65	-0.73	-1.15
	GE	-0.92	/	-0.96	-0.97
	IT	-1.42	0.0	/	-2.12
	UK	-2.12	-2.55	-1.24	/
	RW	-0.38	-0.18	-0.34	-0.16

Table 6: basic materials SITC 2-4

		Importers			
		FR	GE	IT	UK
Exporters	FR	/	-2.08	-2.21	-0.85
	GE	0	/	-2.00	-0.38
	IT	0	-2.03	/	-1.16
	UK	0	-2.36	-2.54	/
	RW	0	-0.20	-0.60	-0.02

Table 7: mineral fuels SITC 3

		Importers			
		FR	GE	IT	UK
Exporters	FR	/	-0.49	0	-3.49
	GE	0	/	0	-3.72
	IT	-0.77	-3.64	/	-3.92
	UK	0	0	0	0
	RW	0	-0.14	0	-0.17

Table 8: manufactured goods SITC 5-9

		Importers			
		FR	GE	IT	UK
Exporters	FR	/	-1.45	-0.63	-0.94
	GE	-1.23	/	-0.61	-0.99
	IT	-1.60	-1.48	/	-1.20
	UK	-1.65	-1.60	-0.71	/
	RW	-0.90	-0.58	-0.48	-0.24

Note: reading across the tables, the coefficients give the elasticities of importing country trade in relation to changes in exports of the countries or regions mentioned in the left hand column.

Quarterly regression results, sample 1970-1978

Estimation procedure: Zellner's Seemingly Unrelated Regression Method fuels, their production capacity is very limited. Only the UK is able to control the oil market in the same way as the Rest of the World.

Table 8 (manufactured goods, SITC 5-9) presents striking differences among the European countries. In the Italian importing market for industrial goods, all suppliers reported in the Table are able to control the market; i.e. import elasticities of substitution for Italy are well below one whichever supplier we look at. It could be said that exporters have been very successful in segmenting the Italian importing market by eliminating chances of price competitiveness between themselves. France as an exporter is in a very strong position in Italy, a fairly favourable position in the UK, but a weak position as a price monopolist in the import market of Germany, where the bilateral elasticity of substitution is well above unity.

Germany as an exporter is in a stronger position than France in the Italian importing market, a weak position in France, and average in the UK with a coefficient very close to one.

The UK shows its weakness in the import markets of France and Germany, but is in a favourable position in Italy.

Italy is a very weak exporter of manufactued goods in every market and must lower its export prices quite substantially if it is to raise its export flows to France, Germany and the UK. Italy, as a consequence, could be said to be a weak international trader, insofar as prices are concerned, both as an importer and as an exporter of manufactured goods vis-à-vis the largest countries of the EC.

Bilateral price equations

No acceptable results were obtained for the bilateral supply equation as described in 11) in o.l.s. estimation. Two-stage least squares estimates were also unsuccessful. No solution has yet been found therefore, for the estimation of the structural coefficients of the bilateral supply flow model. But the equilibrium price can also be expressed in terms of the underlying supply and demand factors and this expression can be placed in the model instead of supply and market-clearing equations. The explicit expression for the bilateral price variable which appears in both equations (demand and supply) becomes:

$$Pm_{ij} = a' + b' \, m_j + c' \, Pc_{ij} + d' \, (Px_i \, r_{ij}) + e' \, t_{ij} + f' \, X_{ji_{t-1}} + w_{ij}$$

where all variables are expressed in logarithms. r_{ij} and t_{ij} are cif-fob adjustment factors, which are defined as $r_{ij} = Pm_{ij}/Px_{ij}$ and $t_{ij} = m_{ij}/x_{ij}$ to take into account all kinds of discrepancies between recorded import and export trade flows. In fact, cif-fob conversion factors are not the only source of discrepancies between bilateral import and export flows. Transport lags, redirections of trade, errors etc. are also involved.

From the expected sign of the coefficients in the structural model, we could expect the coefficients of the reduced form equation of the bilateral price variable to be positive for b', c' and d' (>0), and negative for e' and f' (<0). There is no need to explain the positive effect of the first three variables and the negative sign for x_{ijt-1} (the bilateral supply quantity lagged one period), but the negative effect of the cif-fob adjustment factor t_{ij} might be somewhat surprising. In fact, t_{ij} is the ratio of bilateral imports to export flows in constant terms, i.e. US 1970 dollars. The variable t_{ij} is, then, free from inflation. Increases in productivity in the insurance and transport sectors would decrease t_{ij} and also reduce import prices. For reasons of price homogeneity, the sum of the coefficients of the two price explanatory variables has been set equal to one (c+d = 1).

Moreover, in the reduced form, the coefficient of the variable for total export price of country i(Px_i) and of the variable for the price adjustment factor r_{ij} should be equal, as is shown by the structural model. Estimations were made first without constraints and then subject to constraints. Generally, estimations with and without constraints have shown the same results. In a very few cases, unconstrained results have turned out to be more acceptable from the econometric point of view than the estimation with the constraints. In these cases, estimations without constraints have been chosen and reported in the tables below.

A few brief remarks about the economic interpretation of the reduced form equation for the bilateral import price function are needed. The classical theory which relates price setting to the equilibrium between supply and demand explains the dynamics of the bilateral export pricing of the reduced form equation. Estimation results show that the bilateral export pricing behaviour of each country vis-à-vis its importing partners at the aggregate level is largely explained by two variables: an average export price as expressed by variable Px_i and the price index Pc_{ij} charged by competitors in the same importing market for the same category of products. Px_i (the average export price index) in the national models is mainly the result of an equation based on domestic cost considerations. The elasticity coefficients of the two variables Px_i and Pc_{ij} may be interpreted as proxies to measure price discrimination as discussed by J. Robinson (1969), if the monopolistic exporter tries to maximize total profit on each exporting market. The elasticity coefficients estimated for the two variables should, then, show two different behaviours: the country exporting to a particular importing market can behave as a price maker and base its bilateral export price on its average export price Px_i (based on domestic cost consideration), or it could be a price taker, and choose to adjust its bilateral export price to its competitors' prices. If the exporting country is a price taker in a particular market, the expected coefficient of the competitors' price variable should be very close to one and the coefficient of the average export price should be close to zero. If, on the other hand, the exporting country is a price maker, the opposite will hold.

It is unlikely that every exporting country is free to choose one or other extreme situation; most will find themselves somewhere in between. The coefficients measuring the degree of price setting behaviour (price discrimination among different exporting markets) could thus take any value between zero and one, depending on the competitiveness of the country and on characteristics such as market shares, changes in market shares, specialisation, aggressivity, etc.

Since the price homogeneity condition (that the sum of the two coefficients should be equal to one) has been imposed for estimation of the coefficients, tables 9, 10, 11 and 12 show only the elasticity coefficient for the average export price variable (coefficient d'). The elasticity coefficient for the competitors' price variable can easily be computed by subtracting from one the coefficient given.

Table 9 gives the results for agricultural products (SITC 0-1). The row entries present the elasticities of the exporting countries vis-à-vis the importing countries shown in the column headings. In agricultural exports, France, Germany and the UK are price makers because they show elasticity coefficients for their average export price variable rather close to one. All three exporting countries are able to set their bilateral export prices, especially in the Italian agricultural importing market, almost without considering the price policies of their competitors. In the UK's importing market, France and Germany, with coefficients of only 0.59 and 0.53 respectively, have less scope for price setting behaviour, perhaps because the UK has been participating for so short a time in the Common Agricultural Policy: the UK did not join the EEC until 1973, while the estimation period begins in 1970. Italy, on the other hand, is a price taker in France (0.26) and the UK (0.24) and a price maker in Germany (0.58) but with little room for manoeuvre. These results confirm what has already been said about the elasticities of substitution above, and it is worth noticing that all these results, although estimated separately, are mutually consistent.

Table 10 presents results for basic materials (SITC 2-4). France and Germany are export price setters in all importing markets, while the UK and Italy, with very low elasticity coefficients are price takers. It should be borne in mind that the average export price (Px_i) of the Rest of the World includes only the export prices of the other OECD countries, and not those of the LDCs, OPEC countries and so on. This is because the data bank used contains export price data from the OECD countries only. On the other hand, the competitors' import prices (Pc_{ij}) do cover every country of the Rest of the World because the countries reporting to the OECD data bank trade with all of the world's trading countries (204 countries). This accounts for the very low coefficients of the Rest of the World, which could be expected to be a price maker at least in SITC category 2-4 (basic materials) and category 3 (mineral fuels).

Table 12 shows the results for manufactured goods (SITC 5-9). France and Germany are price makers in all the importing markets considered up to now in the Eurolink project. Italy has a very high coefficient (0.74) in one importing market only, that of the UK, but presents an average coefficient(around 0.50) in the French and German import market. The UK, as an exporter, shows some price discrimination behaviour only in the French importing market for manufactured goods, but not in German and Italian markets. The Rest of the World, which includes the US and Japan, seems to be free to apply an independent export price policy in the British importing market for manufactured goods, but its coefficients are very low in France, Germany and Italy, where the Rest of the World could be said to be essentially a price taker.

Tables 9 - 12

Coefficients for price setting behaviour

Table 9: food, beverages + tobacco SITC 0-1

Exporters	Importers: FR	GE	IT	UK
FR	/	0.64	0.78	0.59
GE	0.73	/	0.79	0.53
IT	0.26	0.58	/	0.24
UK	0.64	0.71	0.80	/
RW	0.44	0.31	0.58	0.48

Table 10: basic materials SITC 2-4

Exporters	Importers: FR	GE	IT	UK
FR	/	0.56	0.72	0.78
GE	0.51	/	0.66	0.71
IT	0.20	0.54	/	0.36
UK	0.07	0.21	0.25	/
RW	0.38	0.38	0.33	0.69

Table 11: mineral fuels SITC 3

Exporters	Importers: FR	GE	IT	UK
FR	/	0.36	0.05	0.35
GE	0.07	/	0.03	0.06
IT	0.07	0.12	/	0.26
UK	0.04	0.09	0.009	/
RW	0.03	0.003	0.04	0.62

Table 12: manufactured goods SITC 5-9

Exporters	Importers: FR	GE	IT	UK
FR	/	0.52	0.55	0.87
GE	0.59	/	0.55	0.67
IT	0.54	0.46	/	0.74
UK	0.64	0.48	0.32	/
RW	0.13	0.23	0.28	0.81

Quarterly regression results, sample 1970-1978
Estimation procedure: Zellner's Seemingly Unrelated Regression Method.

VII SUMMARY OF THE MOST IMPORTANT FINDINGS

By looking at allocation and substitution elasticities and at the price setting behaviour of the four countries at present incorporated in the Eurolink system, some general conclusions can be drawn.

For the agricultural trade sector, France and Germany seem to be in a very strong position. These two countries are able to set their prices in the agricultural importing market of Italy and the UK without much competition from the other exporters on the same markets. The story looks different for the UK, but above all, for Italy. Italy, as a food exporter is essentially a price taker. The UK seems to be a price setter, but agricultural trade goods of UK origin show very high substitution elasticities. Moreover, France and Germany present a trade diversion effect from the EEC member countries in favour of the Rest of the World. The opposite seems to be true for Italy and the UK.

For basic materials only the UK shows some trade diversion effect from member countries to the Rest of the World. On the other hand, France and Germany look to be price setters, and Italy and the UK price takers.

For energy traded goods, only the Rest of the World shows a price setting behaviour, as expected, by controlling 90 percent of the importing markets.

Finally, for manufactured goods, it looks like there is still an EEC trade creation effect for French traded goods in the Italian and British markets, and for UK manufactured exports in the French and German markets. At the same time, France, Germany and Italy seem to be price setters in the EEC importing markets for industrial goods, with the exception of Italian exports to Germany. UK industrial exports look strong in the French importing market, but rather weak in the German and Italian ones. The Rest of the World seems to be a price setter in the UK with almost no competition from other exporters in the same market, but is a price taker in France, Germany and Italy.

Appendix

The dynamic model presented in Section V has been applied to all bilateral equations, but has shown λ coefficients different from zero only for agricultural imports (SITC 0-1) of France and Italy.

The following tables presents the long-run substitution elasticities for those two countries as agricultural importers, compared to the short-run substitution elasticities already reported in Table 5.

Short and long-run substitution elasticities (c coefficients)

(food, beverages + tobacco -SITC 0-1) Sample period 1970-78, quarterly figures

FRANCE (importer)			ITALY (importer)		
Exporters	short-run elasticities	long-run elasticities	Exporters	short-run elasticities	long-run elasticities
FR	-	-	FR	-0.73	-1.5
GE	-0.92	-4.18	GE	-0.96	-2.0
IT	-1.42	-2.68	IT	-	-
UK	-2.12	-7.31	UK	-1.24	-1.82
RW	-0.38	-0.77	RW	-0.34	-0.64

Some comments have already been made, when results were discussed in the main part of this paper. In general, it could be added that these long run substitution elasticities seem to make economic sense to agricultural experts of both the French and Italian importing markets.

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