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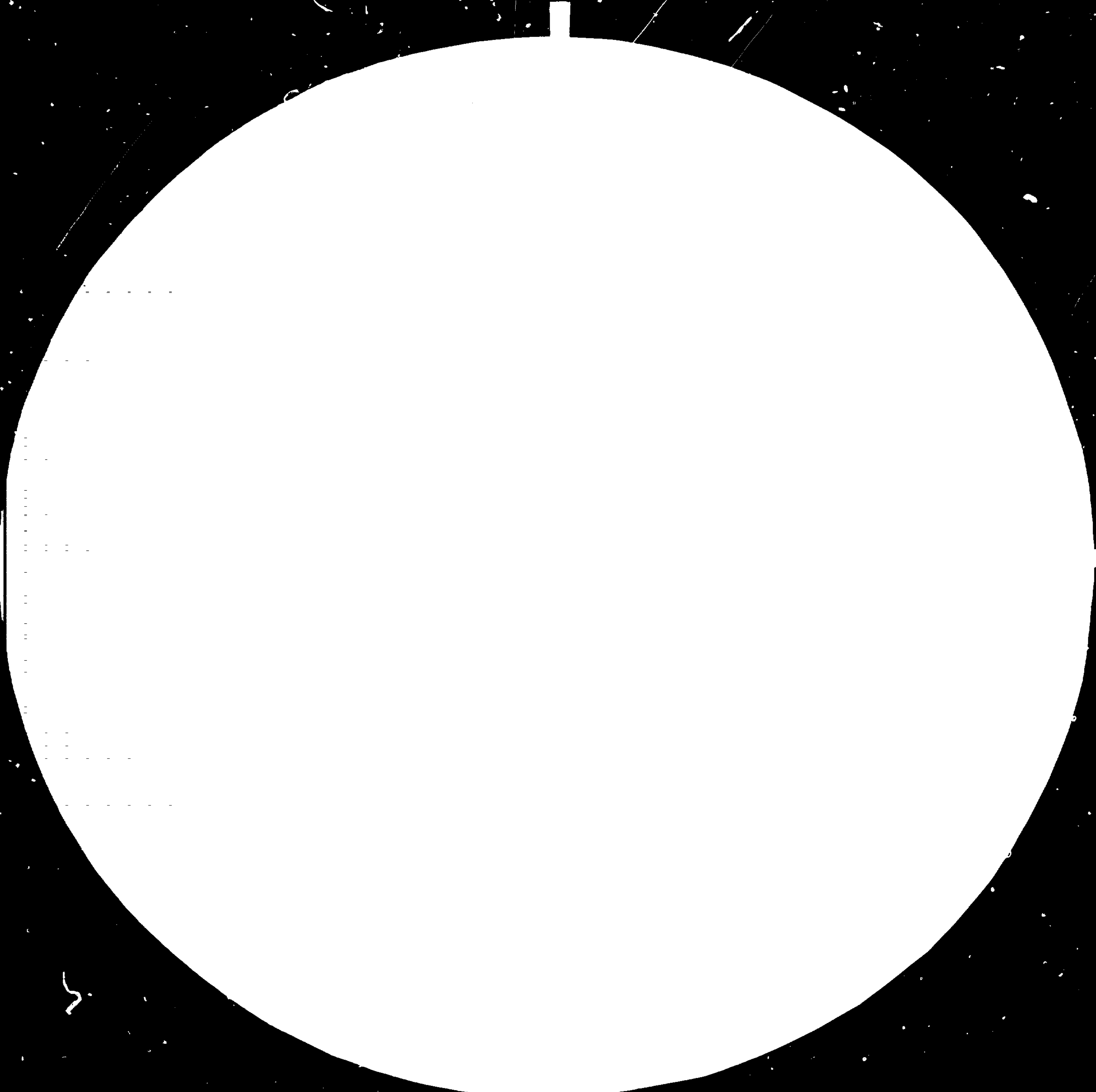

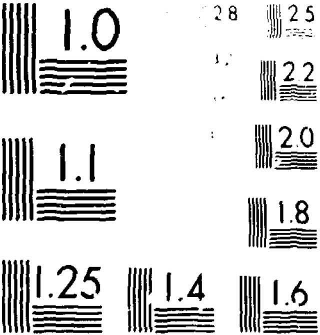

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TRADE INTENSITY INDICATORS.*

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World Modelling Working Paper

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I. INTRODUCTION

The purpose of this paper is to provide information on a methodology for trade matrix scenario generation. A trade matrix is a set of figures arranged in a table which show the countries as exporters along the rows and importers along the columns. Hence, by looking along the rows it is possible to see the distribution of a country's exports in terms of their destination. By looking down the column, the origin of a country's imports can be seen. The broad purpose of the present analysis is to learn, from the changes in these matrices in the past, the underlying behavioural characteristics which would be of assistance in constructing such matrices for the future.

The purpose of such construction is to examine new sets of relationships between the different trading regions of the world. Present trading patterns owe at least part of their form to historical relationships, geographical location, market forces, etc. Changes take place in these structures, at least partly because of policy options pursued by exporters and importers, and changes in the prices of traded goods (for instance, such as occured in the case of oil) can bring about other changes in the structures of world trade. And such changes are closely related to internal policy: export concentration or import substitution for a particular country will have its effects on its trading partners. Again, new strategies of South-South co-operation among developing countries, at least partly induced by the deceleration in co-operation between North and South, will have effects on the trading patterns of the world. It is therefore important to discover what forces have been at work in the determination of existing patterns, and to what extent it is possible, within a given time period, to bring about different trade structures of the world. This process, that of so-called scenario generation, which explores new possibilities, in particular in connexion with international economic co-operation and development, is a field of work closely related to the activities of the studies on industrialization undertaken by UNIDO.

In addition to the general considerations given above, a further impetus for the present work was the technical need to investigate, in terms of bilateral relationships, the implications of scenarios of total regional trade. As part of its modelling activity, UNIDO has constructed a small world input-output model known as the LIDO model[1/] which was intended to examine the implications for world regions of the achievement of the Lima target. The model treated trade only in terms of exports and imports for each region, without then examining the trade between each pair of regions. A methodology has therefore been developed by which the trade of each region can be broken down into its bilateral

1/ See e.g. "Modelling the attainment of the Lima Target: the LIDO Model", UNIDO, Industry and Development, No. 6.

relationships. The present study concentrates on one part of such a methodology, by examining the behaviour of indicators of trade intensity, known as "delta coefficients", which are defined for each trading relationship. The study concentrates upon the behaviour of such coefficients through time, and derives conclusions as to the underlying factors which determine this behaviour. Initial experiments are now being made with the preparation of quantitative scenarios, using a computer package which embodies the conclusions of the present study, and a report on this will be issued at a later date.

This report was prepared by Ms. A. Gelei and Ms. Z. Kapitany, Institute of Economics, Hungarian Academy of Sciences, as consultants to UNIDO.

II. METHODOLOGICAL BASIS

At the outset, it should be noted that this work is directly based on results achieved by previous studies which have stressed structural relationships together with the requirement of consistency in forecasted world trade.[1/]

As opposed to a general treatment of trade within the framework of macroeconomic systems where the import activity is considered as the determining factor (and exports treated as a sort of dependent variable), this paper assigns an equal role to both sides in the formation of trade flows. Moreover, since world trade forms an interrelated and complete system, bilateral flows within it are also highly influenced by further special factors.

The "delta" structural system

In the following we use two dimensional export "delta" coefficients. These are defined as follows:

$$\delta_{ij} = \frac{x_{ij}}{\bar{x}_{ij}} = \frac{x_{ij}}{\frac{x_{i.} x_{.j}}{x_{..}}} = \frac{x_{ij} \cdot x_{..}}{x_{i.} x_{.j}}$$

where: x_{ij} = the trade flow of a given commodity from region i to region j at a given time

$\bar{x}_{ij}$ = the "normal" trade flow of a given commodity from region i to region j at a given time

$x_{..}$ = the total world trade of a given commodity at a given time

$x_{i.}$ = the total export of region i of a given commodity at a given time

$x_{.j}$ = the total import of region j of a given commodity of a given time.

An export flow between regions i-j is called <u>normal</u> if this export flow - x_{ij} - represents the same portion in region i's total exports as the total imports of region j represent in total world trade. A symmetrical definition holds for the import flows.

In this case $\delta_{ij} = 1$.

1/ In particular, the work and publications of A. Nagy: "The Role of Consistent Trade - Network Models in Foreign Trade Planning and Projection of the Socialist Countries", Economic Commission for Europe, 1970. "Trade Projections for CMEA Countries and their Linkage with the World Trade Model", UNCTAD, 1972. "Methods of Structural Analysis and Projection of International Trade, Studies 13", Institute of Economics, Hungarian Academy of Sciences, 1979.

A "normal" trade flow means either that it is not influenced by trade policy, distance and similar effects, or that all of these effects have cancelled out.

When working with delta intensity coefficients, a distinction is made between "volume" and "intensity" effects. First the so-called "normal" flow is computed (thus taking into account the volume effects), and then, by comparing this with the corresponding factual trade flow data, the intensity effects are obtained.

The "delta' coefficients are closely related to share coefficients:

$$\delta_{ij} = \frac{x_{ij}}{x_{i.}} \cdot \frac{x_{..}}{x_{.j}} = \frac{x_{ij}}{x_{i.}} \Big/ \frac{x_{.j}}{x_{..}} = \frac{a_{ij}}{z_{.j}}$$

where a_{ij} = the share of the import market j in the total exports of region i

$z_{.j}$ = the share of the same importer in total world trade.

And similarly:

$$\delta_{ij} = \frac{x_{ij}}{x_{.j}} \cdot \frac{x_{..}}{x_{i.}} = \frac{x_{ij}}{x_{.j}} \Big/ \frac{x_{i.}}{x_{..}} = \frac{b_{ij}}{z_{i.}}$$

where b_{ij} = the share of an exporter country i in the import market j

$z_{i.}$ = the share of the same exporter in world trade.

Or another alternative formulation:

$$\delta_{ij} = \frac{x_{ij}x_{..}}{x_{i.}x_{.j}} = \frac{x_{ij}}{x_{i.}} \cdot \frac{\dfrac{x_{..}}{x_{ij}}}{\dfrac{x_{.j}}{x_{ij}}} = \frac{x_{ij}}{x_{i.}} \cdot \frac{x_{ij}}{x_{.j}} \Big/ \frac{x_{ij}}{x_{..}} = \frac{a_{ij} \cdot b_{ij}}{z_{ij}}$$

Thus, the δ_{ij} coefficient may be obtained either by dividing the import share by the share of the total exports of the exporting country in world trade; or by dividing the export share with the share of the total imports of the importing country in world trade.

It may be seen that the δ coefficient is directly proportional to the regional share coefficients and inversely proportional to world shares (or to the share of the given flow in world trade).

The δ_{ij}^{max} variable

It is a logical step to ask what are the maximum values of the δ_{ij}s and what are the explanatory variables of these.

Using the definition of the two dimensional δ_{ij}:

$$\max(\delta_{ij}) = \max \frac{x_{ij}x_{..}}{x_{i.}x_{.j}} = \frac{\max(x_{ij})x_{..}}{x_{i.}x_{.j}} = \frac{\min(x_{i.}\, x_{.j})x_{..}}{x_{i.}x_{.j}} =$$

$$\max(\delta_{ij}) = \max \frac{x_{ij}x_{..}}{x_{i.}x_{.j}} = \frac{\max(x_{ij})x_{..}}{x_{i.}x_{.j}} = \frac{\min(x_{i.}x_{.j})x_{..}}{x_{i.}x_{.j}} =$$

$$x_{i.} \leq x_{.j} \longrightarrow \frac{x_{..}}{x_{.j}} = \frac{1}{z_{.j}}$$

$$x_{i.} > x_{.j} \longrightarrow \frac{x_{..}}{x_{i.}} = \frac{1}{z_{i.}}$$

Denoting the $(x_{i.} \leq x_{.j}) \longrightarrow (a_{ij} \geq b_{ij})$ case by 1

and the $(x_{i.} > x_{.j}) \longrightarrow (a_{ij} < b_{ij})$ case by 2

$$\max(\delta_{ij}) = \begin{cases} \overset{1}{\nearrow} \dfrac{x_{..}}{x_{.j}} = \dfrac{1}{z_{.j}} = \dfrac{b_{ij}}{z_{ij}} \\ \underset{2}{\searrow} \dfrac{x_{..}}{x_{i.}} = \dfrac{1}{z_{i.}} = \dfrac{a_{ij}}{z_{ij}} \end{cases}$$

The variable on the left side is the maximum value to which the intensity of trade of given i - j markets could theoretically rise.

On the right hand side we arrive at the same expressions presented in the previous part. Formally, the maximum value of trade intensity is equal to the reciprocal of the share of total imports (exports) of the region j (i) in total world trade. This means that this maximum value depends only on one - namely on the bigger - participant's market share in world trade, in an inverse way.

The same relation can be expressed also by the next formula on the right hand side. This form of the max (δ_{ij}) has a more direct economic meaning. Namely, this ratio shows how the share of the given x_{ij} export flow in the bigger total regional trade flow differs from the share of the same export flow in total world trade.

Once again we want to underline that in the δ_{ij}^{max} the determing factor is the bigger of the flows $x_{.j}$ and $x_{i.}$; or, expressed in another way, it is the smaller share, a_{ij} or b_{ij}.

<u>The case where δ_{ij} is equal to δ_{ij}^{max}</u>

In economic terms this means that if $x_{i.}$, the total exports of region i, is greater than the total imports of the region j, ($x_{.j}$), then the maximum possible value of the intensity indicator is determined by the fact that the importer has less import capacity than the value of the total exports of region i. No more exports could have been oriented to the j region than $x_{.j}$, that is, max $(x_{ij}) = x_{.j}$. If $x_{.j}$ is bigger than $x_{i.}$, which means that region i is exporting only a part of the total imports of region j, then the value of the intensity indicator is determined by the exporter, $x_{i.}$. In the first case if region i could export as much as the total imports of region j, region i could thereby reach a maximum intensity of trade relationship with region j. In the second case if all the exports of region i were oriented towards region j, this would create the maximum possible intensity of trade of the region i with j. Therefore the concept of δ_{ij}^{max} involves in a certain sense a deviation from market diversification; indeed it expresses a market concentration.

It has been mentioned that the δ_{ij}^{max} depends on the bigger total regional trade flow's share in total world trade. It gives important economic information when we are comparing the two regional trade flows in value terms and observe which one is the relation between them, case 1 or case 2. Following the comparison in time it is even more interesting to see whether there is any one of them which is typical, or if they are changing in time.

<u>A further definition of δ_{ij}</u>

If max (δ_{ij}) is denoted by δ_{ij}max, then

$$\delta_{ij} = \begin{cases} a_{ij}\ \delta_{ij}^{max} & (1) \\ b_{ij}\ \delta_{ij}^{max} & (2) \end{cases}$$

This is a new expression for δ_{ij} which proves to be very useful in the analysis of the functional relationships defining the behaviour of "deltas". In these expressions of δ_{ij} the export and the import shares could be interpreted as an indicator of the "utilization" of the possible maximum intensity.

<u>The "characteristic share"</u>

As $\delta_{ij}(t)$ is the actual, and $\delta_{ij}(t)^{max}$ is the maximum, possible value of the trade intensity, one is interested in their difference. It is also interesting to know whether this difference has some regular behaviour or features. Therefore the difference has been expressed in a share form:

$$\frac{\delta_{ij}}{\delta_{ij}^{max}}$$

As has been explained, if $\delta_{ij} = \delta_{ij}^{max}$, the trade relationship between the two regions is such that either all of the exports of region i are oriented to region j, or all the imports of region j are coming from region i; i.e., they are concentrated on a single region. Consequently the difference between δ_{ij} and δ_{ij}^{max} is an indicator of intensity under market differentiation.

The difference has been expressed in the following forms:

$$\frac{\delta_{ij}}{\delta_{ij}^{max}} = \begin{cases} \xrightarrow{1} = a_{ij} \\ \xrightarrow[2]{} = b_{ij} \end{cases}$$

This means that the export/import share can be considered as the <u>relative</u> intensity indicator of two regions' trade connexion depending on the relation between $x_{i.}$ and $x_{.j}$.

In the following the $\frac{\delta_{ij}}{\delta_{ij}^{max}}$ ratio will be called the <u>characteristic</u> share and denoted by H_{ij}. Using this notation the final form of δ_{ij} is:

$$\delta_{ij} = H_{ij}\,\delta_{ij}^{max}$$

where,

if $x_{i.} \leq x_{.j}$, $H_{ij} = a_{ij}$ and $\delta_{ij}^{max} = \frac{1}{z_{.j}}$; and

if $x_{i.} > x_{.j}$, $H_{ij} = b_{ij}$ and $\delta_{ij}^{max} = \frac{i}{z_{i.}}$.

It will be shown in the following that this characteristic share has a far more important and interesting role in the interpretation and understanding of international trade than could be foreseen at the time of its definition. It is found that there is a very clear difference between trade relationships which depend on their typical characteristic shares.

III. THE BEHAVIOUR OF THE DELTA COEFFICIENTS AND OF THE EXPLANATORY VARIABLES OVER TIME

Having the actual values of the trade flows in a given time period, the values of δ_{ij} for every t in this period can be computed.[1/] We use the time-function form of our variables:

$$\delta_{ij}(t) = H_{ij}(t)\,\delta_{ij}(t)^{max} = \begin{cases} \xrightarrow{1} a_{ij}(t) \cdot \dfrac{b_{ij}(t)}{z_{ij}(t)} \\ \xrightarrow{2} b_{ij}(t) \cdot \dfrac{a_{ij}(t)}{z_{ij}(t)} \quad \text{and so on.} \end{cases}$$

From the other studies mentioned as references, it is already known that the functions show a certain stability in the long run and in many cases they display clear time trends. But in this present case some of the $\delta_{ij}(t)$'s show a rather pronounced instability over time, and additional explanatory variables must be found.

One hundred (i=5, j=5, four commodities) $\delta_{ij}(t)$ functions were analyzed one by one, in detail, thus including computation and analysis of the following functions:

$$a_{ij}(t),\ b_{ij}(t),\ z_{ij}(t),\ x_{ij}(t),\ \bar{x}_{ij}(t),\ \delta_{ij}(t)^{max}.$$

Having analyzed in detail the time series of $a_{ij}(t)$, $b_{ij}(t)$ and $z_{ij}(t)$, it has been found that in most cases the $z_{ij}(t)$ fluctuated together with one of the other two explanatory variables, namely, with the non-characteristic one, and in the majority of cases the relationship between $z_{ij}(t)$ and the non-characteristic share was a constant one.

As has been already mentioned, the $H_{ij}(t)$'s proved to be of special interest. It was found that in the majority of cases, given regions have typical $H_{ij}(t)$'s and the type of characteristic share does not change in time. Thus the characteristic share was equal to $a_{ij}(t)$ [or $b_{ij}(t)$] during the whole period of observation. Except in a few cases, the characteristic share did not shift from one to the other type. It also was found that for a given region i there was also a typical $H_{ij}(t)$ in respect of its trade relations with region j (and this did not shift in time).

For instance, the characteristic share of Latin America (i) in its exports of agricultural products to all of the other developing regions (j) proved to have $H_{ij}(t) = b_{ij}(t)$ and its $\delta_{ij}(t)^{max} = \dfrac{a_{ij}(t)}{z_{ij}(t)} = \dfrac{1}{z_{i.}}$ in every year for every developing region. This means that the maximal intensity of Latin America's exports of agricultural products to the

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1/ The data used is discussed in section IV below.

developing areas was never dependent on the other region's import share in world agricultural trade, but only on Latin America's world export share. As $\delta_{ij}(t)^{max}$ is inversely related to $z_{i.}$, it follows that the higher the export share, the smaller is the maximum Latin American intensity with all of the others.

In more general terms: if in a given exporting region i it was found that for each point in time the $x_{i.} > x_{.j}$ relation was valid for every j (i.e. the type of $H_{ij}(t)$ never shifted, which means that in this case $H_{ij}(t) = b_{ij}(t)$ for every t for every j) then the consequence is that the $\delta_{ij}(t)^{max}$ functions are also of similar form. Namely, $\delta_{ij}(t)^{max} = \frac{a_{ij}(t)}{z_{ij}(t)} = \frac{1}{z_{i.}(t)}$ for each year. This also means that throughout the period they do not depend on j.

In other words in this case the exporting region's maximum intensity indicator function does not depend on the importing region.

It is even more important to note that in most cases the behaviour over time of the $\delta_{ij}(t)$ function was basically determined by the behaviour of the characteristic share. It can be seen that in many cases the $\delta_{ij}(t)^{max}$ function was found to be constant over time or nearly constant in a given time period. In those cases the $\delta_{ij}(t)$ function was a function of the characteristic share. But in some cases the $\delta_{ij}(t)$ was determined by the $\delta_{ij}(t)^{max}$, and then it was the characteristic share which proved to be quasi-constant.

<u>$\delta_{ij}(t)$ moving together with $H_{ij}(t)$</u>

Examination of the behaviour of the deltas and the explanatory variables shows that <u>the fluctuation in time of the intensity indicators in the majority of cases was linked to the time movement of the</u> $H_{ij}(t)$ and not to that of $\delta_{ij}(t)^{max}$. This means that while, by definition, the <u>value</u> of the deltas in a given i - j relation is determined by both factors, their movement in time followed that of the "characteristic share".

Therefore in these cases the suggested form of the estimated $\delta_{ij}(t)$ will be $f(H_{ij}(t))$. Also, in these cases, $z_{ij}(t)$ always moved together with the non-characteristic share, and in the majority of cases the ratio of $z_{ij}(t)$ and the non-characteristic share was quasi-constant in time. Therefore the suggested form of the estimated $\delta_{ij}(t)$ can be written as:

$$\delta_{ij}(t) = \text{constant} \cdot H_{ij}(t).$$

When $z_{ij}(t)$ was moving together with one of the shares mentioned, this is probably due to the fact that in the smaller share the larger flow of the $(x_{i.}, x_{.j})$ pair dominates, and the share of this flow in total world trade is practically constant.

When the bigger share (including the min $(x_{i.}, x_{.j})$ is decisive in the time fluctuation of the value of $\delta_{ij}(t)$, then $H_{ij}(t)$ can be seen as a "bottleneck", the relative change of which causes the modification of the value of $\delta_{ij}(t)$. Only if this is "loosened", or prrmits a greater opportunity for the intensification of a relationship, can the $\delta_{ij}(t)$ value increase relative to its former value(s); or vice versa.

The two forms of $H_{ij}(t)$ can be analyzed as follows:

if $H_{ij}(t) = a_{ij}(t) = \frac{x_{ij}(t)}{x_{i.}(t)}$ holds for a $\delta_{ij}(t)$ which is increasing togethr with this increasing $H_{ij}(t)$, this means that the export trade between the two regions gained in intensity on behalf of the <u>importers</u>. That is, $x_{ij}(t)$ increased more rapidly than the total exports of region i, or else its exports to region j decreased less than its total exports.

For an example, consider Latin America's manufactures exports. The intensity indicator moved for all markets with $H_{ij}(t) = a_{ij}(t)$. So, Latin America could increase its trade intensity in manufactures with a trade partner only if the latter had appreciably opened up its import market.

If $H_{ij}(t) = a_{ij}(t)$ increases the importance of this export flow from region i to region j in the total export activity of region i, then it becomes even greater. Therefore, if $H_{ij}(t) = a_{ij}(t)$ the $\delta_{ij}(t)$ can grow only if region i is permitted by the importer to do so. Therefore it is on <u>behalf of the importer</u> that $\delta_{ij}(t)$ increases and we take this as the <u>import pull</u> case

It should be underlined that the change in a $\delta_{ij}(t)$ moving together with $a_{ij}(t)$ means also that the export trade intensity between the i and j region depends very little on the role played by region j or region i in world trade.

The second case, where $H_{ij}(t) = b_{ij}(t) = \frac{x_{ij}}{x_{.j}}$ holds for a $\delta_{ij}(t)$ increasing together with a $H_{ij}(t)$ increasing, means that the export trade between the two regions gained in intensity on <u>behalf of the exporter</u>, and this change does not depend on changes undergone by the exporting and importing regions on the world market.

In this case, the importance of x_{ij} flow in the total import activity of region j is greaterthan it is for the region i in its total export activity; which means, that region j is more linked to region i than region i is to region j by its exports.

Therefore if $H_{ij}(t) = b_{ij}(t)$, the $\delta_{ij}(t)$, the trade intensity of the i - j regions can grow only if region j gets relatively more imports from region i, so region i increases its role in market j. In this case the intensity indicator is changing on <u>behalf of the exporter</u> and therefore we take it as the <u>export push</u> case.

We can again take our previous example of Latin America. It was observed that, except for its trade in manufactures, this region's intensity indicators generally moved together with $H_{ij}(t) = b_{ij}(t)$. An increasing trade intensity of its exports could occur only if its exports to the other regions increased more rapidly than the total imports of the other regions did.

It is important to reiterate that when a $\delta_{ij}(t)$ fluctuation is determined by a $H_{ij}(t)$, the intensity of a bilateral trade relation is not dependent (basically) on what role region i or j (depending whether it is $H_{ij}(t) = a_{ij}(t)$ or $H_{ij}(t) = b_{ij}(t)$) has played in world trade.

This means that a certain bilateral trade relation can gain or lose intensity in spite of a change in the importance of one of the regions in world trade.

$\delta_{ij}(t)$ and $\delta_{ij}(t)^{max}$ moving together

In certain cases it has been found that it was only the $\delta_{ij}(t)^{max}$ which played the decisive role in the fluctuation of the $\delta_{ij}(t)$. In these cases the suggested form of the estimated $\delta_{ij}(t)$ will be: $f(\delta_{ij}(t)^{max})$. It will be recalled that $\delta_{ij}(t)^{max}$ = $\frac{a_{ij}(t)}{z_{ij}(t)}$ or $\frac{b_{ij}(t)}{z_{ij}(t)}$.

That is, $$\delta_{ij}(t)^{max} = \frac{x_{..}(t)}{x_{i.}(t)} \text{ or } \frac{x_{..}(t)}{x_{.j}(t)} .$$

For example, with constant total world trade flow, if $\delta_{ij}(t) = c \cdot \delta_{ij}(t)^{max}$, for an increase of $\delta_{ij}(t)$, the $\delta_{ij}(t)^{max}$ has to increase. But this condition means that for an increase of intensity indicator the denominator ($x_{i.}$ or $x_{.j}$) has to decrease.

As opposed to what has been said about the case when the fluctuation of a $\delta_{ij}(t)$ was due to the evolution in $H_{ij}(t)$, here it is the modification of the exporter's role in the world trade which enters into the picture.

It should be stated once more that

$$\delta_{ij}(t)^{max} = \begin{cases} \xrightarrow{1} \frac{1}{z_{.j}(t)} = \frac{x_{ij}(t)}{x_{.j}(t)} : \frac{x_{ij}(t)}{x_{..}(t)} = \frac{a_{ij}(t)}{z_{ij}(t)} \\ \xrightarrow{2} \frac{1}{z_{i.}(t)} = \frac{x_{ij}(t)}{x_{i.}(t)} : \frac{x_{ij}(t)}{x_{..}(t)} = \frac{b_{ij}(t)}{z_{ij}(t)} \end{cases}$$

A $\delta_{ij}(t)$ fluctuation determined by a $\delta_{ij}(t)^{max}$ fluctuation therefore means that it is the change in the role of region i (its export share) in total world trade or respectively the role of region j (its import share) in world trade which influences the intensity of their bilateral trade.

Therefore in the case of a growing $x_{..}(t)$, which is the normal case, the simplest condition for a $\delta_{ij}(t)^{max}$ increasing is that the export flow and the share of it (or the import flow and the share of it) in the total exports of region i (or in the total imports of region j) be invariant. This means an unchanged importance of this trade relationship on the exporter's market (or on the importer's market).

If not only the world trade but also the bilateral export flow $x_{ij}(t)$ is growing in time, the $\delta_{ij}(t)^{max}$ can increase under the following two conditions.

If $\delta_{ij}(t)^{max} = \frac{a_{ij}(t)}{z_{ij}(t)}$, then:

1. The share of this flow $x_{ij}(t)$ in total world trade has to decrease while the share of the same in the region's total export does not change. This involves the total exports of region i growing by the same rate as its exports to region j, and means an unchanged market diversification.

2. The share of the $x_{ij}(t)$ in the region's total export is increasing by a higher rate than the world importance of this flow. In this case it is required that for the region i this export flow becomes more important and more strongly oriented in the given j direction.

Thus these two combined processes, i.e. growth in both $x_{ij}(t)$ and $x_{..}(t)$, mean that $x_{i.}$ is also growing. But for a growing $\delta_{ij}(t)^{max}$, $x_{i.}(t)$ has to grow by a lower rate than $x_{..}(t)$. And this signifies that the total export position in world trade of region i is decreasing. So, market concentration and decreasing world importance go together.

If $\delta_{ij}(t)^{max} = \frac{b_{ij}(t)}{z_{ij}(t)}$, then:

the same holds symmetrically, but from the importer's viewpoint. The two cases cited present only the most realistic situations in world trade and neglect other possible combinations of cases.

IV. THE ESTIMATION OF THE $\delta_{ij}(t)$ FUNCTIONS AND THE RESULTS

All the qualitative relations that have been introduced in the preceding part were based on the analysis of long-term time series. As already mentioned, the following time series were computed: $a_{ij}(t)$, $b_{ij}(t)$, $z_{ij}(t)$, $x_{ij}(t)$, $x_{ij}(t)$, $\delta_{ij}(t)$, and $\delta_{ij}(t)^{max}$.

The data

The direct source is the data bank of UNCTAD and the data in Annex A of the "UNCTAD Handbook of International Trade and Development Statistics, 1979", United Nations, New York. The international trade data for the period 1960-1977 were corrected slightly and aggregated to five regions and three main groups of commodities. Finally the data of total world trade is given by summing up both classifications. The trade flows are all given in fob valuation at current prices in millions of United States dollars.

The data file contains three-dimensional blocks for 18 years with the exporting regions in the rows, the importing regions in the columns, and in the third dimension the commodity groups, making the size of the blocks 5x5x4 for each year. The data is based on the 2 digit SITC classification. The aggregation is given in Appendix 1.

The algebraic form of the estimators

Each $\delta_{ij}(t)$ function had to be examined and determined separately. In the majority of cases the following functions were accepted for the estimation of $\delta_{ij}(t)$:

$$\hat{\delta}_{ij}(t) = c_1 a_{ij}(t) + c_2 t + c_3 \text{ if the characteristic share was } a_{ij}(t)$$

$$\hat{\delta}_{ij}(t) = c_1 b_{ij}(t) + c_2 t + c_3 \text{ if the characteristic share was } b_{ij}(t)$$

$$\hat{\delta}_{ij}(t) = c_1 \; \delta_{ij}(t)^{max} + c_2 t + c_3 \text{ in certain cases.}$$

The analysis as a whole proved that it is indispensable to distinguish between two subperiods, the first being that up to and including 1972. The reason is the obvious one of the effects of changes in the oil price.

Linear functions served well when the characteristic ex-post value of the $\delta_{ij}(t)$ was small ($\delta_{ij}(t) < 0.1$). For $\delta_{ij}(t) > 1$, the fitted linear functions also had a constant term. In these cases a logistic curve would be desirable, but these logistic curves on the observed intervals of $a_{ij}(t)$ or $b_{ij}(t)$ could be said to be acceptably approximated by linear functions.

Some major observations are as follows:

(a) Analysing the fluctuation of $\delta_{ij}(t)$ in time, it was observed that in the large majority of cases (about 65 per cent) it was the H variable (the characteristic share) which had the dominant influence.

(b) The δ_{ij}^{max} determined the modifications of the $\delta_{ij}(t)$'s directly in 14 per cent of the relationships observed. Thus the regression of $\delta_{ij}(t)$ was made on δ_{ij}^{max} in these cases. δ_{ij}^{max} was applied as a second explanatory variable in one of these cases where it was necessary to use two functions. δ_{ij}^{max} had also to be taken into account when the δ_{ij}'s show some stability but also certain movements within a very narrow interval.

(c) The time trend was found to be explanatory in 5 cases.

(d) The remainder are either constant (16 cases) or show no regularity (2 cases).

Returning to (a), among the 65 cases there are some instances where the explanatory variable used was not the H variable but the other share. These instances represent either repeated changes or a stable shift in the type of the characteristic share during the period of observation. Repeated changes in the characteristic share were present when the bilateral trade relationship was very small.

Stable changes took place in the case of the total trade relationships of the Middle East (i.e. those with Latin America and Asia). The explanation for this is that after the oil crisis, the stable H = type a, changed to H = type b. This reflected the dominance of mining (which has H = b) in the total trade of the region. The latest H is the most appropriate explanatory variable in the estimation function.

A list of the 100 estimation functions has been presented in Appendix 2.

V. ANALYSIS OF THE RESULTS OF THE COMPUTATIONS

Cases where fluctuations of $\delta_{ij}(t)$ are linked with $\delta_{ij}(t)^{max}$

In a great majority of cases, it was the b_{ij} ratio which was the characteristic one. This is to say that world trade, in its bilateral relations, appears to operate under export push relationships (see Table 1).

This picture sustained our starting hypothesis and the view of some experts in international trade, for example B. Balasse and A. Nagy,[1/] that the development of the structure of international trade has to be approached from the export activity side. That is the export side is the more active one and it is imports which play the role of a limiting factor in making trade-relationships more intensive. This conclusion holds both in the regional and product group cross-section.

The world exhibits a certain duality: the single region where, practically without exception, the $b_{ij}(t)$ share characterizes its relationship with the rest of the world is the industrially developed countries (IDDCs). For the rest it is the $a_{ij}(t)$ share. This result agrees with the general view that IDDCs have an export-oriented effect on the rest of the world. As far as the trade relationship of the developing regions with IDDCs is concerned, in their exports to the IDDCs they almost always have $H_{ij}(t) = a_{ij}(t)$ type relationships. This expresses the fact that the intensity of their bilateral relationships has been determined by the importer's market.

It also should be mentioned that when these exporters concentrate on IDDC markets, the $\delta_{ij}(t)$ intensity indicator is always close to its optimal value of 1. This also proves the structural stability of these relationships and the close linkage of the rest of the world to IDDC markets.

The developing regions are very often characterized by a dominance of th $_{ij}$ relation. The trade intensity of Latin America with other developing regions was represented by an overall $H_{ij}(t) = b_{ij}(t)$ relation with the exception of manufactures. The region increased its intensity indicator in a total of five cases. Three of these cases are due to an increasing $b_{ij}(t)$. All three occured in the exports of agricultural products, meaning that on the three importing markets it was the role of Latin America which increased; namely on the interregional market (selfreliance increased), on Middle Eastern and African markets.

A decrease of $\delta_{ij}(t)$ caused a decrease in the trade intensity indicator in mining on three markets, including the interregional. This points to market differentiation of Latin American oil exporters, orienting themselves less to other Latin American countries.

TABLE 1

Exporting Region	Product Group	Characteristic Shares	Exceptions of Importing Regions concerning the Characteristic Share
LA (Latin America)	AGRI	b	IDDC
	MINING	b	IDDC
	MANUF	a	-
	TW	b	IDDC, AS, LA (it switches to a)
AF (Africa)	AGRI	b	IDDC,AS
	MINING	b	IDDC
	MANUF	a	-
	TW	a	AF (several switches), MEA MEA (it switches to a in 1976)
MEA (Middle East)	AGRI	a	-
	MINING	b	IDDC
	MANUF	a	-
	TW	several switches	IDDC (a), MEA (b)
AS (Asia)	AGRI	b	ODDC
	MINING	a	AF, MEA
	MANUF	a	AF (it switches to b), MEA (it switches to a in 1976)
	TW	a	LA (several switches), LA, MEA
IDDC (Industrialised Countries)	AGRI	b	IDDC
	MINING	b	IDDC
	MANUF	b	-
	TW	b	-

The same special duality is present when looking at the analysis according to product groups.

TABLE 2

Product Groups	Characteristic shares	Exceptions to the relations concerning the characteristic share
AGRI	b	all MEA exports all IDDC imports
MINING	b	all IDDC imports AS → LA, AS → AS
MANUF	a	all IDDC exports

Here again an exception is found, this time with respect to manufactured goods. In general H=a holds, with the exception of the manufactures' trade of the IDDCs, where their exports relations with the rest of the world are determined by H=b. There are very few exceptions, namely in AS → MEA before 1973 and AS → AF after 1973 where there were switches between the characteristic shares.

Even in the case of Latin America, which is the most industrialized developing region, the same is true. Their trade intensity was almost invariant and very close to 1 in the exports of all products when the partner was the IDDC. This always occured under the $H_{ij}(t) = a_{ij}(t)$ condition, which also shows stability in time. This means that the share of the export flows oriented to developed countries in the total Latin American export flow was almost stable and very much concentrated on these markets.

A rather interesting aspect of the relationships characterizing the trade of agricultural and mineral products was found in the fact that even here the H=b expression is valid in the majority of cases (namely among the developing regions). This means that trade intensity behaves on the basis of export push. Nevertheless, it should be stressed that the developed countries as a whole present an import-limit to this type of flow and their regulating role is quite clear.

The special situation and role of MEA is very clear. In all product groups, with the natural exception of mining, it has played a non-export pushing role. MEA is dependent on the world.

In the case of trade intensity of AS with the other regions (including the interregional flows) it was mainly H=a which determined relationships. Knowing the very export-oriented policy followed by AS, especially in manufactures, it is rather unexpected that even with other developing regions it was the import-pull type relation that characterized its trade.

Cases where fluctuations of $\delta_{ij}(t)$ are linked with $\delta_{ij}(t)^{max}$

a) First it should be stressed that it was revealed by the observations that only in cases of more or less marginal bilateral relationships, or when at least one of the two was very instable region in world trade, was $\delta_{ij}(t)^{max}$ found to be a good explanatory variable of the behaviour of "delta" intensity indicator. (Fourteen of the 100 observed bilateral relationships.)

Only in two cases was it the developed region which played the role of exporter and three times that of importer, but it always was related to a very underdeveloped region: Africa (3 times) and Middle-East and South Asia (once). In 5 cases it was a question of interregional trade between two underdeveloped regions.

b) As it has been said, $\delta_{ij}(t)^{max}$, like H_{ij}, has two different interpretations depending on the flow variable included in it (either x_i or x_j). In the majority of the cases when $\delta_{ij}(t)$ fluctuated together with that of $\delta_{ij}(t)^{max}$, it was the $x_{i.}$, i.e. the total exports of the exporting region, which was included (in 8 cases out of the 14). That means that the modification of the $\delta_{ij}(t)^{max}$ was due to the exporter who made changes in his market orientation to modify the $\delta_{ij}(t)$s.

This situation can be explained by the observed fact that in the interregional trade cases the importer generally was very much dependent on the given exporter in the total imports of the given commodity group. Therefore the import ratio was high and non-variant (or very rigid).

This holds also when it comes to the interregional trade cases, where the share of interregional imports is more or less constant around a relatively significant value (35 - 40 per cent). This was very characteristic when the exporter (region i) was an IDDC and the importer was an underdeveloped region. (See the first two examples below.) Similarly, when the export of an underdeveloped region which concentrated on a developed market the import share was included in $\delta_{ij}(t)^{max}$, and the exporter's ratio ($a_{ij}(t)$) was invariant because it was very high. Again, the stronger partner, by the modification of their relative import activity from the i region, influenced the intensity of this bilateral relationship. (See the next three examples.)

The same concentration was found on certain very marginal intraregional markets. (See the last three examples.)

TABLE 3

Exporter Region (i)	Importer Region (j)	Product Group	Characteristic Share	Share of the Region in Total World Exports (z_i)	Share of the Export Flow (x_{ij}) in the Total	
					Imports of the importer ($x_{.j}$) %	Exports of the Exporter ($x_{i.}$) %
IDDC	AF	Agriculture	b_{ij} t	2.5 - 3.0	70 - 75	4 - 5
AF	IDDC	Manufacturing	a_{ij} t	0.4 - 0.2	40 - 60	1.6 - 4
AF	IDDC	Total	a_{ij} t	3.0 - 3.5	80	0.6 - 0.3
AS	IDDC	Total	a_{ij} t	5.5 - 7.0	85 - 90	4.6 - 9
MEA	AF	Mining	b_{ij} t	0.2 - 0.6	65 - 70	4.5 - 6
MEA	MEA	Mining	b_{ij} t	0.65 - 1.09	40 - 35	7 - 10
MEA	MEA	Manufacturing	a_{ij} t	0.05 - 0.26	18 - 48	2 - 4
AF	AF	Manufacturing	a_{ij} t	0.21 - 0.06	15 - 33	1 - 3

In the first case the IDDC's exports in the total imports of agricultural products in Africa was 70-75 per cent, although the importance of this trade flow was only marginal in the total exports of the exporter: the IDDC's exported only 4-5 per cent of their total agricultural exports to Africa. As opposed to this, African total exports or manufacutres exports were oriented, during the observed 23 years period, almost exclusively to the developed region, although almost negligible in relation to the total imports of that region.

Because of this very assymetrical relationship between the two regions, it depends on the stronger partner's trade activity how important this bilateral relationship is in total world trade.

Findings related to price explosion

On the basis of the analysis of the behaviour of the $\delta_{ij}(t)$'s and their explanation, one can draw the conclusion that in the MEA region, and partly also in the AS region, the effect of the price-oil-crisis of the early seventies was not offset. There was an obvious perturbation entering into other long run processes also, but in many cases the tendencies stabilized and the oscillations were reduced.

Destabilization of the processes was shown by the frequent switches of the characteristic shares determined by the limiting flows in MEA and AS regions. The same phenomenon was shown by the fact that it is in these two cases that the deltas frequently follow the $\delta_{ij}(t)^{max}$, and there were even changes brought about from $H_{ij}(t)$ to $\delta_{ij}(t)^{max}$.

The price-explosion also influenced the formation of the so-called norm in the intensity indicator. The normal flows behaved in a fairly similar way on the strong, stable markets and then showed a marked change as a result of the price explosion. On the unstable markets the oscillation in the $\delta_{ij}(t)$ values was also linked to an oscillation of the normal flows.

Some concluding remarks on the prominent role of $H_{ij}(t)$ in the explanation of the changes in $\delta_{ij}(t)$

It should be stressed in advance that the level of trade intensity between given regions is always determined by all the factors included in the definition of $\delta_{ij}(t)$. In studying the role of $H_{ij}(t)$ it is taken in the majority of cases as a factor prominent not in the determination of the value of $\delta_{ij}(t)$, but in its fluctuation in time.

As already mentioned, the reason for searching for the best explanation of fluctuations of $\delta_{ij}(t)$ was to help scenario building with the LIDO model. By using $\delta_{ij}(t)$ structures we can introduce trade-policy scenarios in the model in an explicit way. Since $H_{ij}(t)$ turned out to be the prominent explanatory variable, we have a starting point to show how the export $\delta_{ij}(t)$ structure could be modified.

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APPENDIX 1

Abbreviations REGIONS	TITLE	UNCTAD Handbook 1979 Column No. of A-1 Table
LA	Latin America	19
IDDC	USSR + Eastern Europe + Developed Market Economies	9+(8-9)+11+14+15 +16+17+18
AF	Africa	21
MEA	Western Asia	22
AS	Socialist Asia + Total Developing Countries	10+23+24

Abbreviations COMMODITY GROUPS	TITLE	SITC-number
AGRI	Food + Agricultural Materials	0+1+22+4+(2-22-27-28)
MING	Raw Materials + Minerals + Metals + Fuels	27+28+67+68+3
MANUF	Total Manufacture	5+6-67-68+7+8+9
TW	Total World Trade	0+1+2+3+4+67+68+5+6-67-68 +7+8+9

APPENDIX II

AGRICULTURE

Origin \ Destination	LA	IDDC	AF	MEA	AS
LA	H=b $\delta = c_1b+c_2t+c_3$	H=a δ=constant	H=b $\delta = c_1b+c_2t+c_3$	H=b $\delta = c_1b-c_2$	H=b $\delta = c_1b+c_2t$
IDDC	H=b $\delta = c_1b-c_2t+c_3$	H=a $\delta = c_1a+c_2b+c_3$	H=b $\delta = c_1\ \delta_{max}$	H=b $\delta = c_1b-c_2t-c_3$	H=b $\delta = c_1b-c_2t+c_3$
AF	H=b $\delta = c_1b+c_2t-c_3$	H=a δ=constant	H=b $\delta = c_1b+c_2t-c_3$	H=b $\delta = c_1b+c_2t-c_3$	H=b $\delta = c_1a-c_2$
MEA	H=a $\delta = c_1a$	H=a $\delta = c_1a+c_2t+c_3$	H=a $\delta = c_1a+c_2t+c_3$	H=a till 1973 $\delta = c_1a-c_2t+c_3$	H=a $\delta = c_1a-c_2t+c_3$
AS	H=b $\delta = c_1b-c_2t+c_3$	H=a $\delta = c_1a-c_2t+c_3$	H=b $\delta = c_1b+c_2t-c_3$	H=b $\delta = c_1b+c_2t+c_3$	H=b $\delta = c_1\ \delta_{max}$.

APPENDIX II

MINING

Origin. \ Destination	LA	IDDC	AF	MEA	AS
LA	H=b till 1967 $\delta = c_1 \delta_{max}$ after 1967 $\delta = c_1 b + c_2 t - c_3$	H=a δ=constant	H=b $\delta = c_1 b + c_2 t - c_3$	H=b $\delta = c_1 b - c_2 t - c_3$	H=b $\delta = c_1 b + c_2 t + c_3$
IDDC	H=b till 1973 $\delta = c_1 b + c_2 tc + _3$	H=a δ=constant	H=b till 1973 $\delta = c_1 b + c_2 t + c_3$	H=b $\delta = c\delta_{max}$	H=b till 1973 $\delta = c_1 b + c_2$
AF	H= a→b $\delta = c_1 b - c_2 t + c_3$	H=a δ=constant	H=b $\delta = c_1 b - c_2 t + c_3$	H=b $\delta = c_1 b - c_2 t + c_3$	H=a→b $\delta = c_1 a - c_2 t + c_3$
MEA	H=b $\delta = c_1 b + c_2$	H=a. δ=constant	H=b $\delta = c_1 \delta_{max}$	H=b $\delta = c_1 \delta_{max}$	H=b till 1973 $\delta = c_1 b + c_2 t + c_3$
AS	H=a $\delta = c_1 a + c_2 t + c_3$	H=a till 1973 $\delta = c_1 a$	H=b till 1973 $\delta = c_1 a + c_2 t - c_3$	H=b till 1973 $\delta = c_1 b - c_2 t + c_3$	H=a $\delta = c_1 a + c_2 t - c_3$

APPENDIX II

MANUFACTURES

Origin. \ Destination	LA	IDDC	AF	MEA	AS
LA	H=a $\delta = c_1 a_1 + c_2 t - c_3$	H=a $\delta = c_1 a_1 - c_2 t - c_3$	H=a $\delta = c_1 a_1 + c_2 t - c_3$	H=a $\delta = c_1 b - c_2 t + c_3$	H=a $\delta = c_1 a + c_2 t - c_3$
LDDC	H=b δ=constant	H=b δ=constant	H=b δ=constant	H=b δ=constant	H=b δ=constant
AF	H=a $\delta = c_1 a_1 + c_2 t - c_3$	H=a $\delta = c_1 \cdot \delta_{max}$	H=a $\delta = c_1 \ \delta_{max}$	H=a $\delta = c_1 b + c_2 t - c_3$	H=a $\delta = c_1 b + c_2 t - c_3$
MEA	H=a $\delta = c_1 a + c_2 t - c_3$	H=a δ(t)trend	H=a $\delta = c_1 a + c_2 t - c_3$	H=a after 1973 $\delta = c_1 \ \delta_{max}$	H=a $\delta = c_1 a + c_2 t - c_3$
AS	H=a $\delta = c_1 a + c_2 t - c_3$	H=a $\delta = c_1 a + c_2 t + c_3$	H=a→b till 1970 $\delta = c_1 a + c_2 b + c_3$ after 1970	H=b→a after 1974 $\delta = c_1 a$	H=a δ(t)trend

APPENDIX II

TOTAL TRADE

Origin. \ Destination	LA	IDDC	AF	MEA	AS
LA	H=a $\delta(t)$trend	H=a $\delta(t)$trend	H=b $\delta=c_1b+c_2t-c_3$	H=b $\delta=c_1b+c_2t-c_3$	H=a $\delta=c_1a+c_2t-c_3$
IDDC	H=b $\delta=c_1b-c_2t+c_3$	H=b $\delta=$constant	H=b after 1973 δ = constant	H=b δ = constant	H=b till 1973 δ=constant after 1973
AF	H=a till 1973 $\delta=c_1b+c_2t+c_3$	H=a $\delta= c_1\delta_{max}$	H= b→a $\delta= c_1b+c_2t+c_3$	H=b→a $\delta=c_1b-c_2t+c_3$	H=a $\delta=c_1b+c_2t-c_3$
MEA	H= a → b $\delta=c_1a+c_2t-c_3$	H=a δ=constant	H= a → b $\delta= c_1\delta_{max}$	H=b $\delta= c_1\delta_{max}$	H=a→b $\delta=c_1a+c_2t-c_3$
AS	H= a→b δ=constant	H=a $\delta=c_1\delta_{max}$	H=b $\delta= c_1\delta_{max}$	H=b $\delta= c_1\delta_{max}$	H=a $\delta=c_1a+c_2t-c_3$