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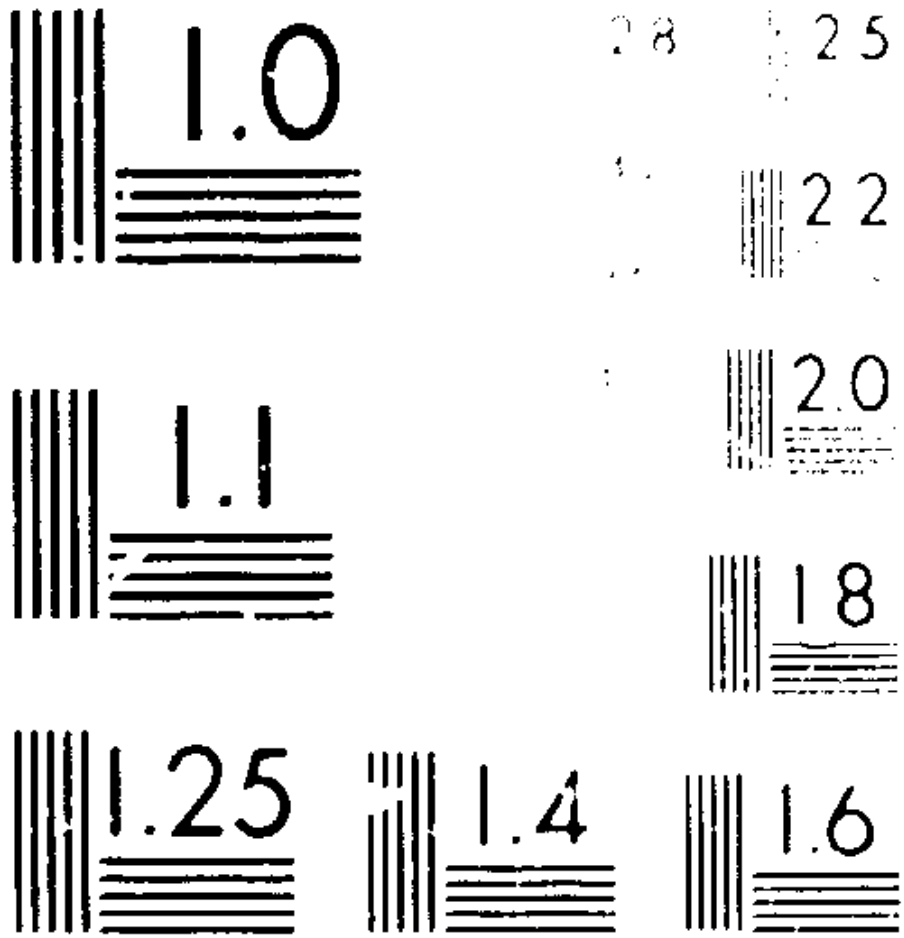
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Joint UNIDO-UNCTAD Project on the
interrelationships between growth
patterns, trade configurations and
industrial structure (UNITAD)

THE ANALYSIS AND LONG-TERM PROJECTION OF INTERINDUSTRY STRUCTURES

TECHNOLOGY CHARACTERISTICS OF REGIONAL MODELS IN THE UNITAD PROJECT *

UNITAD Paper prepared for submission to the
ACC Technical Working Group Meeting
of the Task Force on Long-Term Development Objectives
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Paragraphs

1. This paper summarizes the preliminary results of research activities carried out so far in UNIDO in close cooperation with the Geneva central team of the UNITAD Project. From the inception of the project, it was understood that the basic structure of the UNITAD model would consist of a "system" of eleven regional input-output models interacting with each other - through a world-wide trade structure embodied in a series of trade matrices. While the Geneva team was busy constructing the trade part of the model, the UNIDO team was concentrating on the compilation of input-output tables for these eleven world regions, and on the analysis of structural characteristics of these regional economies for the purpose of projecting the future patterns of industrial development.

2. The UNIDO team undertook this assignment on the strength of its own extensive collection of national input-output tables. The assignment however, turned out to be extremely tedious; furthermore a frustrating aspect of the exercise was a consistent failure of accepted and established economic theories to hold true under the scrutiny of detailed empirical analysis. This explains the empirical approach advocated in this work. It is hoped, though, that efforts expended upon the input-output analysis at such an unprecedented scale and intensity, will prove to be valuable in the final phase of the UNITAD Project.

3. This progress report refers to three analytical papers:

(a) Construction of Base-Year matrices for the regions of the UNITAD Project.

(b) Trend Projections of input coefficients for the UNITAD regional tables.

(c) The Main Component Analysis of matrices of input coefficients as a major step in the projection of UNITAD regional tables.

The Construction of Base-Year Matrices

4. In the first paper, we present the base year(s) (1970, 1975) regional input-output tables, for North America, Western Europe, Centrally Planned Economies of Europe (completion date August, 1980), Japan, Other Developed Countries, Latin America, Tropical Africa, North Africa and West Asia, Indian Sub-continent (Asia I), ASEAN and East Asian countries (Asia 2) 1/.

5. These regional input-output tables were constructed from individual countries tables (where available) and macro-economic data (for all countries). In order to take into account heterogenous areas within regions, each of the 11 UNITAD regions was divided into several sub-regions for which separate sub-regional input-output tables were constructed before being aggregated into the final regional tables.

6. Significant time was spent on the collection of original national input-output tables. The major task involved was, however, to aggregate these tables into the size of 8 by 8 sectors. Since accounting practices differed from country to country, some of the official tables had to be made consistent. From the store of more than 100 national input-output tables, eventually 48 national input-output tables were used for this purpose. Another problem was to obtain sufficient information to distribute the different final demand components among the sectors. For those countries which had no input-output tables, estimates on these final demand vectors were made on the basis of available national account data.

7. The regional input coefficient matrix and the final demand matrix were independently estimated and made consistent by the RAS method. The

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1/ There still remains the table for other Asia (Centrally Planned Asia) which is left for the future.

evaluation of results was made in terms of deviations of coefficients before and after RAS[1/] and by using the principal component analysis (see paper 3). Modifications were made by changing value added coefficients and final demand flows. Altogether more than ten preliminary variants were calculated for each region.

The Trend Projections of Input Coefficients

8. The second paper describes the result of an attempt to project input coefficients through statistical analysis.

Input coefficients differ between countries. Several economic hypothesis were tested using a sample of 30 countries for cross-country analysis, in an effort to discern some consistent input-output coefficient behaviour. The parameters used were:

a) The level of economic development, measured by per capita gross domestic product.

b) The size of country measured by the size of population.

c) Population density, measured by number of inhabitants per square kilometer.

d) Output-mix, measured by shares of industries (at the 24 sector level) in the sectoral output of each base sector (in the UNITAD 8 sector classification).

9. The four economic variables outlined above were tested with the help of multiple linear regression analysis and were confirmed to various degrees. Regression equations, with an R^2 as low as (or higher than) 30% were only found for 11 out of 72 coefficients. The most significant explanatory variable was GDP per capita which appeared in the equations 25 times, while the size of the country appeared 12 times and population density appeared in 19 equations.

1/ The software developed for the purpose includes:
1. The programme for the construction of the base year tables (based on multiple data sources),
2. A programme for the RAS method and-
3. A programme for evaluating the tables before and after RAS.

10. Due to the highly aggregated sectoral classification scheme used, the influence of output-mix within each sector was significant. The analysis was carried out, therefore, with two sets of standardized input-output tables, one at the 24-sector and the other at the 8-sector level classifications. Some impact of output-mix was found in 40 (out of 64 possibilities) input coefficients. In general, however, the explanatory power of a large majority of equations was very poor. The values of R^2 were in most cases between 20% and 30%. An attempt to improve the results[1/] by expanding the sample size to 34 countries tables and by the use of simple log-linear regression equations did not succeed.

11. It is a firm conclusion of this analysis that projections of regional input-output coefficients should not rely solely on regression analysis with cross-sectional data. The current report, actually, concentrates on our latest experiment which mixes up regression work with the principal component analysis (reported elsewhere). The report also contains projections of input coefficients under alternative growth assumptions of different regions.

The Main Component Analysis

12. The third paper stems from the frustration generated by the results of regression analysis. If GDP per capita, size of the country and density of population etc are not good explanatory variables, what other parameters could be used to improve the results? The Geneva team proposed a graphical display of data to identify some consistent pattern before any further statistical analysis of regression type would be carried out. For this purpose they conducted a main component analysis which involved the

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1/ The results were reported in Analysis of Coefficients from Input-Output Tables (UNIDO/ICIS. 122), and presented to the Expert Group Meeting on the Analysis and Projection of Technological Characteristics in the UNITAD System of Models, held in Vienna from 22 to 24 October, 1979.

construction of the correlation matrix between input coefficients derived sector by sector from 42 national input-output tables standardized at the 8-sector level. As a next step, eight eigen vectors/eigen values of this matrix were computed. The interesting result was that some 80 to 95% of the variance of the input coefficients for the 42 countries was spread on two, sometimes three eigen vectors out of eight. The coordinates of the sectoral input vectors on these two or three axes were used to display countries in a new coordinate system.[1/]

13. The first visual inspection of the graphs thus obtained, confirmed the pre-investigation suspicion that the input coefficients are influenced by other factors than the economic variables used in the repression analysis. Specifically, in each diagram, one could detect clusterings of countries which have geographical and cultural affinities, as well as economic similarities. In the best cases, the analysis was able to interpret the diagram in terms of output mix. In other cases, "statistical artefacts" (such as an inflation of services coefficient) was brought up by the main component analysis.

14. In interpreting these diagrams, efforts were directed to identifying the output composition of each sector as well as other possible differences in the input compositions, country by country. Needless to say, only a very detailed analysis of local production processes with specific knowledge of the country's economic situation could produce any meaningful result. Given the time constraint, therefore, the report contains only some preliminary findings of this.

15. The main conclusion, though, remains, i.e. that the main component analysis brings out a host of valuable information for projection purposes.

1/ The positions of countries can be graphically displayed using up to three pairs of those eigen vectors to become axis of the two dimensional graph.

This includes:

a) Sectors for which a strong "regional" component exists.

b) Sectors in which the output mix is a major factor.

c) Sectors in which the tax system introduces the main "noise" in comparing the coefficients -

d) Sectors in which statistical artefacts introduce a serious bias.

16. This leads directly to our second conclusion. As long as the proposed model system retains a no larger than eight sector classification scheme, a major part of input coefficient variances should be explained in terms of "output mix". A far reaching implication for the sectors concerned is that their input vector can be considered as a weighted average of "pure technology" coefficients, irrespective of the level of industrialisation of the country concerned. This goes a long way in explaining the failure of preceding attempts in terms of relations to macro-economic variables. In the best cases, the output mix can be related to the international division of labour so that the relevant vectors of input coefficients (e.g. the light industry vector) become policy parameters in the system.

17. Some concluding remarks should perhaps be made. A correct projection of the "A" matrix of input coefficients is an absolute prerequisite in a long term simulation model since the output mix, in the classical Leontief equation, is depending on the inverted matrix $(I-A)^{-1}$. In this connection, the Main Component Analysis is not a panacea but it provides a good "compass" to show the road. Two aspects are worth further considerations:

a) If a variety of coefficients are found in different countries for the same sector, depending on regional similarities or output mix, any "deterministic" method to project the "A" Matrix should be prohibited. The future industrial structure of developing countries should be made a function of policy decisions taken by national decision makers (enterprises and government) and also largely of the factors governing the international

division of labour[1/]. One practical conclusion is that more information is required to project the "A" matrix: in addition to a compass, a map is required. One solution is to use scenario writing to picture possible "maps" another is to get factual information directly from decision centres in particular medium term plans from enterprises and government.

b) The level of aggregation has a strong influence on the whole issue. In some of the sectors at the 8-sector level, regional averages are close to each other (energy is a good example since one of the sub-sectors, "utilities" has a dominant influence in many countries). The extent to which the output mix influences the coefficients is also dependant on the level of aggregation. Further work is therefore needed to investigate how technical coefficients can be projected at various aggregation levels. The next step in this direction, in UNIDO, is already initiated, i.e. an attempt at analyzing the dispersion of input coefficients in 53 countries, with a level of aggregation of 43 industries.

1/ See on this point the UNITAD paper on the "interplay between trade and development".