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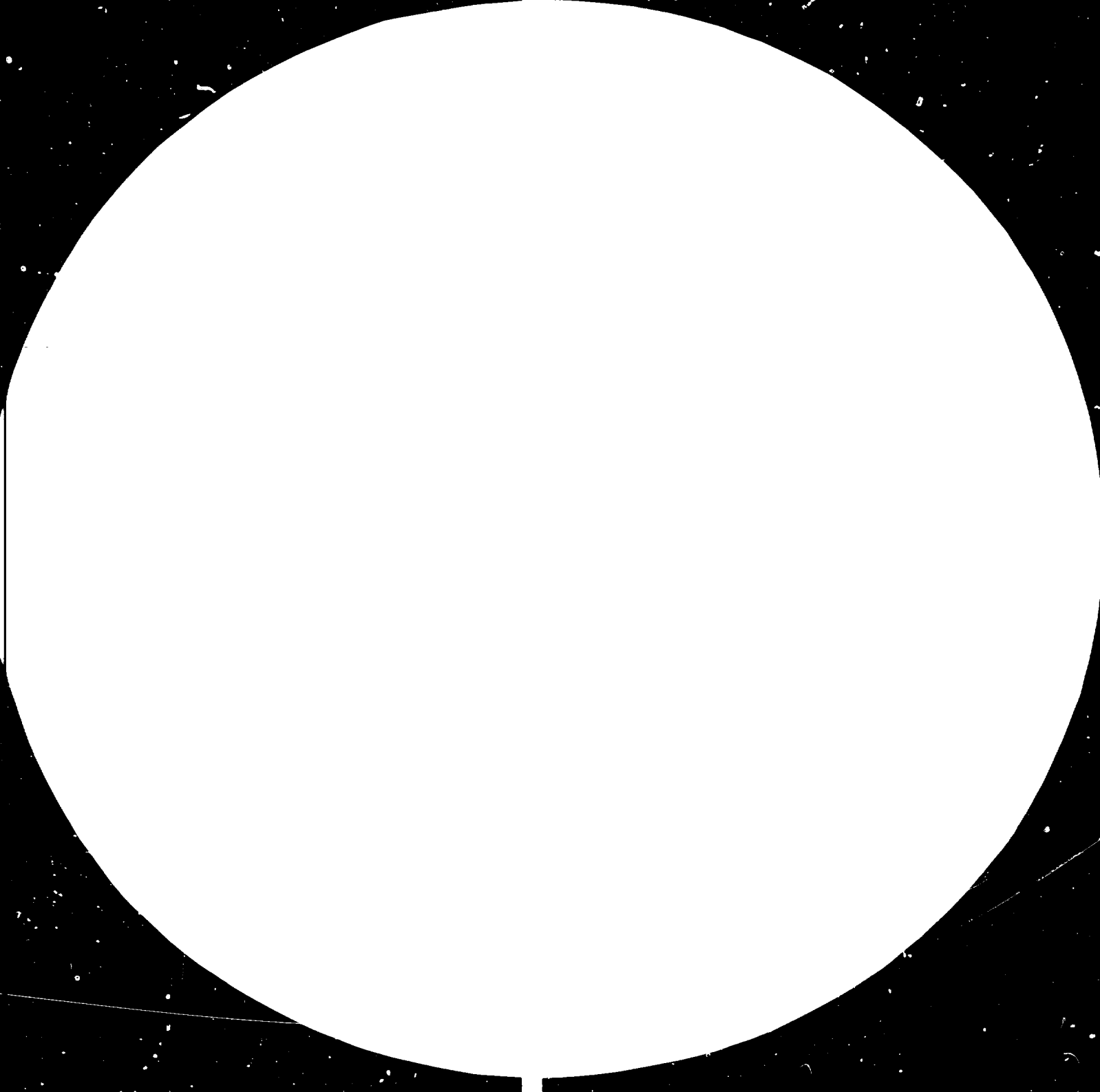

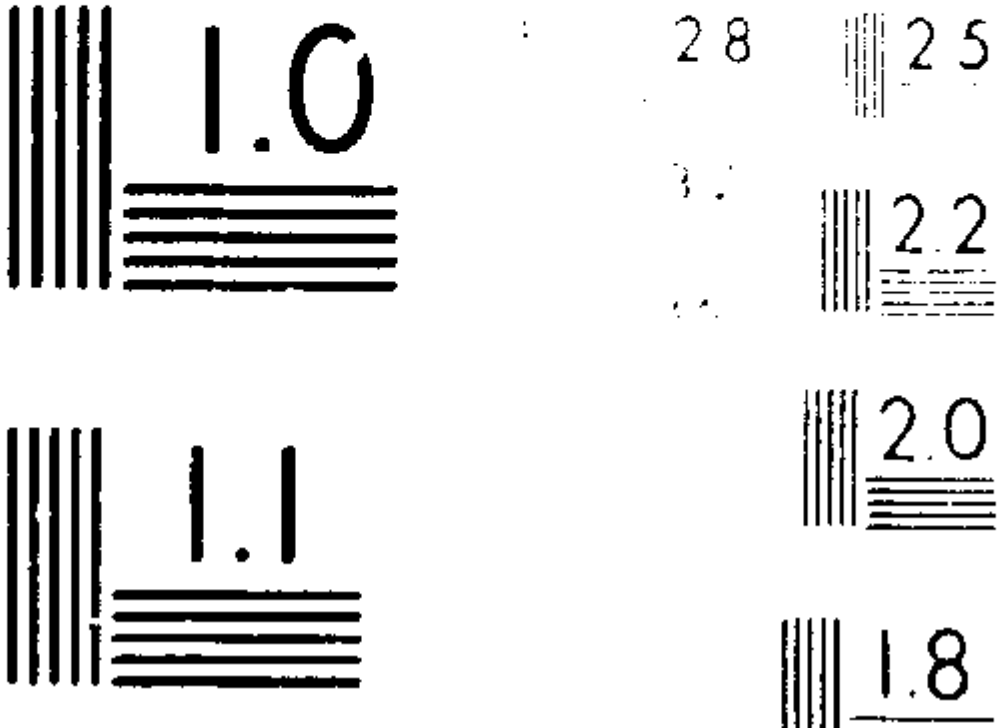
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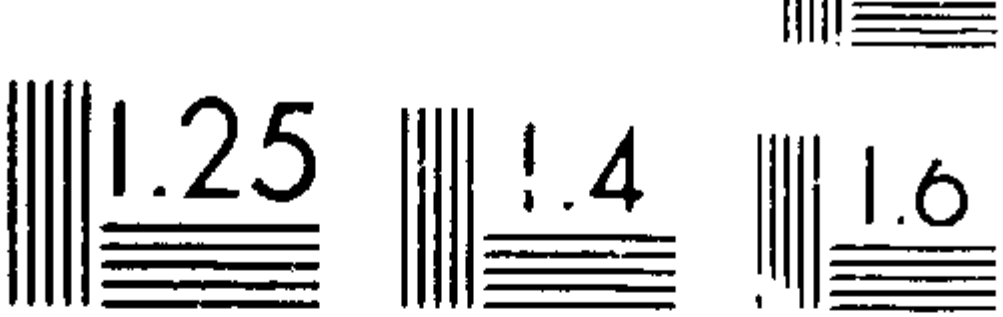
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UNITED NATIONS INDUSTRIAL
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Joint UNIDO-UNCTAD Project on the Interrelationships between growth patterns, trade configuration and industrial structure (UNITAD)

1980 Report

On

The UNITAD System *.

(prepared by the UNITAD team)

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CHAPTER 1

Introduction

I. Basic Purpose and Scope

1. The UNITAD Project is a joint UNCTAD-UNIDO Project financed by a group of donor countries (FUNDPAP) and supported by the modelling group of the ACC Task Force on Development Objectives. The Project was initiated in 1978 and is meant to be used as an analytical tool for exploring a number of issues relevant for the formulation of the new international Development Strategy, but it can be used for the investigation of other problem areas and issues which are of interest to the various parts of the United Nations system.

2. The Project is oriented towards the investigation of industrialization and development issues observed and identified at the level of individual developing regions, but its distinguishing feature is that these "internal" issues are dealt with within a given international economic framework. For analytical purposes the international framework can be defined by using different sets of assumptions, ranging from the continuation of the prevailing world economic structures and mechanisms to new conditions as those envisaged in the New International Economic Order. The basic purpose of the Project therefore should be seen as the elaboration of an analytical toold capable of identifying the complex two-way relationship which exist between the orientation and objectives of industrial and development strategies, at the regional level, and a given international framework (the trade framework in particular).

II. The Model System

1. The core of the Project is a simulation model system conceived for analytical purposes and the subsequent projections. The present

version of the system (considered as a simplified version) consists of eleven regional models (five for the developed and six for the developing regions) interlinked through seven trade matrices, each of which corresponds to a well-defined product group. These inter-regional trade matrices, which also include a summarized picture of intra-regional flows, represent what may be called the "world trade structure" in the model system. The regional models will also be inter-related through balances of interregional financial flows so that a "world financial structure" will also be available for analytical purposes. By introducing desired changes in the "world economic structure", as defined above, different "world economic structures" can be obtained, each of which having its particular implications for "internal" industrial and global development (grasped at the regional level). In this way the model can be conveniently used for simulating the impact of this or that pattern of "world economic structure" on the industrialization and other aspects of development of any of the developing regions, and vice versa for periods of different lengths.

4. For the purpose of studying the industrialization and development strategies and related problems, the models for the developing regions (Latin America, Tropical Africa, North Africa and the Middle East, Indian sub-Continent, Asian and countries of East Asia, Centrally Planned Asia) have been worked out in considerable detail. Put in a simplified and condensed form, each regional model contains:

   (i) an input-output table, 8 x 8 sectors, linking the output-mix with an endogenously generated final demand vector. The eight producing sectors are: agriculture, food processing, energy,

basic products, light industry, equipment goods industry, construction and services;

(ii) a technology mix, as embodied in technical coefficients of the input-output tables and in the variables of the production functions. The latter include the capital-labour coefficient as well as policy and other variables, such as the average size of plants, the technical progress and the market-size, and are computed in the model for twelve sectors. In that classification, the energy sector is decomposed into four components (oil extraction, coal mining, utilities and oil refineries) and the basic sector into two (mining other than coal, primary processing);

(iii) the technology of the agricultural sector for most developing regions is different according to the size of holdings (large, medium and small farms) and is based on policy and other variables including the land-labour ratio, the cropping intensity, the capital-labour ratio, and the proportion of material inputs per worker;

(iv) on the domestic final demand side, total private consumption is determined by the functional income distribution (exogenously given) while its structure is a function of the size distribution of household income (for some developing regions only), average income per capita and prices. Government consumption depends on the functional income

distribution, with an exogenous structure. Investment is demand-oriented and is a function of the technology-mix and the output-mix;

(v) trade has received an elaborate treatment. For each basket of goods (seven groups) and for services, the imports of each region are a function of the output-mix (in particular the industrial structure), and of two policy variables, i.e. the level of protection (tariff and non-tariff protection) and of the "average market size", i.e. an indicator sensitive to the establishment of economic groupings in the region. Exports are demand-oriented, i.e. are a function of total imports of each region and of the trade shares for the seven baskets of goods. In the present version, the trade shares are exogenously given but two sub-models have been tested to treat them endogenously in future versions. In the meantime, trade shares can be compared informally with results of the sub-models and fixed exogenously as policy variables.

(vi) a domestic saving sector (made up by households, enterprises and government) as well as financial capital flows determine the sum of domestic and foreign savings, which is then compared with the total resource requirements for financing the investment activity;

(vii) the employment balance is obtained through the production functions which determine the demand for employment, and through a demographic and labour supply sub-model;

(viii) for developing regions, the land balance is obtained by substracting the land demand, endogenously determined, from the land supply which includes a term for land extension.

5. The model is expected to be run from the base year 1975, to the years 1990 and 2000. For certain issues of a long-term nature (demographic changes and certain technological problems) the model can be run to the year 2010 and beyond.

6. The model belongs to the family of simulation models. Besides considering as exogenous the policy instruments, the model treats exogenously certain variables - like most prices, the production factor-mix, etc.. - which are generally treated endogenously in the short and medium-term forecasting models. The model therefore is less deterministic than the usual forecasting models, and alternative scenarios can be explored by attributing different values to the exogenous variables.

7. The model also belongs to the family of the gap models. It assumes equilibrium on the product market, but it does not contain equilibrating mechanisms for the markets of capital, labour and land or for the foreign accounts sector. Each scenario therefore will be associated with three major gaps, i.e. the employment, the saving-investment and the land gaps. The feasibility, desirability and plausibility of a given scenario will be assessed on the basis of the sign and size of these gaps and of the values of other relevant socio-economic indicators.

III. The Original Features of the Model System

8. Some of the original features of the UNCTAD system which implicitly indicate the broad problem areas which can be conveniently explored. can be briefly defined as follows:

(i) the "world trade structure" embodied in the seven trade matrices can simulate:

- collective self-reliance policies for specific groups of commodities at sub-regional or regional levels;
- new inter-regional trade structures (by commodity groups) obtained by simulating different North-North, North-South and South-South configurations;
- trend-like world trade structures with the quantification of growth effects (of both the importing and the exporting regions) on the direction and volume of trade;

(ii) the import functions of each region are meant to explore substitution effects resulting from the growth process as well as policy decisions on sub-regional or regional groupings and on the protection level;

(iii) on the "internal" side, a specific part of the regional models for developing regions is meant to study the impact of internal effective demand on the industrialization and growth process. More precisely:

- the model can simulate changes in the rural-urban income distribution and corresponding changes in savings and consumption patterns (for some developing regions only);
- it can trace up the effects of income consumption policies in the rural area on the technology-mix, the output-mix, employment and growth;

(iv) the system can also investigate the impact of technology policies on industrial patterns and growth. This latter part of the system, which is the outcome of an analysis of technological changes in 25 developing and 10 developed countries over the last 12 years, has probably no equivalent in existing world models.

[illegible] cues cut from the preceding paragraphs, the range of areas and policy issues which can be investigated with the use of the [illegible] system is rather wide. However, within this range a few issues [illegible] view of the prevailing and foreseeable world economic situation seem to deserve particular attention.

Most of the earlier projection works done within the United Nations system in connection with the implementation of the Lima objective had been based on scenarios which, grosso modo, imply international conditions similar to those which had been prevailing in the 1960s and early 1970s, and which today may appear as somewhat optimistic from many points of view including the future prospects of industrial exports of the developing countries. The prevailing economic and policy trends in the developed countries point indeed to the need of elaborating scenarios different from those used in the past. Some scenarios should continue to run along the North-South axis but taking into account the possibility of a continuation of the present trends, others should give greater attention to the implications of the various aspects of collective self-reliance which the developing countries are determined to promote.

* * *

IV. The possible orientation of the Project

11. Parallel with the more technical aspects of its work the UNITAD team has had to explore a wide range of policy issues associated with industrialization and development, in the light of the past, present and - to the possible extent - the foreseeable economic and policy trends. Special studies had to be prepared for identifying the main alternatives open to governments in selected areas and for obtaining a preliminary picture of the possible orientation of scenarios for the projection work. As seen by the team, the main problem areas and issues which can be usefully explored with the help of the UNITAD model are:

(i) Issues related to technology and technology policies;

(ii) Issues relating to trade and the industrialization strategies;

(iii) Other specific issues.

(i) Issues related to technology

12. The model itself and the wealth of technological data accumulated and analyzed by the team can be conveniently used for investigating the impact of various technologies on the patterns of industrialization and, conversely, the technological implications of industrial patterns and strategies. It can be used for exploring a wide range of issues associated with the choice of technologies and industrial structures and their implications for the various development objectives.

13. As has been proven of late, the choice open to developing countries in the area of technology is significantly wider than had been thought only a few years ago, and it is likely that further research will open

new alternatives. Each technological variant has its own implications for the multifarious objectives and aspects of development. The task of the policy-decision maker is therefore not an easy one, particularly since he is usually called upon to look for technological patterns which meet best the competing, and sometimes conflicting claims of individual objectives.

14. The micro-aspect of the problem, situated at the level of individual sectors and industries, is to find out and apply the most appropriate technological solutions within a given output-mix. The concept of "appropriate" technology is a relatively new concept and not without certain ambiguities, but it has asserted itself in practice in a number of developing countries. Basically, it rests on the observation that most technologies are designed in developed countries where the factor endowment and other conditions radically differ from those in developing countries. The concept implies therefore that, to the largest possible extent, the developing countries should opt for labour-intensive technologies instead of the capital-intensive ones. According to UNIDO, recent research has shown that in a large number of industries a significant range of efficient technologies does exist; even in some fairly advanced industries, certain technologies with highly positive effects on the creation of employment and reduction of expenditures on capital can produce profitability levels comparable to those obtained by applying capital-intensive methods.

15. However, technological alternatives do not equally apply to all manufacturing sectors, and in some they hardly exist at all. The analysis of technological characteristics of

manufacturing carried out by the UNITAD team, points that the input coefficients of certain sectors observed at different levels of development as well as for different market sizes and population densities, tend to behave as technological constants, which only confirms the general opinion that beyond a certain point no change in technology can be obtained without changing the output-mix. This shifts the problem to the macro-economic level, i.e. to the basic policy decisions which determine the whole industrial pattern.

16. It is almost obvious that less sophisticated and less complex patterns of consumption and output tend to widen the range of technological solutions which correspond better to the factor-mix and other conditions of developing countries. A greater accent on the essential needs of the population, for instance, in conjunction with a reduction of income disparities and/or a greater accent on employment, would certainly lead in that direction. Similarly, though to a more limited extent, a strong emphasis on rural development which is associated with the dissemination of small-scale industries - actually observable in many countries - whould open new possibilities for the application of technologies consistent with the local needs and conditions. These and similar issues are well within the scope of the UNITAD project.

17. Alternatives which can be obtained through macro-economic decisions are not illimited either. Industrial patterns which tend to facilitate the technological problem of industrialization are generally well in line with the basic social objectives of development, employment-creation in particular ; up to a certain point they may not be incompatible with a number of other objectives, but beyond that point they may clash openly with the requirements of the overall efficiency of the economy and, especially, with the achievement of a necessary level

of technological capability. The development of technological capability embodied in a strong and expanding capital goods sector is an absolute condition for reducing the economic dependence of developing countries, and therefore must be regarded as a highly important objective in itself. If the capital goods sector does not expand at an adequate rate the domestic economy will increasingly be at the mercy of the foreign suppliers. The dependence in this crucial sector which, in the final analysis, commands the whole production process in its widest sense, can be reduced only by engaging successfully in the production of capital goods. This is a process which proceeds by stages since, subject to some extent to resource endowment, the principal technical factor governing the possibilities open to a country is access to and the mastering of technology. An important stage in the transformation of a developing country is attained once it is able to produce the equipment needed for its consumer goods industries so that imports of equipment are reduced only, or mainly to multi-purpose machinery serving for the production of other capital goods. The attainment of this stage is facilitated or rendered more difficult according to the degree of sophistication of the consumption pattern. However, at that stage, the main assymetries in the technological capacity between the developing and the developed countries are still virtually intact. The decisive step consists in moving to the next stage, i.e. the manufacture of producer goods which serve for producing producer goods. The problems which most develping countries face with regard to technological independence will be further discussed in the next sub-section.

(ii) Issues related to trade and industrialization strategies

18. The main problem area on which the UNIDO project is asked to concentrate may be defined as the interaction between trade and industrialization, viewed in the broader context of development. This is a vast and highly complex area which includes issues of great practical importance to the policy-makers. The role attributed to trade, its geographical orientation and its patterns have far-reaching implications for industrial and overall growth; it also affects industrial structures, technology policies, employment policies as well as a number of other aspects of development. No wonder therefore that all developing countries have experienced, and continue to do so, great difficulties whenever the question arises of the role and place which should be attributed to trade in the overall industrialization strategy. As is well known, virtually all countries had begun to industrialize by concentrating attention on the domestic market, although it may be queried whether this approach had been chosen deliberately or enforced by internal and external circumstances. This unilateral approach, however, had soon shown its inherent limitations. On the opposite side of the spectrum are countries which had adopted early bold export-oriented strategies and had succeeded to make a rather spectacular breakthrough. However, the number of these countries is very small, and in most instances the success has been associated with rather exceptional international circumstances which are not likely to reappear in the near future. In the more recent years the majority of countries have been trying to combine in various proportions elements of the two basic strategies, in the hope that a reasonable balance between import substitution and export orientation would be struck somewhere. However,

the hard fact remains that in most cases the success of the industrialization effort will largely depend on what will be achieved in the export area.

19. The adoption of the Lima objective in 1975 has been above all a reconfirmation of the fact that no real solution to the fundamental problems of developing countries can be found without a further acceleration of industrial growth. However, rapid industrial growth cannot be envisaged without a comparatively more rapid expansion of industrial exports which have a dual function: to increase the capacity to import and to overcome the obstacles to industrialization created by the narrow domestic markets. As is well known, this second factor acts as a structural impediment to industrialization in the great majority of developing countries. The problem is particularly severe in countries where the small volume of domestic demand does not reflect only the low level of income per head but also the small, and sometimes very small size of the population. Technological alternatives may exist, but even so the required technologies in many industries are often linked to a scale of production which by far exceeds the present and, sometimes also, any foreseeable level of domestic demand. Economically, the establishment of these industries is not feasible if the export component is not present from the start. An attempt has been made within the UNITAD Project to qualify the incidence of the market size both on industrial development and on trade.

20. The exploratory work on the necessary conditions for the implementation of the Lima objective has indeed assumed that industrial exports of developing countries in the coming years would grow faster than output. The intra-trade of developing countries is supposed to grow somewhat faster than exports to developed countries but high rates of growth are also retained for the latter flow. Implicitly, the presence

of international conditions more or less similar to those of the 1960s and early 1970s has generally been taken for granted. However, in the meantime, the international conditions have changed drastically. Moreover, none of the existing expectations around the time of the Lima Conference regarding the possible improvement of the world economic environment and effective policy action in favour of the developing countries, has materialized. The new wave of protectionism, largely directed against exports from developing countries has not come to a halt. The trade and industrial policies of the OECD countries continue to follow a strongly defensive orientation, with little thought to their longer-term effects on the growth and future of the world economy. At the present moment, on the eve of the new decade, the end of the stagflation is nowhere in sight, and the short- as well as the medium-term prospects are being viewed with increasing pessimism.

21. All told, to count with substantial improvements in economic and policy trends in a nearer future would not be very realistic. Consequently, thought should be urgently given to scenarios different from those used in past projection work. The future prospects of manufacturing exports from developing countries should be explored on the assumption that protectionism in the developed region would continue - using , of course, different plausible variants. Particular regard should be given to the effects of protectionism in sectors where the competitiveness of developing countries is the highest and in those where it is likely to increase. What should be also investigated more closely is the prospective "absorption" capacity of imports of individual sectors of the developed regions, in view of assessing the magnitude of the necessary adjustments in the production structure and capacity of the developed regions.

22. However, while appropriate scenarios should continue to explore possibilities which may be found along the South-North axis, strong arguments clearly speak in favour of engaging also in the construction of scenarios with emphasis on co-operation along the South-South axis, notably the unequivocally expressed determination of developing countries to put greater accent on collective self-reliance - a policy move which a continuation of the present economic and policy trends is virtually bound to accelerate. For a large number of developing countries, in fact, sub-regional and regional co-operation provides a more convenient framework for industrialization and development than its alternative - a direct integration in the world economy. Clearly also, a higher degree of economic independence, which is closely associated with the level of technological capability, is more likely to be attained through combined action of groups of countries than through isolated efforts of individual countries. Moreover, the objective conditions, possibilities and scope for a large-scale co-operation among developing countries are now infinitely greater than at the time of the emergence of the first economic groupings.

23. Taking up again the problems associated with the market size and exports, there is no doubt that the combined performance of developing countries, in the area of manufactured exports looks impressive. Ever since the early 1960s those exports have been growing considerably faster than production, and faster also than world manufacturing exports. But this encouraging global picture conceals tremendous variations in the participati of individual countries in the export expansion. In 1978, for instance, 77 per cent of manufactured exports of the group to the OECD countries, by far the most important market, was accounted for by the ten leading exporters only; the twenty-five countries that follow on the list accounted for a modest addition of 16 per cent, whereas the remaining

7 per cent was distributed among more than 70 countries covered in the statistics. These are disturbing figures which raise the fundamental question of the real chances which the isolated efforts of the majority of the developing countries stand in the export area. How many of the small and very small countries in an early stage of development can expect to extend their domestic markets by relying mainly on the sophisticated and highly protected markets of the developed countries? For most of these countries, in fact, trade cooperation schemes, which can be envisaged at sub-regional, regional and inter-regional levels, is the logical alternative. Solutions along these lines, of course, do not imply autarchy. They simply imply that most weak economies should not place great hopes in direct ties with the world economy; what they need is a more appropriate economic framework which, inter alia, is called upon to act as a link with the world economy.

24. Clearly, the trade-creating and trade-diverting effects of trade cooperation schemes can be extremely significant. Moreover, the primary effects of such schemes on regional and inter-regional trade flows are likely to have implications for the commodity patterns of trade and, beyond that, on the production and employment structures of individual regions or country groups. Some important implications of trade cooperation schemes can be studied with the use of the UNITAD model.

25. As indicated in the preceding sub-section, the technological capability which is intimately linked with the strength and development of the capital goods sector is one of the determinants of the industrialization process. However, this is precisely the field where a large number of developing countries cannot expect to go very far by relying

solely on their isolated efforts. Most developing countries are obliged to accept a transfer of technology which, irrespective of its form, injects technical progress in small doses carefully measured by the supplier. In this respect the various arrangements with large foreign firms, which have the merit of being trade creating and of introducing developing countries to intra-industry trade, often have serious drawbacks. They generally tie the partner to well-specified operations which are only a fractional part of the complex process required for the production of the final good. The alternative, however, to engage in the whole production process exceeds the possibilities of the isolated efforts of most developing countries thus pointing to the need of the search for new solutions.

26. The problem of the capital goods sector and of the technological capability is a fundamental problem of the developing countries as a group. This problem is well reflected in the structure of manufactured trade with the developed countries and in the huge deficit vis-à-vis the latter group. In 1978 the value of the OECD exports to the developing countries, accounted for about two-thirds of capital goods, was of the order of US$ 171 billion - roughly 25 per cent of the OECD world industrial exports. The flow in the opposite direction amounted to some US$ 44 billion and was mainly composed of light manufactures. These figures no doubt show the high degree of dependence of the supplying countries on the combined market of the developing countries, but they also point to the interest of the suppliers to maintain their privileged position in technology and production of capital goods. Above all, the figures point to the imperative need for developing countries to combine in an appropriate way their human, natural and financial resources in order to increase jointly their technological capability and expand production of capital goods for which their combined market offers virtually illimited possibilities. Economic

groupings of varying size and scope are a convenient framework for pooling together and putting to the best use the common resources. In certain instances, however, particularly in the area of technological research and highly advanced industries where special skills and facilities as well as large financial means are required, flexible joint investment projects which transgress the boundaries of sub-regional and regional co-operation will certainly be necessary.

To a varying degree, many issues associated with the technological capability and, more generally, with the productive capacity and its orientation in developing countries, within the framework of collective self-reliance, can be studied with the help of the UNITAD model.

(iii) Other specific issues

27. The model can also be used for studying selected aspects of the energy problem which are bound to have a prominent place in any scenario aimed at exploring the possible evolution of the world economic system and the possible course of industrialization.

28. In the first place UNITAD should concentrate on the long-term evolution of the demand for energy arising from the development plans and industrialization strategies. More particularly, the model should be used to measure the energy requirements of selected patterns of output and technologies, noting in passing that one of the main consuming sectors is the energy sector itself.

29. A further stage subject to the possibility of expanding the model, might consist of the simulation of various combinations of the existing and potential energy sources and of a study of different geographical distribution of such sources. More precisely, several patterns of technology and output should be considered, notably:

(a) the development of new "decentralized" technologies, especially solar and bio-mass;

(b) the development of solid fuel resources;

(c) the development of liquid and gas fuel resources;

(d) the development of primary electricity - both hydro and nuclear.

One step further might consist of studying possible patterns of the North-South allocation of scarce energy resources, especially liquid fuels and gas.

30. Among other subjects which could be studied in co-operation with other UN bodies and Agencies (FAO, ILO and the Regional Economic Commissions), the following deserve attention:

(a) The balance between agriculture and industry:

Growth of agriculture is an objective in itself as it is called up to ensure adequate nutritional levels. At the same time, however, it is an objective intimately linked with that of industrialization, and it acquires a particular importance in scenarios geared to collective self-reliance. Clearly, there is a two-way relationship between agricultural and industrial growth: in one direction, agriculture supplies a great many inputs to a number of industrial sectors - agro-food industries and textiles in particular, and it has to meet the increased food demand generated by industrialization; in the opposite direction it is industry which supplies inputs to agriculture, such as chemicals and machinery, as well as an expanding demand for industrial consumer goods. A project which should be carried out in co-operation with FAO and the Regional Commissions, could explore

all inter-industry aspects under different scenarios. This in turn would provide the possibility of studying the implications of a balanced agriculture-industry growth for the main macro-economic aggregates, including employment, the trade deficit and the saving-investment problem.

(b) Social aspects:

As indicated earlier, the model is particularly well-suited to investigate changes in consumption, production and technology patterns which can be obtained by putting greater emphasis on the essential needs of the population, attaching higher priority to the employment objective and/or resorting to a redistribution of personal incomes. In co-operation with other UN agencies therefore to the Project could be oriented to the exploration of the various aspects, requirements and implications of policies which aim to satisfy the essential needs of the population and to promote health, education, housing and other social objectives and aspects of development.

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V. Suggestions for priority issues

31. Several important issues might be suggested for further study:

(i) Investigation of the "absorption" capacity (by main manufacturing sectors) of the developed regions regarding exports from developing countries, in view of assessing the magnitude of the necessary adjustments in the production structure and capacity of the developed regions; for certain selected categories of manufactures the incidence of a continuation of protectionism in the developed regions on exports from developing countries could be also explored;

(ii) Investigation of the possible effects of assumed trade co-operation schemes among developing countries (at sub-regional, regional and inter-regional levels) on regional and inter-regional trade flows. According to the analytical assumptions, the investigation can be carried further so as to include effects on the commodity patterns of trade and, beyond that, the implication for the production and employment patterns. Considering industrial development in a broad and dynamic perspective, the model can produce useful indications about world trade structures compatible with different industrial structures and consumption patterns at each stage of the progress of developing regions;

(iii) Illustration of the impact of different technologies on the main economic balances of individual regions;

(iv) Exploration of conditions, within the framework of economic groupings, particularly suitable for the development of the

capital goods sector and the allocation of the common natural, human and financial resources;

(v) Investigation of selected aspects of the energy problem by concentrating on the long-term evolution of the demand for energy (as indicated by the national development plans) and by using the model for measuring the energy requirements of selected patterns of output and technologies;

(vi) The study of inter-relationships between agriculture and industries and their implications for the growth of the domestic market, employment, the trade deficit and other macro-economic aggregates (a Project which could be undertaken in co-operation with FAO and the Regional Commissions);

(vii) Social aspects of development i.e. investigation of changes in the consumption, production and technology patterns induced by a greater emphasis on the essential needs of the population, employment, health conditions and other social objectives (possibly in co-operation with ILO and the Regional Commissions).

CHAPTER 2

The Analytical Work Underlying the Model

General remarks

32. The preceding review of the main issues which the model proposes to address leads to a series of specific queries, i.e., how is the model trying to handle these issues?

- On technology, how can technological choices be grasped, with their implications on employment and capital requirements?
- As to trade issues, how can markets for exports of the various regions be identified under various assumptions on the world trade patterns? How can the import requirements of various industrial strategies be measured?
- On the energy side, what specific issues can the model grasp, e.g. the impact on energy and trade balance of various technological developments?
- On the agriculture-industry balance, can the model explore the possible impact of various institutional patterns in the agricultural sector?
- On the socio-economic front, to what extent can the model give an idea on the impact of income distribution policies on the growth of the internal markets and the satisfaction of essential needs.

33. A full reply to these questions would require a detailed examination of the equations of the model, which goes beyond the scope of this report. It may be sufficient to note that the mathematical structure of the model is relatively simple, as was outlined in the introduction[1], and that the interest of the model lies essentially in the behavioural equations. The "Comparative Advantage" of the UNITAD team was its access to a vast amount of data, some of which untapped, in the United Nations, UNCTAD, UNIDO and FAO data banks in the field of trade, input/output tables, industrial statistics, agricultural holdings, etc., and no effort was spared to compile these data over an observation period extending roughly from 1960 to 1975. The data were analyzed in the light of available economic theory (which sometimes was falling short of the problems at hand), on the basis of the econometric estimations of coefficients. The purpose of this chapter is to summarize the various phases of this work and to outline the main conclusions, however unfair such a brief treatment may be to the analysis conducted by the team[2].

1/ See paragraph 4, introduction. The complete mathematical formulation is given in Annex 1.

2/ In a subsequent phase extensive accounts of the most original part of this work will be published. The section on technology is based on unpublished work by G. Jerger and J. Royer and on the following papers:

- An analysis of technology indicators - October, 1979 (J. Requena and J. Royer)
- The UNIDO contributions on technology characteristics on regional models in the UNITAD Project (Y. Cho and J. Royer), June, 1980, submitted to the ACC technical working group
- Trend projections of input coefficients for the UNITAD Regional Tables (G. Margreiter and J. Skolka), June, 1980
- The main component analysis (B. Dissmann, A. Duval, J. Royer and M. Weisser), July, 1980
- Construction of the base year matrices for the regions of the UNITAD Project (V. Gregor, C. Margreiter, M. Mauler, M. Celtl and L.N. Rastogi), June, 1980.

I. Technology Issues

34. Technology, in the broad sense, is mainly embodied in two parts of the model, i.e.:

(i) the eight by eight input-output matrices of the different regions;

(ii) the production functions of twelve sectors;

(i) The input coefficients

35. Over the past twenty-five years considerable research has been conducted concerning the time behaviour of input coefficients (or technical coefficients). The following conclusions seem to be generally agreed upon:

(a) In the advanced industrialized countries, with a very complete technological structure, changes in technical coefficients take place very slowly. Several authors like A. Carter in the United States and Tilanus in the Netherlands have widely demonstrated that over a five to ten year period changes of the coefficients are small and do not affect very substantially the relation between final demand and output. The main reason for this slow evolution of the technical coefficients can be easily explained: the technical coefficients only can change substantially if all the production technologies of a sector are changed; but the process of change of production technologies takes place only with new investment and therefore it takes many years before the moment that the entire production structure has adjusted. In other words, ten years from now many of the existing plants will still be functioning and using roughly the same input structure.

(b) If one is interested in the relative accuracy of the output response to final demand, it is relevant to refer to the research work of Koopmans and other using the I/O model and activities analysis, with different aggregation levels. The conclusion is that for long term models the use of more aggregated tables may be recommended as they will have a higher degree of inertia without losing much precision at the output level. One implication is that, at a higher level of aggre-. gation, technical coefficients should be interpreted, not as reflecting a "technology" (as in the Leontieff world model) but as technology mixes influenced bythe output mix within each broad sector. The inertia of these coefficients, over a period of then years, is therefore related to the slow changes in output mixes as well as to the slow diffusion of new technologies. This, it is clear, cannot be extended to the case of developing countries where the output mix can undergo drastic changes in a period of ten years.

(c) In the long run, both in industrializing and in advanced industrialized countries, there is a possibility if not a likelihood, of important changes in the input structure induced by the continous erosion of techniques due to technical progress and/or to a change of relative prices (thus a substitution process in the input structure).

36. In the UNITAD Project, no sophisticated attempt was made so far to project the input structure of the five developed regions. This can be justified by the preceding arguments: any serious inquiry on new

technologies, using the ex-ante method based on information from enterprises, is costly, as compared to the fact that, with a few changes, higly aggregated (8 sectors) tables can be used for a 1990 projection. However, available tables all reflect technologies and output-mixes of the pre-oil crisis period and this deserves some attention. Information was therefore requested from a consultant[1/] on changes which could be observed in one of the few developed market economies (France, Germany, United States) where long time series of detailed input structures are available.

37. The results of this analysis at the 38-sector level, for the period 1970-78, can be summarized as follows:

(a) In the agricultural sector, the sum of all energy inputs remains fairly constant in spite of a very slow substitution between electricity and petroleum. The input of fertilisers seems fairly stable in physical terms but its increasing importance in value terms, in relation to the price of petroleum products, may well induce technological changes. As of today, the most spectacular change remains the well-known trend towards more intermediary inputs and a lower contribution from primary inputs (labour and capital). This is likely to continue up to 1990 and will be taken into account in a "Business as usual" scenario. There is room also for an alternative scenario simulating a reversal of this trend in Europe, on account of possible employment policies within the EEC;

1/ Acknowledgement is due to Prof. E. Fontela (Geneva University) for the main findings in paragraphs 35 to 37.

(b) In the Food Processing sector, petroleum inputs are declining since 1973-74 most probably on account of energy savings measures, as there is little indication of a substitution process. More likely, the change in relative prices may induce a measure of control of packaging materials, thus introducing a declining trend in the input of light industry;

(c) In the energy sector, a rapid substitution is taking place from petroleum to coal, but this is of interest only within the sector, as, remarkably, it has not affected coefficients at the 8 sector aggregation level. Another source of change worth being considered is a possible increase in indirect taxes affecting the value added coefficient. Obviously it is altogether another proposition to project the input structure beyond 1990;

(d) As to the Basic Product sector, hardly any aggregate coefficients are affected by the observed decrease of coal and petroleum and the increase of electricity and gas. This means a substantial increase of the energy coefficients in value term, (since the real term value of this coefficient amounts to 7-8 per cent, i.e. a high proportion of total cost)

(e) In the light industry sector, the small energy coefficient (below 2 per cent) is continously declining since 1974 in all sub-sectors, thus suggesting that the energy crisis has induced serious efforts of energy saving. By comparison, one may wonder why this was not as spectacular for the heavy industry (Basic Products) as for light industry. The answer may be that (i)

energy savings were continously under review in the former sector pre and post energy crisis, while it was neglected in the light industry sector before the crisis and (ii) the output-mix and the technology of heavy industry can only move slowly due to the magnitude of the investments required;

(f) No change attributable to the energy crisis can be observed at the 8 sector level for the remaining sectors: Equipment goods, Construction and Services but technological trends initiated before the crisis proceed without change (in particular the trend towards automation, the increased importance of repairs and the intra-consumption of the services sector).

The conclusion for developed countries seems therefore confirmed: at the highly aggregated level of the UNITAD tables, few changes are needed to make the 1970 tables valid for 1990, at least in a "business-as-usual" scenario. These changes have been introduced.

38. In contrast, an unprecedented attempt was made by the UNITAD team, in close cooperation with UNIDO, to bring some light in the controversial issue of the projection of input-output matrices in the process of industrialization of developing countries. The most common assumption in large models of this type is that the technology and output-mix reflected by input coefficients were comparable across country and could be related to macroeconomic variables through multiple regression analysis. On the strength of the UNIDO's extensive collection of input-output tables, this track was thoroughly investigated for a sample of 30 countries, using the following explanatory variables:

(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.

The result, however, was negative[1/]. In an attempt to check the influence of the quality of original data on these results, the analysis was repeated with 34 selected country tables but the overall negative conclusion stood.

39. Another approach was also explored, i.e. taking as explanatory variables of the regressions, the shares of industries (at the 24 sector level), in the sectoral output of each base sector (at the 8 sector level). The idea was to check whether industrial specialization (at the 24 sector level) was responsible for the spread of technical coefficients at the 8 sector level. Some impact of output mix was actually found in 40 (out of 64) input coefficients, but with a poor explanatory power of most equations (R^2 between 20 and 30 per cent). The interpretation of this rather meagre results of regression work could therefore be expressed in the following manner: could the UNITAD team assume that the unexplained part of the variance, i.e. 70-80 per cent, should be ignored and treated as a noise (due to the poor quality of data)- or should it be attributed to missing factors, in which case the crucial point was to identify such factors.

40. A major step forward, in this connection, was achieved by using a graphical display of the data - the main component analysis -

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1/ Regression equations with an R^2 as low as (or higher than) 30 per cent were only found for 11 out of 64 independant coefficients.

sector by sector[1/]. The interesting result was that some 80 to 90 per cent of the variance of the input coefficients for a sample of 42 countries could be identified in the graphs. The first visual inspection confirmed the suspicion that input coefficients are influenced by other factors than the economic variables in the regression analysis. Specifically, in most diagrams, one could detect clusterings of countries by regional affinities - as opposed to GNP per capita - and, within such clusterings, an influence of economic variables. In the best cases (energy, light industry, capital good industry) the analysis was able to interpret the diagram in terms of output-mix, thus suggesting the interesting assumption that technology patterns in individual industries tend to be similar within regions[3/]. In other cases, the influence of the tax system or simply "statistical artefacts" (such as biased coefficients[2/]) were brought up by the analysis.

41. The following conclusions can be drawn:

(a) On the methodology side, if a variety of coefficients are found in different countries for the same sector, depending on regional similarities[3/] or output-mix, any "deterministic" method to project the Matrix of input coefficients should

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1/ The analysis consisted in building up the 8 eigen vectors of the correlation matrix of the input coefficients of each vector; the eigen value corresponds to the share of the variance explained by the eigen vector. It was found that 80 or 90 per cent of the variance was spread on two, sometimes three eigen vectors out of eight. The graphs were obtained by taking pairs of eigen vectors as axes.

2/ There is a strong suspicion that many such biasses were introduced by a blind RAS treatment.

3/ The reasons for regional similarities are yet to be explored. One may think of the size distribution of enterprises and all "traditional" features of small scale industries. In other cases, the modern sector is similar, due to same factor proportions, demand mix, output mix, etc...

be prohibited. Instead, soft modelling techniques such as the main component analysis, should be used;

(b) 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; the resulting output-mix should be reflected in input-output tables;

(c) The level of aggregation has a strong influence on the whole issue. The negative aspect is that, at the 8 sector level, the influence of the output-mix is blurred in many sectors. The advantage, though, is that some rough projection can be made for the decade 1990 to 2000 or a more distant future, with only a few changes reflecting output-mix. This justifies the level of aggregation of 8 sectors for a long-term model and conversely points to the considerable uncertainty introduced by a detailed input-output table;

(d) In practice, in the trend scenarios described in the last chapter of this report, the matrix of input coefficients for developing regions was endogenously determined to simulate a move towards technologies of industrialized regions selected on the basis of the main component analysis (see paragraph 124). It will, however, be attempted, in further versions of the model, to introduce policy assumptions regarding specific processes of industrial specialization, and to study their impact on capital requirements, employment and trade.

(ii) The production functions

42. Production functions, relating investment demand and employment requirements to output, were obtained by multiple cross-country regression analysis. The dependent variable was productivity (gross value added at constant prices per worker) to be explained by a number of exogenous variables: capital per worker, value added coefficient (ratio of value added to gross output), average size of plant, size of market. Before presenting the results, a few words should be said on sources and problems.

43. The main source of data[1/] was the United Nations Yearbook of industrial statistics (YIS) based on annual surveys conducted in countries at the enterprise level. Information coming from reporting entreprises for 40 ISIC three digit sectors, included: production (gross-output and value added), employment, compensation of employees, gross fixed capital formation by utilizing sector and size of establishment. These data were processed for a sample of thirty three countries for the years 1967-76, and some 55 indicators derived from original data were computed for each of the 40 sectors, by country[2/]. Two limitations of the data should be mentioned, beyond the uncertainty on their reliability; firstly, the scope of the surveys, in each country refers to a minimum size of establishments, varying from 5 to 20 workers. Depending on the cut-off point, information on small scale plants is missing, thus introducing a bias which can be measured, for example, on employment figures for the manufacturing sector.

1/ The only partial exception refers to socialist countries were national data on capital stock and other variables were used.

2/ Altogether, this required the manipulation of more than 700.000 data.

The following table gives an idea of the magnitude of the bias in six of the UNITAD regions:

Employment (million workers) in Manufacturing, 1975

Region	ILO[1/] source	YIS source	Ratio YIS/ILO
North America	20.326	18.993	0.94
Western Europe	42.472	36.275	0.85
Japan	13.460	11.337	0.84
Other Developed	2.802	2.797	0.99
Latin America	11.960	10.530	0.88
East Asia	8.480	6.303	0.74

The YIS source, weak as it may be for the six regions of the table (employment bias between 1 and 26 per cent) appears to be almost the unique source for Africa and West Asia. Employment for the base year had therefore to be guessed for these regions, by cutting down the YIS productivity by a more or less arbitrary figure. For the Indian Sub-Continent, the situation is reversed, the YIS data were not acceptable and the ILO employment figure was taken as a basis. All in all, the production functions derived from the YIS source were adjusted to take account of the cut-off bias by a multiplyer within the range of the ratio quoted in the table. The underlying assumption is that the bias affects the level, not the growth of productivity, which may be a strong assumption.

1/ ILO source is based on Employment and Industrial surveys. ILO publication also uses YIS estimates but such figures were not retained for the above comparison.

44. The second limitation of the YIS source is the absence of data on capital stock. Following several authors, an attempt was made to compute a proxy for this variable. Electricity consumption per unit of output was tested and rejected and instead, the sum of gross capital formation for five years (normalized for ten years) was retained.[1/] A simple model[2/], making assumptions on the life of equipment in each sector, yielded estimates of the capital stock, on the basis of the above proxy. Comparisons with two countries, North America and Corea, showed that both indicators were reasonably correlated with the Capital stock derived from national sources (rank correlation 0.99 among sectors). Two alternatives were therefore available in the model, as proxies for capital per worker, i.e. CAPLE (gross investment over ten years per worker)and PKL (Capital stock per worker estimate derived from the former). In spite of theoretical advantages of PKL, CAPLE was retained for the sake of simplicity, pending further studies on the complex link between PKL and the "true" capital stock per worker. One additional remark should be made: there is no proportionality between CAPLE and the true "K/L" especially where comparing developed and developing countries; in fact, for countries with very high rates of manufacturing growth during the observation period, like Corea, more capital was accumulated during the décade 1967-76 than during any preceding period, so that CAPLE is not far from K/L. This does not hold true for developed countries.

1/ See in particular ECE study on "Structure and change in the Manufacturing sector".

2/ Writing $I_t = (r + \lambda)\ K_{t-1}$, where I_t stands for gross investment for year t, r the exponential rate of growth of capital stock per annum, and λ the replacement rate.

45. The general form of the production function is:

$$LP = (Caple, Ivy, Tle, Du, t)$$

where LP stands for the productivity (value-added per worker)
Caple= for a capital labour indicator (see below)

Ivy = for the value added coefficient (ratio value-added to gross output)

Tle = for the average size of plants (workers per plant)

Du = for a dummy variable on market size (see below)

t = for time

Caple, as already noted, is a proxy for K/L (capital per worker), but his magnitude differs from that of K/L.

Du, is a decreasing function of total GNP, meant to measure the influence of total market size (admittedly the domestic market only) since its value was calibrated according to GNP in 1970 prices, so as to divide countries basically into four groups: North America (Du=-1), other DD's (Du=0), large DG's (Du=-1), i.e., GNP $>$ 7.5 10^9 1970 US$ small DG's (Du=-2), GNP $<$ 7.5 10^9 US$. However, the definition of Du varies with the sector (see detailed analysis). For some sectors, a fifth category was distinguished, i.e. very small markets, roughly corresponding to least developed countries (du=-4).

46. A few remarks on this function are in order:

(a) the variables have been entered in neperian logarithmic (Ln) form, except Du and t, so that the relation between productivity (LP) and capital-labour ratio (Caple) is comparable to a Cobb-Douglas function[1]. However, the coefficient of Caple is likely to differ from that obtained with a direct estimate of the capital stock, since there is no proportionality between Caple and K/L;

1/ With an elasticity of substitution equal to 1.

(b) the coefficient of the average plant size (Tle) introduces a further influence of labour, i.e., with a positive sign it denotes economies of scale, and with a negative sign dis-economies of scale;

(c) the influence of the value added coefficient (Ivy) requires some explanation. This variable is the complement to 1 of the ratio of material inputs to gross output; in time series regressions, it is generally colinear with K/L (and the coefficient is not significant) but when it is significant the variable introduces a substitution of material inputs for primary inputs (capital or labour). In a cross-country analysis, a low correlation between K/L and Ivy appears in most sectors (except for capital goods), so that the coefficient of Ivy is often significant. The most general interpretation which suggests itself is that this variable is an indicator of the changing output mix within the sector in the process of industrialization. Actually, the main component analysis of the input vectors of the I/O tables pointed to this interpretation: in many sectors the value added coefficient was sorted out as responsible for a large part of the variance and was found to reflect the dominant sub-sectors, thus linking the analysis to long-term industrial specialization strategies. It may, therefore, be noted that both in the I/O tables and in the production functions, the UNITAD technology sub-system is aiming at taking directly into consideration the industrialization strategies of the region. There are, though, cases where the traditional interpretation (substitution material/ primary inputs) may still be retained (see detailed analysis);

(d) the influence of market size (P) was demonstrated long ago by Allyn Young and was evidenced by H. Chenery[1/], its interpretation in terms of micro-technology is interesting: it suggests a "package effect", i.e. sets of enterprises complementary to each other. As will be seen, the market size influences strongly the technology of some sectors;

(e) finally, the time variable can be introduced by dividing the sample in two sub-samples, the five-year period 1967-71 and the next period (1972-76). The interpretation is that of neutral technical progress. The related coefficient was found significant for three (out of twelve) sectors, i.e. refineries, primary processing and capital goods industry (see detailed analysis).

1/ See Chenery and Syrquin (1975)

47. The equations selected for the market economies of the UNITAD system are given below[1/]. (The actual constants are adjusted from region to region to account for the cut-off bias - see above).

Production Functions

(Ln LP = dependent variable)

Sector	C^t	Ln Caple	Ln Ivy	Du	t	(R^2)
Agri-food	4.0	0.65	0.78	-0.25	--	(0.84)
Oil extraction	1.2	0.59	—	—	—	(0.74)
Utilities	—	0.60	1.6	-0.32	—	(0.89)
Coal extraction	3.0	0.55	—	-1.29	—	(0.80)
Other mining	3.0	0.65	1.26	-1.38	—	(0.77)
Oil refineries	6.8	0.25	—	—	0.2	(0.91)
Primary Processing	6.7	0.28	0.65	-0.27	0.16	(0.86)
Light Industry	5.0	0.54	1.21	-0.26	--	(0.91)
Capital goods Industry	7.7	0.12	—	-0.48	0.15	(0.85)

Note: All coefficients are significant at the 0.05 per cent probability level.

1/ Production functions for the CPE's have been obtained from the same sources(YIS) for Czechoslovakia, Hungary and Poland, while for USSR, capital stock variables have been taken in national sources. The straight forward Cobb Douglas functions, calculated from time series are not analyzed here for the sake of conciseness. They will be given in subsequent reports.

48. A few general comments are given here so as to restrict a detailed analysis (see further below) to the capital goods industry (similar analysis for the primary processing and light industry sectors are given in an annex).

(a) no equation with plant size (Tle) is used in the model on account of the difficulty of projecting that variable as exogenous variable, but as the detailed analysis will show, economies of scale are significant in some sectors;

(b) the value added coefficient is found significant in all composite sectors: Agri-food, utilities, other mining, primary processing, light industry (for capital goods, see detailed analysis). This strengthens the interpretation that this variable reflects the long-term industrial specialization strategy;

(c) the coefficient of Caple is surprisingly uniform, around 0.5-0.6, except in sectors where time was found to be significant. In those sectors, there was an obvious correlation between Caple and time, although the coefficients retained were significant. If time is omitted, the coefficient of Caple is much higher for primary processing and oil refineries - for capital goods, however, the time variable does not change the magnitude of the Caple coefficient, which remains small (0.12). The interpretation is trivial i.e., a relatively low capital intensiveness.

(d) "neutral" technical progress appears in three sectors, oil refineries, primary processing and capital goods industry, where technology change is known to be fast. This, admittedly, is an over simplification of a complex matter since technical progress is also known to be at work in other sectors and, further, is often embodied in Capital (relation with Caple).

(e) finally, three levels can be distinguished for the influence of market size (Du). For three manufacturing sectors and for utilities (Agri-food, primary processing and light industry), the coefficient is around 0.26. For the capital good sectors, it jumps to 0.46, and it reaches 1.3 - 1.4 for mining. The difference between the coefficients of the capital good sector and other manufacturing sectors is worth noting since it can be interpreted as a difference in technology due to the "package effect" already mentioned. As to the high coefficient for mining, it is simply a reflection of geographical distribution of mines among countries with different levels of GNP;

(f) for the utilities sector, another dummy variable was tested, i.e. the proportion of non thermic (dams, nuclear) over thermic energy. The variable was not found to influence the productivity significantly but it appeared to be correlated with capital per worker (Caple) so that it can be used to project Caple on the basis of plans for non thermic energy.

The case of the Capital good industry

49. This sector, which includes ISIC groups 382 to 385 is extremely composite, and the main component analysis showed that no coefficient was related in an obvious way to the growth of GNP per capita. It was possible, by going down to about 20 sub-sectors to trace up the link between the material input coefficients and dominant sub-sectors. The regression analysis while confirming these conclusions, shows unifying features in the technology of the sector. It was conducted on a sample of 32 observations, of which 18 for DD's and 14 for DG's.

50. The first feature is the existence of a correlation between capital intensiveness (Caple) and value-added coefficient (Ivy). This correlation, which is reflected in the correlation matrix of the variables (0.53), is such that the two variables are usually co-linear and rarely appear simultaneously with significant coefficients in the same equations. The

interpretation is trivial, i.e., sub-sectors with a high capital intensiveness coincide with those with the smallest proportion of material input (and the highest share of value-added). As a consequence, two series of equations emerge:

$$LP = f\ (Ivy,\ Tle,\ Du) \text{ and } LP = f\ (Caple,\ Tle,\ Du)$$

51. The second finding is a decreasing trend, both in DD's and DG's, in plant size, in terms of workers, during the observation period. In DG's, an interesting regression shows that the largest the market size (-Du), the smallest the plant size[1/]. It is not surprising therefore, to find out a negative coefficient for the variable Tle in equations explaining the productivity, both in DD's and DG's; in other words, in this sector, like in the light industry sector, small plants are more efficient than large plants (dis-economies of scale).

52. The next feature confirms the complexity of the sector as reflected in the main component analysis. No clear trend emerges neither for the value-added coefficient nor for capital intensiveness. More precisely, for the latter, increasing trends are found in DD's and decreasing trends in DG's. This is an "a contrario" evidence that the important factor underlying these variables is not GNP per capita but the output mix. Hence the difficulty of projecting these exogenous variables without a knowlegde of expected changes in output mix.

53. Good regressions ($R^2 = 0.80$) obtain when trying to explain productivity with Capital intensiveness (or value-added coefficient), plant size and market size, for the DD's alone or for the group DD's + DG's as a whole. Poor regressions ($R^2 = .41$) are however found for the DG group alone.

1/ In DG's the following regression obtains:

$$\text{Ln Tle}_2 = 0.34\ DU + 0.78\ \text{Ln Tle}_1$$

where 2 and 1 refers to the two observation periods.

Furthermore, the time variable appears to be significant both for DD's and for the group as a whole, which is not surprising since productivity increased during the observation period without any clear trend for the major explanatory variables. The following equations obtain:

DD + DG $R^2 = 0.85$

(1) $\text{Ln LP} = \underset{(26)}{7.7} + \underset{(4.6)}{0.12}\text{Ln Caple} - \underset{(-11)}{0.48}\text{ Du} + \underset{(2.1)}{0.15}t$

DD $R^2 = 0.88$

(2) $\text{Ln LP} = \underset{(7.8)}{8.4} + \underset{(0.4)}{0.05}{}^{*}\text{LnCaple} - \underset{(-9.6)}{0.44}\text{ Du} + \underset{(2.2)}{0.15}t$ * not significant.

54. The value of the constant is high as compared with other sectors, whether in DD's or DG's, i.e., the productivity of the sector is high irrespective of the amount of capital. However, this finding should be qualified in view of the influence of the other two variables: market size and neutral technical progress, i.e., two weak points for many developing regions. This calls for policies to promote these factors, i.e., management, knowhow, research and development, training of qualified manpower, for influencing technical progress; and creation of a large internal market for specific standardized items, ECDC and export policies for influencing the market size.

Final remarks on production functions

55. A first concluding remark is that the two main sources, i.e., the UNIDO set of I/O tables and the Yearbook of industrial statistics, appear as very rich sources of information, however incomplete and biased they are. A number of valuable insights on technology can be gained from their analysis, although some are more suggested than demonstrated. The way is, therefore, open for a deeper analysis, especially as to the link between the technology (input coefficients, production functions) and two key variables, i.e., the output mix within large sectors and the market size.

56. Some further analysis, left for subsequent reports, has been conducted on other socio-technical characteristics. One, made by UNESCO, refers to the requirement for qualified manpower. The other, conducted by the UNITAD team, concentrates on the relationship between technology (in particular Capital-labour intensiveness) and factor shares in the output. In many sectors, a decreasing share for labour income appears during the first stage of industrialization. This finding - which runs contrary to the neo-classical theory - should enable the model users to simulate cost variations at various stages of industrialization. At the present stage, some rough figures have been entered in the model.

57. The level of aggregation adopted in the model for the analysis of the manufacturing sector, i.e., Agro-Food industries, Primary processing, light industry and Capital good industry seems adequate to handle a number of policy choices on industrialization. In this connexion, this analysis can be compared with that of many authors[1/] who have used cross-country regressions to derive structural changes in the process of development. It should be recognized that cross-country comparisons are bettter equipped than time series to bring out long-term structural changes. The danger, though, is to adopt a deterministic attitude in drawing conclusions, i.e., to suggest a unique path for the industrialization process. In this study, a systematic attempt has been made to avoid such a criticism, by underlining the importance of regional differences, and above all by allowing policy choices to be made on key variables, such as capital intensiveness, plant size, market size, output mix, technical progress. Policy assumptions for these variables can be given to generate scenarios selected from the priority issues in Chapter 1.

1/ Such as Chenery, set alia.

II. The interplay of trade and development[1/]

58. As was recalled in the first chapter, trade and development issues constitute the very heart of the UNITAD system. This section will attempt to give an overall view of the response of the trade sub-system to a number of policy issues. The first part outlines the theoretical background of the model, the second part describes in general terms the substitution and complementarity mechanisms determining the level of imports in the eleven regions, the third concentrates on the competition between exporters and the determination of their shares, as embodied in the seven trade matrices.

(i) The theoretical background of the model

59. The abundant economic literature on trade in the last thirty years sometimes completed and often contradicted Ricardo views on comparative advantages. These developments can be roughly classified as those refining the factor proportion theory along the line of the Heckscher-Ohlin-Samuelson theorem, those based on the product cycle and technological gap and new insights on specific aspects from a number of authors[2/]. A few paragraphs - over-simplifying these theories - may be useful to justify the choices made in the UNITAD system.

60. The factor proportion theory is based on strong hypotheses, inter alia a world of perfect and pure competition. It predicts a positive trade balance of developing countries with industrialized countries in sectors

1/ This section summarizes and updates the paper: "The Interplay of Trade and Development in the UNITAD Model" (by A. Duval, M. Gilli and J. Royer) June, 1980. Submitted to the ACC technical working group of the Task Force on Long-Term Development Objectives.

2/- On the factor proportion theory, see in the bibliography H.B. Lary (1968), G.C. Hufbauer(1970), W. Leontief (1956), G. Fels (1972);
- on the product cycle theory, see S. Hirsch (1975), D.S. Keesing (1965), R. Vernon (1970);
- on other theories, references are made in the text to research published by Bela Balassa, B. Herman, P.B. Rayment, G.K. Helleiner, S.B. Linder, J. Tinbergen.

with a low capital, low skill content and the reverse, i.e., a negative balance in sectors with a high capital, high skill content. While there seems to be a large accord between theory and facts[1/] in some sectors (e.g. consumer non-durables), the theory has major limitations: it predicts a maximization of welfare for all trade partners, while permanent disequilibria seem to be the rule not only in a few countries over short periods but in most developing countries and some industrialized countries over long periods. Another difficulty is the definition of "factors" which can be defined as influencing trade: physical capital, qualified manpower, human capital, etc. Finally, a grey area for the theory is "intra-industry" trade taking place in intermediary goods, equipment goods and consumer durables, i.e., a high proportion of trade in manufactures.

61. Some limitations can be partially explained by the exceptions to the basic hypotheses underlying the theory, in particular trade obstacles like discriminatory tariffs and other restrictive practices (hence, the importance given to protectionism in the UNITAD trade system)

However more applicable to the North-South trade appear to be those theories postulating the existence of monopolies, or oligopolies for differentiated goods (and restricting the application of factor proportion theories to standardized goods). In the sectors of equipment goods and consumer durables, these theories identify a hierarchy of countries according to the control of sophisticated technology, so that the technology gap allows the development of monopolistic positions for large plants in large home markets. This approach goes a long way in

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1/ See in this context, Tuong, H.D. and Yeats, A.J. "On factor proportions as a guide to the future composition of Developing Countries Exports", mimeo, UNCTAD, Geneva, and more generally G. Fels (1972).

justifying the importance accorded by UNCTAD and UNIDO to the transfer of technology and their efforts to eliminate discriminatory practices for differentiated goods. What was retained in the UNITAD system is the idea that a large market size is a crucial condition to develop the capital good industry. This is embodied not only in the technology equations, as was already seen, but also in import equations, where the market size has a depressing effect on imports of equipment goods.

62. The same factor, market size, is the focal point of some theories explaining the spectacular growth of intra-industry trade. The latter concept is defined here with reference to commodities in which domestic production is matched by similar imports in a proportion close to the exports of the sector. A promising theory, presented by Rayment and other authors[1/2/] is the development of a dynamic process of industrial differentiation. Any manufacture good is seen as produced by a chain of activities taking place in distinct enterprises; as the market for the end product growths up, economies of scale or comparative advantages in factor proportions induce the separation of new components in the chain and hence a further industrial differentiation. This theory, which at the micro-level can be reconciled both with the factor proportion and the economies of scale theories, goes a long way in explaining the policies of transnationals to locate component plants in developing countries, so long as they have full control both of the technology and of the sales of the product, which is part of a chain of activities located

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1/ See Rayment, P.B. "Intra-Industry specialization and the Foreign Trade of Industrial Countries", Essays in honour of Prof.C.T.Saunders, Cambridge, 1980.

2/ We leave aside Linder's ingenious theory explaining intra-industry trade by overlapping consumer preferences for a given commodity at the same level of development; as Rayment observed, consumer preferences cannot be the determinant for explaining intra-industry trade for capital and intermediary goods which constitute the major part of intra-industry trade (90 per cent according to Rayment).

in different countries. It is extremely difficult to capture this effect in a macro-economic model since it lies entirely on micro-technology characteristics and on decisions made by transnationals on the basis of socio-political conditions as much as on cost differential. The distinction between micro and macro effects is a fundamental difficulty which cannot be escaped in a macro-economic model.

63. In this respect, it may seem tempting to introduce market prices - or faute de mieux unit values derived from trade statistics - as an explanatory variable for trade changes. Whether factor proportions or economies of scale or any other variable lies behind the behaviour of trade partners, their decisions at the micro level, must be profitable at market prices. Hence, the idea, expressed by B. Herman (1978)[1/] that, rather than trying to explain trade by factors influencing cost (sector proportions) or prices (monopolies), it would be advantageous to introduce market prices directly as explanatory variables. A successful demonstration of this approach was actually made by the same author (see third part) at the five-digit SITC level. But a world system which would go down to that level of aggregation would be unmanageable, not to speak of the difficulty of projecting specific market prices in the long run, in particular for differentiated goods.

64. Using unit values, prices effects were actually tested in import equations, but price elasticities of imports were found to be relatively small at the level of aggregation of the UNITAD system[2/]. This may be due to the fact that at the level of aggregation of the model (seven baskets of goods), unit values are very far from true "prices" and include a strong "quality" bias. Unit values were also tested in a sub-model (the non linear semi-aggregated model) governing the competition between exporters in each region, i.e., the substitution between import shares. At the macro level (see third part), the results of the model, although not devoid of interest, have shown strong limitations. Orthodox price

1/ B. Herman - "Market Penetration: A Formal Analysis" mimeo (1978)

2/ Furthermore, in regional models, domestic prices are influenced positively by import prices so that high importing prices, for example, have a depressing effect on import volumes via the reduction of consumption and the resulting decrease in domestic activities.

elasticities (with a negative effect), in the north-south trade were only found for four groups of commodities; the volume shares, instead, were almost insensitive to prices for energy materials, intermediary products and equipment goods, i.e., three out of the four most important groups determining total imports. This result - partly due to the insensitiveness of the model and the level of aggregation, is probably not foreign, altogether, to the existence of oligopolies in those sectors (see table III in part III).

65. Another tool, the gravitational model experimented by J. Tinbergen, W. Leontief and several others, simple and crude as it may seem at first glance - admirably captures a number of substitutions between import shares in the four manufacture sectors. Its principle ties in well with the theory of "virtous circle"[1/] which explains the success of an exporter by a dynamic process of increased competitiveness through increased market size. A model of this type was also tested in the UNITAD system, where the spectacular breakthrough of East Asia on the North American market, or of Japan in all regions is well reflected (see tables I & II in the third part). The gravitational model, in which no price variable appears explicitly, can therefore be said to illustrate the effect of competitiveness (price and quality) on differentiated goods better than another model with explicit price variables.

66. Eventually, an empirical choice was made by the UNITAD team: trade shares are kept exogenous, but are derived in a cautious way from both sub-models. More will be said to justify these choices in the third part of this section.

1/ See in particular Bela Balassa in "Export Composition and Export Performance in the Industrial Countries, 1953-71" in "Review of Economics and Statistics" November, 1979.

(ii) Import functions: Complementarity and substitution processes

67. In each regional model, imports are determined separately for seven baskets of goods and one of services, i.e. three natural resources oriented-groups (agricultural products, raw materials, energy materials), four group of manufactures (intermediary products, consumer non-durables, equipment goods, consumer durables) and services. As in many input output models, the import vector (by production sectors[1/]) is substracted from the domestic demand and exports to yield a final demand bill which governs the output mix through the inverted matrix of input coefficients. The domestic output and its structure are therefore extremely sensitive to the magnitude of each import group. The larger (the smaller) that magnitude, the weaker (the larger) the corresponding domestic sectors. The system, however, is a simultaneous system of equation in which imports are in turn dependent on domestic activities and on policies variables, so that the general form of import functions, for any of the eight categories, can read:

$$\text{Imports} = f(\text{AV, prices, market size, DUT}),$$

in which AV stands for variables related to domestic activities and DUT is a dummy variable representing the protection level (both custom duties and non-tariff protections).

1/ The classification for the seven baskets of goods differs from that of production sectors. Imports and exports of goods are first determined in the "trade" classifications and then converted into imports and exports by production sectors through transition matrices. The transposed matrices serve as bridges between the two corresponding price systems.

68. The choice of these variables is meant to reflect two opposite influences on the level of imports, i.e., the activity variable (supposedly with a positive sign) governs complementary imports, while the other three variables (supposedly with a minus sign) tend to decrease the level of imports and determine a substitution process via the influence of imports on the final demand bill. The influence of prices, which intervene both directly and indirectly, will be examined in part III. The main originality of the import equation lies in the importance given to three substitution processes, i.e.:

- those induced by tariff and non-tariff protection;
- those made possible by the growth of the relevant domestic sectors as a result of national development policies, and in particular income distribution policies;
- those governed by the enlargement of market size through collective self-reliance policies, at regional or sub-regional level.

The last two processes are fundamentally the same but are captured in two alternative sets of equations, in which the "market size" variable is either the growth of output or the growth of pupulation. An additional remark which will be justified in the text is that both cross-country and time series analyses were used to estimate the equations.

69. As to the first substitution, an attempt was made to derive from past observations estimates of the impact of protectionist policies, reflected by the dummy variable called DUT, which required extensive

data compilation. The rate of import duties levied on each group of commodities was first compiled for each country, which involved averaging rates of duties for the various sub-items of the group. An estimate was then established by GATT and UNCTAD experts for non-tariff protection, i.e. the level of non-tariff protection was classified in three categories:

- no protection
- licensing
- level close to absolute prohibition.

Finally the tariff and non-tariff protection levels were cross-classified in a 3 x 4 matrix, each cell corresponding to a value of the dummy variable between 0 and 5. The cross-country analysis made the variable DUT appear, with the correct negative sign in all commodity groups, but its importance is variable. In particular, it was impossible to measure the effect of protectionist policies for consumer non-durables in developed countries. This may be explained in two ways: the level of protection was reported as identical in EEC countries, which may be an idealistic view of reality; this could be adjusted by using better indicators, but a more subtle argument may challenge further attempts: Non-tariff protection, in this sector, is said by some authors[1/] to take the form of restricting practices which would limit the amount and the choice of commodities produced by developing countries on sale on the market of developed countries.

1/ See G.K. Helleiner in "Structural Aspects of Third World Trade: Some trends and some Prospects in "The Journal of Development studies",April 1979.

70. The second type of substitution is induced by the growth of domestic sectors in the process of industrialization. As growth proceeds, new complementary imports emerge, which should be captured in the positive coefficient of the activity variable, while the growth of the competing domestic output should introduce a negative term in the import function. In time series, it is generally difficult to separate the two effects since the activity variable and the output of the domestic competing sector are often co-linear, but in a cross-country analysis these two "structural" effects can be, and in most cases were, separated. As an example, imports of agricultural goods are positively related to the growth of the manufacturing sector, i.e., an activity variable which conveys the emergence of new complementary imports, and negatively related to the growth of the agricultural sector, i.e., the market size variable which brings out the substitution effect.

71. The third substitution effect is the collective substitution process within a sub-regional or regional grouping. Here a simplifying treatment was adopted but the main purpose was kept, i.e., to measure the impact of such policies on the volume of trade outside the region. To this effect, an indicator denoting the market size in terms of total population was measured in the cross-country analysis. When using these equations (determined on a sample of countries) for the UNITAD regional models, the value given to that variable (and tested in time series) was that of the average market size (in terms of the population) of the region. The import functions thus appear to be very sensitive to the emergence of any sub-regional grouping through

its impact on the average market size within the region[1/]. It may be noted that there is no need in the model to identify the composition of any such grouping, as long as its population size is given.

72. The main findings of the analysis, on the magnitude of the three substitution effects, can be summarized as follows:

(a) the degree of protection, through variable DUT, is appearing in all commodity groups, but is more important in consumer non-durables (DG's), Equipment goods (Dg's and DD's) and Consumer Durables (DG's); in the latter groups, the coefficient of DUT, in the logarithmic equations, varies between - 0.2 and -0.3, say around - 0.25.

(b) to illustrate the impact of protection policies in the equations, it is sufficient to observe that the cut of imports of manufactures of the same country when the protection level increases from 1 to 5, will reach, in relative terms 63 per cent, in other words, the import level can be cut down to 37 per cent of what it is with no protection. The effect of the variable is therefore far from negligible, to say the least;

(c) population, as already observed by Chenery, is an efficient market size indicator which is not too much correlated with other variables and is significant in most logarithmic equations,

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1/ As an example, the average market size in Western Europe was around 45 millions of people before the Rome treaty, and reached the magnitude of 120 millions of people in 1970 mostly as a consequence of the emergence of the EEC (at that time, the six). Note that the average is computed using population figures as weights.

with a coefficient around - 0.3. This means that, if a country of 10 million inhabitants joins an economic grouping of 100 millions, the imports of manufactures from outside the grouping will not be multiplied by 10 (all things being equal), but by 5, in other words with a significant market size effect (a 50 per cent cut);

(d) the substitution process induced by the growth of the competing domestic output is also observed in all equations as growth proceeds. This is measured by the negative coefficient of the sectoral output, or sometimes GDP. The best example is given by the equipment good imports where the elasticity of GDP, for developing countries is - 0.8. A 6 per cent annual growth of GDP over 10 years generates a market 1.8 times which induces a substitution effect amounting to 20 per cent of the increase.1/

1/ The ratio of imports between the second period and the first is given by two terms: a positive term with an elasticity of 1.4 relative to investment which, in this case will yield a multiplying factor of 2.3; and a negative term tied to GDP which gives a multiplyer of 0.6 so that the ratio will amount to 1.4 only (80 per cent of 1.8). This can be compared with the substitution effect given by the term Ln POP in paragraph (c). Assuming an increase of 1.8 means in this case the forming of a sub-regional grouping which increases the average size by 80 per cent (in the case of the EEC, this average size tripled). This yields a multiplyer of 1.45 for the imports, i.e., a result very close to the one obtained by the growth of GDP.

(e) as was already observed, the three variables inducing substitution effects, would not appear in a time series where they are in general co-linear with growth. The cross-country analysis made it possible to distinguish these effects, except in cases where the protection variable appears to be correlated with the size of countries. This is observed for DG's for agricultural goods, raw materials, energy materials and equipment goods. The economic interpretation is interesting since it suggests (particularly for equipment goods) that large countries tend to impose a substitution policy through protection policies in these sectors. In such cases, the model builder can only impute the substitution effect to one of the two variables, actually the market size, on the assumption that an adequate level of protection is imposed.

(iii) Trade matrices and trade shares: the competition between exporters

80. The trade interaction between the eleven regional models is obtained through seven trade matrices. Regional models generate eight import figures by production sectors. Imports of services are merely totalled and the world total is distributed to exporting regions according to a given structure (pool system). Imports of goods, after conversion into the trade classification, provide margins for the seven trade matrices (one for each good basket). In any matrix, the 11 x 11 import shares generate export flows for each region. If shares were kept constant the model would be purely demand oriented, since exports growth would be entirely governed by the growth of the importing

regions in each specific basket of goods. The interesting point, in this respect is the diversification of imports by seven categories with fairly different demand behaviour: Food imports are dependent on the growth of agriculture, a weak point in many developing regions. Raw Materials and Energy have low growth elasticities relative to GDP, and their growth (in real terms) is slow if developed economies, which have the lion share of the demand, are depressed. The demand for intermediary products and for equipment goods emanating from developing regions is very fast, as was observed in the first chapter (mainly due to the accelerator mechanism for equipment goods). The structure of imports, in the model, will therefore closely follow the changing industrial structure and the development strategies simulated in the model. In particular, it is worth recalling that protection policies (variable DUT) and ECDC (variable Δ POP) as well as price elasticities can check the demand for imports considerably.

74. Import prices (by basket of goods) are generated by export prices (and the transposed matrix of shares), which are determined by two factors: firstly, the price of domestic final demand and an exogenous price differential. The former is a cost-price generated by the I/O table from the prices of Value-Added by sector, which are themselves dependent on exogenous assumptions made on the shares of primary factors (capital, labour), and an inflation trend. The latter, i.e., the price differential, is meant to represent a rent (or an export duty) for primary goods, especially energy.[1/]

1/ The resulting income accrues to the Government, in the present version. It can easily be channelled to other agents (households, enterprises) by changing a vector of parameters.

In the present version, such differential is different from zero only for agricultural goods, raw materials and energy. The model can, therefore, simulate the changes introduced in exogenous world prices on the trade balance, the terms of trade, etc.

75. The competition between exporters (reflected by substitution between trade shares) introduces a crucial element in the determination of exports. As already observed, two sub-models (the gravitational and the semi-aggregated models) were tested to make these shares endogenous, but the final decision was to use these models with caution outside the system, as a guidance to determine trade shares. Before examining these sub-models, it can be observed that in a simulation model like the UNITAD system, trade shares can be used to simulate trade policies, so that, irrespective of the merit of a sub-model, it seems legitimate to treat trade shares not as endogenous, but as policy parameters. Simulations will actually be carried out with trade shares fairly different from their trend values, in scenarios imposing various trade configurations, e.g. increased penetration of DG's on on the market of DD's, or collective self reliance policies.

76. The gravitational model is well-known in the economic litterature[1/]. Any bilateral flow for a specific commodity depends on three variables[2/].

1/ Similar models have been suggested by authors such as H. Theil, W. Leontief, J. Tinbergen. See also UN ECE Economic Bulletin Vol.24/2, "Trade Network Projections and international consistency tests", New York, 1973.

2/ The analytical expression of the model is as follows:

$$S_{ij} = \frac{a_{ij} X_i^{b_{ij}} M_j^{c_{ij}}}{\sum_i a_{ij} X_i^{b_{ij}} M_j^{c_{ij}}}$$

with S_{ij} = share of region i in imports of region j

X_i = total export of region i (all destinations)

M_j = total imports of region j (all origins)

The a_{ij}'s, b_{ij}'s, c_{ij}'s were estimated so as to minimize the sum of a weighted square of the differences between the observed and the calculated shares for the period 1963-75. The weights were taken as the inverse of the observed shares, so as to give more importance to small shares.

(a) total imports (all origins) of the importing region;

(b) total exports of the exporting region;

(c) an "economic distance", estimated by the model, but which can be parametrized, which is influenced not only by transport conditions but by a host of institutional and sectoral characteristics. The justification of the model lies both in the observation that the share of exporters depend on the competitiveness of the exporter (the theory of virtuous circle), the growth of the importing market and economic and institutional factors embodied in the economic distance. Admittedly, the model is fairly mechanical, in that it can generate exponential changes in partners shares while, in reality, adverse forces are bound to slow down and eventually limit the growth of the share of any exporter. Lower and upper limits have, therefore, to be put on the results of the model before using it. For this reason, it has been felt preferable to leave it outside the system but to take "cum grano salis" the trends in manufacture shares derived from it. Table I and II illustrate the shares which have been moved upward in the trend scenario, based on tendencies found in the gravitational model using the same growth rates by regions. As already observed, the penetration of Japan in the equipment goods and consumer durables sectors and of East and South East Asia in the intermediary goods and non-durable goods sectors extend to almost all regions.

INCREASING SHARES FOR MANUFACTURES IN THE TREND SCENARIO 1975-1990

(1) 1974 share and (2) 1990 shares in percentage points

1. Increasing Import shares in Developod markets*
(data derived from the gravitational model)

Basket of Goods	Importing Markets									
	North America Exporting Regions		Western Europe Exporting Regions		Eastern Europe Exporting Regions		Japan Exporting Regions		Other DD Exporting Regions	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Intermediary Products	WE 30.0	36.0	WE 79.2	84.0	AS 0.3	3.0	NE 3.6	10.8	JP 19.8	25.7
	OA 0.1	1.0	EE 3.3	3.6			AS 14.7	23.5		
			JP 2.2	2.9						
Non-Durable Goods	OD 0.2	0.3	WE 81.2	85.3	NE 2.8	11.2	AS 37.4	56.1	NA 18.6	37.2
	LA 5.5	11.0	EE 3.1	4.0	IN 2.0	2.2			LA 1.0	10.0
	AS 23.2	30.2	IN 0.6	1.2	AS 0.3	3.0			IN 1.2	1.8
Equipment Goods	JP 13.9	27.8	JP 5.1	9.2	IN 0.1	0.8	WE 26.6	27.9	EE 0.2	0.3
	LA 1.0	5.0					EE 0.7	4.2	JP 15.2	38.0
	AS 3.4	8.5					OD 0.9	6.3	IN 0.1	0.6
							LA 1.1	11.0		
Consumer Durables	OD 2.2	4.4	JP 5.7	13.7	NA 0.9	1.4	OD 1.8	2.7	JP 18.9	37.8
	LA 3.4	9.5	LA 0.7	1.0	EE 16.1	32.2	LA 3.6	10.8	LA 0.3	2.4
	NE 0.1	0.3	AS 2.3	3.5	JP 2.4	7.2	TA 0.1	0.2	IN 0.4	1.6
	AS 10.1	18.0			LA 0.1	0.5	IN 1.1	3.3	AS 5.6	6.7
					NE 0.6	6.0	OA 2.6	7.8		
					IN 0.3	3.0				
					AS 0.1	0.6				

* See symbols for regions in Table II. Intra-trade shares are underlined.

II. Increasing Import shares in Developing markets (1) = 1974 (2) = 1990
(data derived from the gravitational model)

Basket of Goods	Importing Markets																	
	Latin America Exporting Regions			Tropical Africa Exporting Regions			West Asia and North Africa Exporting Regions			Indian Sub-Continent Exporting Regions			East and South East Asia Exporting Regions			Other Asia (CPE) Exporting Regions		
		(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)
Intermediary Products	JP	13.8	27.6	EE	2.3	4.6	EE	6.5	9.1	EE	33.3	38.3	OD	4.4	7.0	JP	45.8	57.3
				LA	1.1	7.7	JP	18.9	28.3	OD	1.9	3.0	LA	0.4	4.0	OD	1.4	4.2
				TA	8.7	12.2	OD	0.8	1.6	LA	0.8	1.4						
				OA	0.8	3.2	LA	0.2	0.4	NE	2.2	2.9						
										AS	3.8	9.5						
Non-Durable Goods	LA	22.2	44.4	LA	0.2	2.0	JP	8.4	9.2	OD	0.2	0.5	JP	16.3	29.3	EE	46.5	53.3
	OA	0.2	0.8	TA	3.2	5.8	LA	0.1	1.0	LA	0.1	1.0	OD	4.3	7.5	AS	4.1	12.4
				OA	4.4	13.2	TA	0.1	0.2	IN	7.4	16.3	LA	0.5	5.0			
							IN	1.6	4.0	AS	4.2	16.8						
							AS	6.3	12.6									
							OA	3.8	9.5									
Equipment Goods	JP	14.4	28.8	EE	1.3	5.2	EE	12.8	19.2	EE	25.3	50.0	NA	30.9	32.4	JP	25.7	48.8
	LA	6.1	11.0	LA	0.4	4.0	JP	7.3	14.6	LA	0.1	0.4	EE	0.7	2.1			
				TA	0.5	0.7	LA	0.2	1.8	NE	0.1	0.6	JP	33.6	38.6			
				OA	0.3	0.8	NE	1.3	3.9	IN	7.0	7.7	OD	2.2	4.1			
													LA	0.2	2.0			
													IN	0.3	1.8			
Consumer Durables	EE	28.5	34.2	OD	31.4	43.6	JP	15.8	23.7	IN	37.8	52.9	EE	2.4	7.2	EE	21.1	31.2
	JP	16.9	17.2	LA	0.2	2.0	LA	0.3	3.0	LA	0.1	1.0	OD	3.4	10.2			
	LA	7.5	13.5	NE	0.1	0.4							LA	0.2	1.6			
	IN	0.1	0.3															

Symbols for Regions:

NA = North America
WE = Western Europe
EE = CPE, Europe
JP = Japan
OD = Other Developed
LA = Latin America
TA = Tropical Africa
NE = West Asia and North Africa
IN = Indian Sub-Continent
AS = East and South East Asia
OA = CPE, Asia

Note: Intra-trade shares are underlined.

77. The semi-aggregated model[1/], which is also used as a guidance to project the exogenous shares, is based on an extension of the linear expenditure system used by R. Stone in projecting private consumption in his long-term growth model. The explanatory variables for any bilateral flows are the total imports of the importing countries and the prices (here the unit values). The original linear model has been modified so as to introduce a logistic curve for the share of each exporter (estimated by econometric methods). This model therefore has two advantages, the first is to estimate the influence of prices in the competition between exporters, and the other to introduce the idea of a ceiling (an asymptotic share) for any share.

78. It was hoped originally that the model could be used to illustrate what was called the "Tinbergen theory of diminishing elasticities" by B. Herman[2/]. Four decades ago, Tinbergen introduced the concept of elasticity of competition, i.e. the penetration (change in market share) which accompanies a one per cent reduction of relative prices. The law of diminishing elasticities as expressed by B. Herman, predicts that "if a small supplier lowers his price, he will attract not only new buyers, but also some of his competitors customers". But if the largest supplier "tends to monopoly, he may well enlarge the market but the share he holds will be less and less affected by price change". This was actually tested by Herman on 258 five digit commodities, in which diminishing elasticities were found for about two third.

79. Unfortunately, the tests conducted on the semi-aggregated model proved disappointing in several respects. Although the fit is generally good, allowance has to be made for two defects, i.e. the position of the

1/ Acknowlegdgement should be addressed to Dr. J.J. Snella, Department of Econometrics from Geneva University, who designed and computed the model, and to Dr. B. Herman, Netherland Economic Institute, who kindly discussed the first results with the UNITAD team.

2/ See. B. Herman. Market penetration: a formal analysis, Mimeo - Netherland Economic Institute.

asymptot has little to do with diminishing price elasticities, and more generally, at the level of aggregation of the UNITAD system, the model is relatively insensitive to price changes. It has however the merit of being relatively stable, as compared to the gravitational model, and to give a first impression on price substitution. This can be illustrated by conducting two simulations of the semi-aggregated model. In the first, (S_1), 1990 prices offered by developed suppliers are twice their 1975 level, while the price offered gy developing suppliers is kept constant at the 1975 level. In the second (S_2), the price changes are inverted for the groups, so that developed suppliers have a comparative advantage. The following table compares two past shares (1964 and 1974), the projected 1990 shares of the gravitational model and the two responses (S_1 and S_2) of semi-aggregated model:

III - Export shares of Developing regions in trend simulations
(World=100)

Volume shares in per cent

Commodity Group	1964	1974	GRAV 1990	S_1 [a]	S_2 [b]
1. Agricultural [c] products	36.8	31.5	26.3	32.2	28.3
2. Raw Materials	28.3	32.2	24.3	40.9	27.7
3. Energy Materials	60.6	65.5	75.8	65.4	67.3
4. Intermediary Products	10.8	10.0	12.3	11.5	9.9
5. Non-Durables	12.9	16.1	26.8	35.3	19.6
6. Equipment goods	0.9	2.5	7.5	4.9	4.5
7. Durables	9.4	8.9	17.7	18.0	12.4
Totals: [c]					
Primary goods (1 to 3)	36.9	35.5	46.3	48.0	43.0
Manufactures (4 to 7)	6.8	7.3	12.5	13.3	9.0

a/ Comparative advantage to DG's
b/ Comparative advantage to DD's
c/ Also includes Processed Food

As can be seen from Table III, simulation S_1, in which DG's have a comparative advantage, yields figures above the gravitational model for Agricultural products, Raw materials, Consumer non-durables and durables.

On the other hand, the volume shares are, even in the most favourable simulation, inferior to those of the gravitational model for energy materials, intermediary products and equipment goods, and are almost insensitive to prices, so that, if the volume share is kept constant, the current value share has a positive price elasticity close to 1. This might be plausible for energy materials and perhaps equipment goods but much less for intermediary products. All in all, the semi-aggregated model was used to generate (outside the model) "reasonable" exogenous shares for primary goods for the trend scenario, and their price elasticities could be used with caution in the system itself in a future version.

80. A last remark should be made on trade shares for primary goods. It stands to reason that supply considerations should be introduced in any projection for the long or very long-term future. Since no supply mechanism is built in the model for raw and energy materials, this can only be done by manipulating trade shares exogenously. This, again, is a justification for keeping these shares exogenous.

81. The results of the introduction of the projected shares in the trend scenario will be fully commented in Chapter 3. It may be sufficient to say that, when comparing the impact of 1974 and trend shares, the balance of goods and services, in current values, seriously deteriorates for North America and slightly for Western Europe, drastically improves for Japan, and moves upwards for Latin America, West Asia and North Africa, India and East Asia; the other regions are not very much affected.

ANNEX I

PRODUCTION FUNCTIONS - TWO DETAILED ANALYSES

A. The case of the primary processing sector

1. The sample included nine developing countries for two five-year periods each (eighteen observations) and nine developed countries (eighteen observations), altogether 36 observations. For the group as a whole, the correlation matrix of the variables reveals a strong positive correlation (+0.8) between Capital intensiveness (Caple) and market size (-Du), which can be expected[1/]. For the group of developing countries, two specific correlations are observed. The first, positive between plant size (Tle) and market size (-Du) (+0.6), and the second negative, between plant size and capital intensiveness (-0.7). The latter correlation suggests the existence, in these countries, of large plants (in terms of workers) with a simple type of processing requiring little capital. This is a general feature for all manufacturing sectors. No such correlations are observed for developed countries.

1/ For developing countries, the following regressions obtains:

$$Caple = 1.2 - 0.9\ Du \quad (R^2 = 0.60)$$

This explains the growth of Caple over time.

2. The behaviour of the exogenous variables over time is interesting: the value-added coefficient (Ivy) increased in both country groups, thus the share of material inputs increased slower than the share of value-added, but the reasons may be different for DG's and DD's. In DG's, both the plant size and the capital intensiveness increased fastly over time, while the increase was very small for DD's, due to a decrease of Caple in the course of recessions for some countries. In DG's, therefore, the increase of Ivy can be related to a structural change of technology, while for DG's this is likely to be a short term cyclical effect[1/].

For the group as a whole, three equations can be mentioned to illustrate the technology:

(1) $R^2 = 0.74$ $\quad$ Ln LP = 3.4 + 0.68 LnCaple + 0.96 LnIvy
(4.5) (8.9) (4.6)

(2) $R^2 = 0.84$ $\quad$ Ln LP = 6.7 + 0.32 LnCaple + 0.65 LnIvy - 0.25 Du
(7) (3.3) (3.7) (-4.7)

(3) $R^2 = 0.86$ $\quad$ Ln LP = 6.7 + 0.28 LnCaple + 0.65LnIvy - 0.27 Du +0.16t
(7) (3) (4) (-5) (2.3)

Equation (1) relates productivity with Capital intensiveness and value-added coefficient. When market size is added up (equation 2), the coefficient of determination increases from .74 to .84, and the coefficient of Caple is more than halved (from 0.68 to 0.32), on account of the correlation between Caple and Du. This outlines the importance of market size in the technology. Finally, the trend for neutral technical progress in equation (3) (+0.16t) can be attributed to DD's only, probably thanks to the slow increase of Caple at a time productivity kept growing. For the group of DG's alone, the two variables (Caple and time) are colinear and no "neutral" technical progress emerged when computing the same regression for that group.

1/ No account was taken of change in capacity utilization for the sake of simplicity, in a period when, for most countries, growth was consistently high up to 1974.

The case of the light industry

3. The sector includes not only the major ISIC group for the textile industry but also ISIC division 381, i.e. metal products and a number of other industries (furniture, rubber and plastic products etc...). The regression analysis is based on 20 observations for DG's and the same number for DD's (40 observations altogether).

4. The correlation matrix of the variables for the whole sample reveals positive correlations of productivity with value-added coefficient (0.8), Capital intensiveness (0.7) and market size (0.7), as well as loose correlation between capital intensiveness and market size (+0.45), value-added coefficient and market size (+0.44). A check on the two correlations matrices for DD's and DG's separately shows hardly any influence of market size on any variable within each group, so that the observed correlations are based on differences between the two groups of countries. Furthermore, no correlation can be observed between any of the variables and time.

ties in with a result of the main component analysis relating the input coeffic ents to the output mix (textile and sometimes plastics products, in DG's, and a balanced basket of industries in DD's).

5. In both groups, the value-added coefficient decreased during the observation period. The increasing share of material inputs can perhaps be interpreted as a move of the output mix towards the production of intermediary goods away from the final product (in DG's, from clothing to textile processing, etc...). An inverse behaviour of plant size opposes DD's and DG's: the number of workers decreased in the former group and increased in the latter. The Capital intensiveness increased everywhere, faster however in DD's compared to DG's, as can be expected.

6. The regressions of productivity on explanatory variables are poor in DD's ($R^2 = 0.42$), good in DG's and in the sample as a whole. For DG's the following relations obtain:

(1) $R^2=0.88$ Ln LP=5.06 + 0.5Ln Caple + 1.3 Ln IVY

(4.6) (3.8) (9.7)

(2) $R^2=0.92$ Ln LP=5.9 + 0.5Ln Caple + 1.2 Ln Ivy - 0.2 Ln Tle - 0.2 Du

(6) (4.9) (10.6) (-2.7) (-2.1)

The first equation shows that 88% of the variance is explained by two variables, i.e., capital intensiveness and value-added coefficient, the latter reflecting structural changes in output-mix. The second equation completes the picture by showing that another 4% of the variance is explained when adding up two variables, plant size and market size. The negative coefficient of the number of workers per plant introduces dis-economies of scale (see remark already made for the primary processing industries). To note also that the market size (Du) is hardly significant for the DG's alone.

7. One may compare the above equations with the regression obtained for the sample as a whole (DG+DD):

(3) $R^2= .91$ Ln LP = 5.1 + 0.5Ln Caple + 1.2Ln Ivy - 0.26 Du

(5.8) (5.8) (9.9) (-5.1)

(4) $R^2= .92$ Ln LP = 5.6 + 0.5Ln Caple + 1.2Ln Ivy - 0.16Ln Tle - 0.25 Du

(6.5) (6.0) (10.5) (-2.2) (-5.2)

These equations are very close to equations (1) and (2) but the market size variable is much more significant, for the reason already observed, and the coefficient of plant size less significant. By far the most significant variables are capital intensiveness (Caple) and Value-added coefficients (Ivy), thus confirming that the "technology", in the macro-economic sense is explained by the capital labour substitution and the output-mix. This leaves choices for a variety of industrial strategies.

III. The Agricultural Sector [1/]

Introductory remarks

82. In the economic literature of the 1950's and 1960's the role of agriculture in development was seen as secondary, and its functions were considered complementary to those of the industrial-modern sector. The latter was thought to represent the main sector of accumulation and growth. Subsequent theoretical investigation and the very disappointing performance of agriculture in most developing countries during the last two decades have convinced many observers and policy-makers that the role of agriculture in development should be radically reexamined [2/].

83. Erratic and inegalitarian growth, persistence of malnutrition, periodic famines, extremely slow growth of agricultural incomes, together with increased food dependence from abroad, have continued to affect, although with different intensities, a large number of developing countries. The African and Scuth East Asian ones were particularly badly hit. The figures of Table IV, in fact, show that with the exception of the Centrally Planned Economies of Asia and of the West Asia countries, agriculture and food output per capita have increased at low or negative rates.

Table IV: Growth Rates of Agricultural Output per Capita

Region*	Agricultural Output per Capita		Food Output per Capita	
	1960-65 to 1970	1970 1976	1961-65 to 1970	1970 1976
Africa	0.2	-1.5	0.1	-1.4
L. America	0.2	0.1	0.8	0.5
West Asia	0.4	1.1	0.3	1.4
Far East	0.8	0.1	0.9	0.2
Asian CPE	1.0	0.7	0.9	0.6

Source: FAO, Fourth World Food Survey, Rome 1977
*These regions only broadly coincide with those defined in UNITAD

1/ This section summarizes and updates the paper "Institutional and Technical Factors in Agriculture: Evidence for Selected Developing Countries" (by G.A. Cornia), July 1980, submitted to the ACC Working Group of the Task Force on Long-term Development Objectives.

2/ The U.N. Committee on Development Planning, under the chairmanship of Tinbergen, recognised the need for such a reexamination already in the 1960's.

84. However, the situation is substantially worse than highlighted by these overall tendencies. Indeed, the initial conditions from which the low growth has been taking place were already quite distressing. In most developing countries average per capita food supply was conspicously lower than requirements, while food consumption was traditionally very skewed. Now, recent investigation has shown that such inequality would appear to have increased even in countries experiencing relatively rapid agricultural growth. Thus, the combined effect of low starting points, slow or negative growth of food output per capita, and the worsening of the distribution of income and food consumption explain how the number of people with a deficient food intake has increased, and how the food threat continues to hang on many countries.

85. Quite evidently, slow and inegalitarian agricultural performance has been accompanied by a very slow growth of agricultural incomes, rural wages and small farmers incomes in particular. This tendency has often been reinforced by a deterioration of the internal terms of trade. Besides obliging many peoples to go by with empty stomachs, such a situation has contributed, in many instances, to reduce effective demand and, thus, to keep domestic industrial output low. It is now widely acknowledged that at the early stages of development, the role of agriculture in overall growth is determinant and that succesful industrialization policies can hardly take place unless a viable, surplus-generating agriculture has been created. As the Chinese say, agriculture is the foundatior, and industry the leading sector. If the foundations are weak - to continue the analogy - industry collapses. Similarly, the growth of agriculture is very much conditioned by the supply of key industrial inputs.

86. Economic theory and empirical investigation have, by now, showed how strictly interwoven are the growth of the two sectors. It is customary to summarize the major interplays of industry and agriculture in the following way:

(1) Food and agricultural raw materials are supplied to the other expanding sectors of the economy, usually industry and services. Were this flow to be insufficient or irregular, industrialization would be likely to be jeopardized by inflation, profit squeeze, increasing wages, declining domestic demand for manufactures and labour unrest.

(2) Part of rural cash incomes are spent for the purchase of industrial products. It is now clear that the growth of industry cannot take place exclusively via the growth of export markets owing to increasing protectionist and 'beggar-your-neighbour' measures. Hence, in developing countries, a conditio sine qua non for sustained industrial growth is the growth of the domestic market, through the increase and fair distribution of agricultural incomes.

(3) Particularly for those economies without a 'rent' sector, such as gold or oil mining, agriculture has to carry the weight of generating investible surplus, at least at the early stages of development. Indeed, the multiform squeeze of agriculture has permitted the accumulation of capital in industry in many of today's developed countries. A weak, stagnating and feudal agriculture cannot carry that weight. Many consider, therefore, that only rapid and diffused growth of agriculture can generate the necessary surplus to be used for capital accumulation in industry.

(4) The gradual modernization of agriculture entails a continuous flow of inputs originating in industry, such as cement, fertilizers, pesticides, more or less simple farming implements, pumps and, when mechanization sets in, tractors, trucks, etc. Two broad industries are responsible for the supply of such items, i.e. the equipment-good and the basic-product sectors. Their growth is therefore to be considered essential if agriculture has to take off. Unfortunately, however, many developing countries are dependent in these sectors on the vagaries of foreign trade.

87. So, although there is nowadays a large consensus on the need for increasing agricultural output while drastically improving rural income distribution, views and policies differ widely on how to attain such objectives. According to what could be labelled 'the technocratic option', output growth and rural development are largely a technical problem. More land, more inputs, more labour, etc., should be imputed to agriculture, which would by this very fact see its output increase steadily. According to the opposite view, 'the institutional option', the existing economic and power structure in agriculture is the major obstacle to rural development. The provision of more and improved inputs, it is conceded, although necessary, would not be sufficient to ensure a fast and egalitarian growth, capable of wiping out rural poverty. The increase in the supply of inputs should be accompanied, or preceded, by measures assuring broadly equal access to land and other productive assets to the rural population. This could be achieved either through land redistribution or through some type of collectivization of agriculture. According to this view, the experience of South Korea and Taiwan or of China prove the feasibility of such blueprint in the two cases hypothesized. Of course, there are also many other 'options' which combine elements of the one and the other in various ways and degrees.

88. Quite evidently, the adoption of one instead of the other approach would have very different consequences in terms of benefit from growth, as well as in terms of the speed of such growth. In addition, the entire agriculture-industrial relationships and, hence, overall growth, would likely be affected in very diverse ways. This is why, to the most possible extent, an attempt has been made in the UNITAD system to model the structure and functioning of agriculture so as to test alternative rural development policies. In particular, the model has been devised in a way so as to simulate an input intensive path, as well as the effects on agricultural growth of an hypothesized land reform.

The formalization of the agricultural sector

89. As one can easily note from the preceding remarks, for obvious reasons, the agricultural sector has been given a different treatment in developing versus developed countries. In the latter, agriculture does no longer play a predominant role, neither in production and accumulation nor in distribution and consumption. This is why the production, technology and distribution aspects have been treated in a simpler way. Agricultural final demand is fixed mainly by the level of domestic food consumption and by trade in agricultural commodities. Through the Leontief relation, the model determines jointly the level of output and value added to be produced by agriculture. Once agricultural value added is known, labour productivity in agriculture is made dependent from the overall level of productivity of the economy. Indeed, it has been observed [1] empirically that the relation $L_1/L = f(VA_1/VA)$ (with L and L_1 and Va and VA_1 representing overall and agricultural labour force and value added) tends to behave according, both over time and across countries, to a reasonably uniform pattern.

1/ See Danieli Luisa: "Labour Scarcities and Labour Redundancies in Europe by 1990: an Experimental Study", Dipartimento Statistico Matematico, Università di Firenze, 1971.

90. In the linear case this relatinn can be transformed as follows: $VA_1/L_1 = \alpha + \beta VA/L$. This relation makes labour productivity in agriculture dependent from the overall one. Labour demand can thus be derived by dividing total value added by labour productivity. Technical conditions of production (land, cropping intensity, inputs, etc.) are not made explicit in this framework, except by the structure of the inputs vector in the input/output table. Of course, the value of such vector strongly influences the level of value added as well as the demand for inputs. Investment demand is derived by multiplying labour demand for a given capital/labour ratio.

91. For developing countries, agriculture has been modeled in greater detail, so as to take into consideration those variables which are considered by informed observers as the key to rural development. To start with, land - which is explicitly introduced into the system - and other resources are distributed to three types of landowners: large, medium and small (in Africa the distinction which has been made is between subsistence holdings and plantation sectors). The definition of large, etc. varies according to the overall degree of land-scarcity. In Latin America, for instance, small farms can reach 20 hectares and large farms exceed 200 hectares, while in South and East Asia, small and medium farming never surpass 2 and 10 hectares. Production takes place on each of the three types of farms according to different techniques. Indeed, it has been observed that the inputs of land, intermediate inputs and capital per worker are higher in larger holdings, while the opposite is true for labour inputs and cropping intensity. As a result, labour productivity is generally higher, while yields per hectare are lower on big estates. Since the distribution of land among the three types of farms is kept exogenous in the system, it is possible to reckon the effects of alternative

patterns of landownership in terms of land, labour and capital inputs, as well as in terms of agricultural output and value added. Hence, the model can be used to explore the employment, output and distributional effects of land reform. The results of such a strategy can be contrasted with those of strategies emphasizing agricultural modernization through a more intensive use of fertilizers and machinery.

92. The explicit introduction of all production factors also allows experimentation with different types of agricultural modernization and technological transformation. For instance, one may explore the viability of the "East Asian pattern" (as applied in Japan, Taiwan and China) which requires an increase in fertilizers, labour and infrastructural works (mostly for irrigation) versus that of the "Western pattern", where an increase in intermediate inputs has been accompanied by mass mechanization, increase in the size of holdings and progressive expulsion of labour from agriculture.

93. For developing countries the model also introduces the cropping intensity (as the ratio between harvested and farmed area) as well as the total land supply. The latter is equal to the amount of arable land plus land extension, which should not exceed the maximum feasible values as estimated by FAO. The introduction of these variables allows to test other agricultural strategies based, where possible, on the extension of the arable area (as in Latin America) or on the extension of the harvested area by means of higher cropping intensities. These strategies, however, are not costless. An increase of the arable area generally requires a considerable investment - up to 2,000-3,000 1975 US$ per hectare - in land clearance and preparation. Similarly, an increase in cropping intensity entails year-round irrigation and, hence, the execution of works of canalization, well-digging, etc. Unless these activities are carried

out through the mobilization of surplus labour, a strategy of this type may require the substantial shift of investible resources towards agriculture.

94. The overall functioning of the agricultural sector in developing countries is similar to that adopted for the developed ones. Agricultural final demand depends upon domestic food consumption (which, in turn, varies according to the overall level of income and its functional and size distribution) and upon trade in agricultural commodities. Agricultural output and value added are obtained through the Leontief's inverse relation. In the case of developing regions, as a next step, the share of value added and output to be produced by each of the large, medium and small farming sectors depends upon the amount of land allocated (exogenously) to each of them. In each of them labour productivity is dependent on LN/WO (land per worker), CRI (cropping intensity), KA/WO (capital per worker) and (GO-VA)/WO (intermediate inputs per worker). In symbols, VA/WO = f [LN/WO * CRI, KA/WO, (GO-VA)/WO]. As noted earlier, the exogenous variables of this function are very different in the large, medium and small farms. This entails that labour productivity, as well as the requirements for land, labour, capital and other inputs, will vary considerably for the three different types of farming. Total productivity and requirements are obtained by adding up the three sectors. It follows that production factor requirements are considerably affected by the share of land accruing to each class of farms. Labour and capital demand in agriculture are added to those of the other sectors of the economy and compared with their corresponding supplies, so as to determine the total excess or shortage of production factors. Similarly, total land demand is compared with land supply so as to assess whether the strategy envisaged is plausible or not. A negative land gap is clearly not feasible and the assumption on which it is based should therefore be modified.

Results of the empirical analysis [2/]

95. In the analysis of these various issues, a number of alternative data sources have been used. The most important is an unpublished collection of production data at the farm level, provided by the Farm Management and Production Economics Service of FAO. For 19 developing countries, this source provides farm data concerning owned, operated and harvested area, cropping intensity, labour, capital and fertilizer inputs, output, value added and others. All developing regions of the UNITAD system are adequately represented in such a sample, which covers 3167 farms altogether. These data have been used for estimating the labour productivity functions. Other sources of data include the results of the 1960 and 1970 'World Census of Agriculture' by FAO and 'Agriculture: Towards 2000', recently issued by FAO. They have been used particularly for the compilation of the data on land distribution, land use patterns, land supply and cropping intensities. The 'Economic Accounts for Agriculture' by FAO, the 'United Nations Yearbook of National Accounts' and the United Nations document PPS/Q1R/5 'Major Economic Indicators Showing Historical Development Trends' have been used to cross-check the data on labour, intermediate inputs and capital use obtained from the FAO collection of farm data. Lastly the input/output tables provided by UNIDO were used, as for the other sectors, to take care of intermediate consumption for both developing and developed regions. For the latter, the productivity relation outlined above was estimated on data contained in document PPS/Q1R/5.

96. The results of the analysis concern the test of the farm-size/land-yield relation; the estimation of labour productivity relations; the analysis of substitutability and/or complementarity among production factors; and,

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2/ The results presented here refer only to the developing regions. For the developed ones the empirical analysis has consisted solely in the estimation of the parameters of the functions $L_1/L = a+b\ VA_1/VA$. Their interest being limited, they have been omitted in this presentation.

the compilation of trend value for the exogenous variables of the agricultural sector. The latter will receive only a brief mention here.

97. Concerning the relation between farm-size and land-yield for the 15 developing countries, which could be retained after debugging the original tapes, a number of indicators have been ranked in ascending order according to the size of the farm (measured in hectares). They are: gross output per hectare (GO/LN), man-days of work per hectare (MD/LN), intermediate inputs (seeds, fertilizers) per hectare ([GO-VA]/LN), capital per hectare (KA/LN), cropping intensity (CRINT), gross output per worker (GO/WO) and gross output per man-day (GO/MD). When examining these indicators, a number of clear relations appear to hold true for practically all the developing countries studied. The main findings show that: a) factors inputs per unit of land man-days, cropping intensity, intermediate inputs and capital, are inversely related to the size of the farm; b) yield per unit of land, measured in output as well as in value added terms, also decrease as the size of the farm increases; c) labour productivity increases as the size of the holding rises. Regression analysis has been used to obtain a rigorous test of these evident tendencies. For this purpose, the following models have been estimated, for each country, using the original farm data:

a) resources use	$\log MD/LN = a + b \log LN$	
	$\log KA/LN = a + b \log LN$	
	$\log (GO/VA)/LN = a + b \log LN$	
	$\log CRI = a + b \log LN$	
b) land yield	$\log GO/LN = a + b \log LN$	
c) labour productivity	$\log GO/WO = a + b \log LN$	
	$\log GO/MD = a + b \log LN$	

The results of this test are presented in Table V hereafter, which confirms, to a very satisfactory extent, the existence of a negative relation

Table V: Elasticity of Output, Man-days, Intermediate Inputs, Capital (all per hectare), Cropping Intensity and Labour Productivity with respect to Farm Size

COUNTRY	GO/LN	MD/LN	[GO-VA]/LN	KA/LN	CRINT	GO/WO	GO/MD
Barbados	-0.36	-0.51	***	-0.53	-0.22*	0.37	0.16**
Mexico	-0.20	-0.77	0.32	-0.38	0.07	1.07	0.58
Peru	** *	-0.43	***	* **	-0.15	0.80	0.47
Ethiopia	-0.55	-0.94	-0.30	-1.00	0.15*	0.26	0.38
Nigeria	-0.23	-0.57	-0.18	-0.56	***	0.59	0.29
Tanzania	-0.47	-0.57	-0.67	-0.95	-0.07	0.27	0.04*
Uganda	-0.74	-0.83	-0.74	-0.59	-0.41	0.15*	0.09
Syria	-0.64	-0.71	-0.60	-0.63	-0.17	0.20	0.08
Sudan	-0.42	-0.43	-0.27	-0.45	**	0.28	***
Bangladesh	** *	-0.09*	-0.44	-0.37	-0.17	0.58	0.10**
Burma	-0.58	-0.65	-0.51	-0.44	-0.05*	0.16	***
India	-0.18	-0.52	-0.25	-0.32	0.08	0.61	0.33
Nepal	-0.21	-0.23	-0.30	-0.50	-0.17	0.50	***
Korea	-0.42*	-1.49	-0.73	-1.26	***	0.73*	1.06*
Thailand	** *	***	** *	-1.08	-0.15	0.41*	***

SOURCE: Computations of the author; all parameters are significative at over 90 per cent unless otherwise stated;

* significant at over 80%

** significant at over 70%

*** significant at less than 70%

between factors use and land-yield on the one side and farm-size on the other, as well as a positive relation between farm size and labour productivity. The former relation, in regions where land is a scarce resource, which is always true for irrigated land, suggests that small farms are socially more efficient than large ones; therefore, a land redistribution would increase total output, besides improving income distribution.

98. The FAO farm data have also been used for the estimation of the labour productivity functions of the system. Such functions, which can be derived from an extended Cobb-Douglas, take the following form: $GO/WO = e^{A}\ (LN/WO * CRI)\ * (KA/WO)\ * ([GO-VA]/WO)$ where the symbols have the same meaning explained above. The estimations country by country have then been aggregated by means of appropriate weights so as to obtain the following regional estimates:

Table VI: Parameters of the productivity function in agriculture

	Const.	α	β	γ	$\alpha+\beta+\gamma$
Latin America	3.4	0.37	0.14	0.44	0.95
Tropical Africa	3.1	0.34	0.19	0.38	0.91
West Asia	2.5	0.20	0.22	0.52	0.94
South Asia	4.0	0.60	0.12	0.30	1.02
East Asia	5.0	0.70	0.10	0.22	1.02

99. The coefficient of the labour force in the complement to 1 of the sum $(\alpha+\beta+\gamma)$. In South and East Asia, this coefficient can be taken as equal to zero, thus suggesting a saturation of manpower in agricultural production. Small positive coefficients obtain for Latin America and West Asia and a more positive significant coefficient for Tropical Africa where manpower is scarce. The coefficient of capital per worker is generally low, so that the elasticity of land per worker is clearly

related to land scarcity. On the other hand, the elasticity of intermediate inputs per worker are more important in land abundant countries, such as those of Latin America, Tropical Africa and some of West Asia. To sum up, one gets a picture where output elasticities of each production factor would appear to be related to its relative scarcity.

100. As a further step in the analysis, the elasticities of the production factors obtained, country by country, from the estimation of the extended Cobb-Douglas production function $GO = e^{A} (LN * CR)^{\alpha} * WO^{\beta} * M^{\gamma} * (GO-VA)^{\delta}$ have been plotted one against the other, to see if any uniform pattern exists that would indicate the existence of relations of substitutability and/or complementarity among the production factors. The 15 elasticities of land (α) (see Table VII, hereafter) have been plotted against the 15 elasticities of labour (β); so have those of labour (β) against those of capital (γ). And lastly, the elasticities of intermediate inputs (δ) were analyzed with respect to those of labour (β). The overall picture which appears to emerge from this analysis indicates that, as could be expected, there is a strong relation of substitutability between land and labour, emphasizing the existence and the feasibility of both extensive and intensive types of agriculture. Labour and capital employment seem also to be linked - although less clearly - by a relation of substitutability while, on the whole, labour and intermediate inputs appear to be highly complementary in production. These broad findings would seem to suggest that, given the present and expected endowement of production factors in agriculture in developing countries, an acceleration of mechanization would have a labour displacing rather than an output increasing effect. One may, therefore, suggest to forestall it until full employment is achieved. These findings would also appear to substantiate the hypothesis that a policy based on a more intensive use of intermediate inputs would be likely to produce positive output and employment effects.

Table VII : Elasticities of the Cobb-Douglas production function

Country	Constant	LN*CRI	M D	K A	(GO-VA)/WO	SUM a/	R^2
Barbados	1.79	0.17**	0.52	0.08***	0.38	1.15(0.90)	0.66
Mexico	3.54	0.19*	0.26	0.04**	0.25	0.74(0.70)	0.43
Peru	2.30	0.58	0.35	0.11**	0.23	1.27(1.16)	0.81
Ethiopia	0.74	0.20	0.44	0.23	0.25	1.12	0.63
Nigeria	4.20	0.54	0.18	0.11	0.13	0.96	0.80
Uganda	4.40	0.25	***	0.22	0.14	0.61	0.69
Tanzania	1.95	0.38	0.40	0.23	0.12	1.13	0.63
Sudan	1.76	0.22	0.35	0.29	0.19	1.05	0.50
Syria	2.23	0.15	0.28	0.09	0.52	1.01	0.63
Bangladesh	5.10	1.03	0.03**	0.10**	***	1.16(1.06)	0.65
Burma	-0.64	***	0.47	0.48	0.27	1.22	0.82
India	2.67	0.40	0.28	0.11*	0.30	1.09(0.98)	0.87
Nepal	3.96	0.71	0.03**	0.25	0.06***	1.05(0.96)	0.79
Korea	6.42	0.62	***	***	***	0.62	0.24
Thailand	4.25	0.73	0.08**	***	0.26	1.07(0.99)	0.89

Source: Author's computation;
all parameters are significant at over 90% unless otherwise stated;
* significant at over 80%
** significant at over 70%
*** significant at less than 70%
a/ the figure in brackets correspond to the sum of the elasticities which are significative at over 80%

101. Among the work of analysis and compilation of the exogenous data of the system, two major results are worth mentioning. The first concerns the very small changes in land concentration which appear to have occurred between 1950 (only for a few countries) or 1960 (for most countries) and 1970. The comparison of the data provided by the 'World Census of Agriculture' of these years show, in fact, almost no changes in the distribution of the operated holdings classified by farm size. The 1970 values, which have also been retained for the central scenario of the model, show the following values.

Table VIII: Per cent distribution of land by size of operated holdings

	small	medium	large
Latin America	6.6	21.6	71.8
Tropical Africa	84.3		15.7
West Asia	20.0	38.0	42.0
South Asia	20.9	48.2	30.9
East Asia	37.0	37.2	25.8

Source: UNITAD's estimates on the 1970 'World Census of Agriculture' data, FAO. The definition of 'small', 'medium', 'large' is the following: Latin America: 0-20 / 20-200 / 200-∞
Tropical Africa: 0-10 / 10-∞
West Asia: 0-10 / 10-50 / 50-∞
South Asia: 0-2 / 2-10 / 10-∞
East Asia: 0-2 / 2-10 / 10-∞

102. As one can see, Latin America has potentially an enormous amount of land which could be redistributed. Tropical Africa, on the contrary, seems to be characterized by a prevalence of small subsistence holdings. In the West Asia and in South Asia there would seem to be scope for redistributing a certain amount of land from the large to the small holdings. This seems to be all the more recommendable when looking at the possibility of extending the arable area in the various regions of the UNITAD system.

Table IX below shows that only Latin America, Tropical Africa and, to a very limited extent East Asia, can count on a possible extension of the arable area for increasing output, income and consumption in agriculture. For the countries of the other regions, other strategies ought to be adopted.

Table IX : Land supply in 1975 and 1990 (10^6 hectares)

	Land available in 1975	Possible extension between 1975 and 1990	Maximum land available in 1990
Latin America	176.6	60.8	237.4
Tropical Africa	184.9	23.8	228.7
West Asia	72.4	4.0	76.4
South Asia	209.7	6.0	215.7
East Asia	51.8	8.5	60.3

Source: 'Agriculture: Towards 2000', FAO, 1980.

IV. Income Distribution, Consumption and Savings [1]

Introductory remarks

103. It is now widely acknowledged that, in many developing countries, past growth fell short of achieving the target of eradicating mass poverty owing to grave distortions inherent to the distribution of income. The consumption of essentials (such as food, clothing and health products) has grown at very moderate rates. Furthermore, when considering the various income groups, the picture becomes even more disconcerting. Indeed, in many countries, the shares of the lower deciles in food consumption have been declining even during periods of relatively rapid agricultural growth. The revision of development thinking is therefore seriously reconsidering the relation between distribution and growth. In particular, it is felt that more work should be done in identifying and analyzing the mechanisms which determine the observed inequalities in the distribution of income. The new approach which is being followed [2] focuses on the identification of socio-economic groups characterized by different professional profiles (entrepreneurs, skilled and unskilled workers, while collars, small farmers, landless labourers, urban unemployed, etc.) and on their income accounting. Within each industry, total value added is distributed to the various income recipients; assumptions are then made on the shape of the income distribution within each income group. The various distributions are then mapped together into the overall size distribution (by percentiles) of household income.

1/ This section summarizes and updates the paper "Aggregate Consumption and Consumption Patterns: evidence from time-series and cross-sectional data" (prepared by G.A. Cornia, M. Gilli and G. Jerger), submitted to the meeting of the ACC Technical Working Group of the Task Force on Long-Term Development Objectives, Geneva, 10-11 July 1980.

2/ See for instance Rodgers Gerry et al.: "Bachue Philippines: Population, Employment and Inequality", Saxon House, 1978. See also Adelman, Irma and Robinson Sherman: "Income Distribution Policy in Developing Countries, a case-study for Korea", Oxford University Press, 1975.

104. However, such an approach requires an amount of information which, for a model with UNITAD coverage, does simply not exist. Were it to exist, it would require an amount of processing and manipulation which could not be handled within the UNITAD system. This is why it was decided to adopt a somewhat simplified approach which, although avoiding the thorny issue of income accounting for each socio-economic group, still leaves the possibility of simulating the effects of exogenous changes in the distribution of income on the level and structure of private consumption and, indirectly, on the satisfaction of some essential needs. The system also allows for the illustration of the basic features of the functional income distribution, as well as the effects of changes in its structure on the total saving rate.

The formalization of the income distribution, consumption and saving sector

105. Within each industry, value added is decomposed through two exogenous value added coefficients in labour and capital income. By adding through sectors one obtains total labour and total gross capital income. For developing countries a distinction is made between the urban and the rural sectors. The latter is equivalent to agriculture plus a fraction m non-agricultural activities carried out in rural areas. Notice that the parameter m can be interpreted as a policy instrument by means of which a given balance between rural and urban can be achieved. Hence, for developing countries, the system generates rural labour income, rural capital income, urban labour income and urban capital income. For both developed and developing countries, the system describes the intersectoral income transfers: capital income is distributed between the enterprise, household and government sectors, while all labour income accrues to households. Governments levies direct taxes on household and enterprises

as well as indirect taxes which are considered net of subsidies to production. It is equally assumed that household payments and receipts on the social security and welfare account balance out.

106. Once all these transfers have taken place, the system generates the net disposable income of government and households (rural and urban for developing regions), and the gross (i.e. including all depreciation) disposable income of enterprises. The system estimates at this point a simple keynesian consumption function (in constant prices) for the household sector, of the form PC/POP = a + b NDIH/POP, where PC, NDIH and POP stand for private consumption, household's net disposable income, and total population. For the developing regions, this function has been estimated separately for the rural and the urban sector, since it is reasonable to expect a different behaviour from them. For government, the system estimates a simple consumption function in current prices, i.e. GC = α NDIG, where GC and NDIG stand for government consumption and net disposable income. Enterprises are assumed to save all their gross disposable income. In this way the system, characterized by three different saving/consumption propensities, determines total consumption (private and government) and total domestic savings (for developing countries, private consumption and household savings are broken down to rural and urban).

107. Total private consumption and relative prices of consumption categories, both endogenous, are the main variables determining the structure of the household consumption basket, by means of a simultaneous non-linear (or linear) expenditure system (NLES or LES). In symbols PC(i) = f(PC, p(i)) where PC, PC(i) and p(i) stand for total private consumption, private consumption of item (i) and its relative price.

108. The consumption categories are the usual ones adopted in national accounting and in most household expenditure surveys, i.e. food, clothing, rent, furniture, health, transport, education and miscellaneous[1]. These categories are very broad and each includes the essentials as well as luxury goods. However, they can be used as a first approximation for assessing the degree of satisfaction of some basic needs, such as food and clothing. At this point it can be noted that the structure of private consumption depends upon the hypotheses made about the shape of the household size distribution of income. Indeed, if the expenditure system is of the non-linear type, i.e. if the marginal propensities to consume of each category change with the level of overall consumption, modifications in the household size distribution of income ential changes in the structure of the overall consumption basket. A shift of income from the top to the bottom deciles, for instance, would be likely to increase the overall demand for essentials while accordingly reducing that of luxuries. The extent to which a NLES can accurately measure changes in the consumption structure is very much an empirical matter.

109. Many claim that, at this level of disaggregation, the changes are likely to be very modest. Furthermore, it should be stressed that if the expenditure system is of the linear type (LES), no numerical changes in the consumption basket would derive from a hypothesized income redistribution. For the regions where the rural-urban disaggregation has been introduced, it is still possible to analyze in this case the effects of changes in the rural-urban distribution of manufacturing and service activities on the overall saving rate and consumption structure. In particular this could be useful for analyzing some effects of rural development.

1/ 'Private consumption by object' is transformed in 'private consumption by origin' by means of a transition matrix, which is usually named consumption converter. Such matrix has been built up for each UNITAD region.

Empirical results

110. The data sources used for the data analysis and estimation of the relations between income distribution, saving and consumption include the United Nations' 'Yearbook of National Accounts'; the ILO's 'Household Income and Expenditure Statistics'; the World Bank's 'Income Distribution Statistics: a Compilation of Data'.

111. The results of the empirical analysis commented on below refer to the saving/consumption function and to the expenditure system. Table X reports the estimates of the function PC/POP = f(NDIH/POP). For the developed countries, the United Nations' 'National Accounts' data were used, whereas for developing regions, the estimations were carried out on the basis of the ILO source. The results confirm previous findings for the developed countries. In less developed regions, the results consistently indicate higher consumption propensities in the urban than in the rural sector. Subsequent investigation (the results of which are not reproduced here for reasons of space) indicates that such a phenomenon is primarily to be ascribed to the difference in source and stability of income between the urban sector (where wages are predominant) and the rural sector (where self-employment incomes are most common). Geographical location and household size would also appear to have a certain influence on the observed dualism. Another interesting finding of the analysis of the ILO expenditure surveys concerns the shape of the overall saving/consumption function. Indeed, the results of an extensive statistical test show that there is no evidence whatsoever to support the Keynesian assumption of declining marginal propensities to consume for rising incomes. At the margin, the propensity to consume has been found to remain constant in the overwhelming majority of the cases analyzed. If this is true, measures aiming at redistributing income cannot be opposed on grounds that they reduce the saving rate and, therefore, growth.

Table X: Aggregate consumption function parameters *

		North America	Western Europe	Eastern Europe	Japan	Other Developed	Latin America	Tropical Africa	West Asia	South Asia	East Asia	Centrally Planned Economies Asia
URBAN	a	104	200	-	184	219	120	40	150	25	90	-
	b	.89	.82	-	.64	.77	.72	79	.85	.76	.70	-
				-								-
RURAL	a			-			160.	50	150.	35.	80.	-
	b			-			.61	74	.85	.65	.65	-
				-								-

* PC/POP = a + b NDIH/POP ; all estimates are in 1970 constant prices; regional results were obtained by aggregating parameters estimated at the national level.

112. The empirical results concerning the estimation of the consumption expenditure system are a little less satisfactory. A non-linear expenditure system (NLES) has been succesfully fitted to the time-series data of developed regions, as indicated by the good values of the statistical tests. For these regions it is therefore possible to simulate the effects of changes in the household size distribution of income on the structure of consumption and output. For the developing regions, it has so far not been possible to estimate a satisfactory non-linear expenditure system, because of data limitations. Indeed the household expenditure surveys do not provide, quite obviously, information on prices, so as to oblige to specify a stochastic model different from that adopted for estimation on time-series. Pending further investigation, it was decided to opt for a linear expenditure system, which was satisfactorily estimated for the urban and rural sector separately. Table XI below provides a summary of the marginal propensities to consume for each of the categories (their sum is equal to one) which have been retained for the developing regions

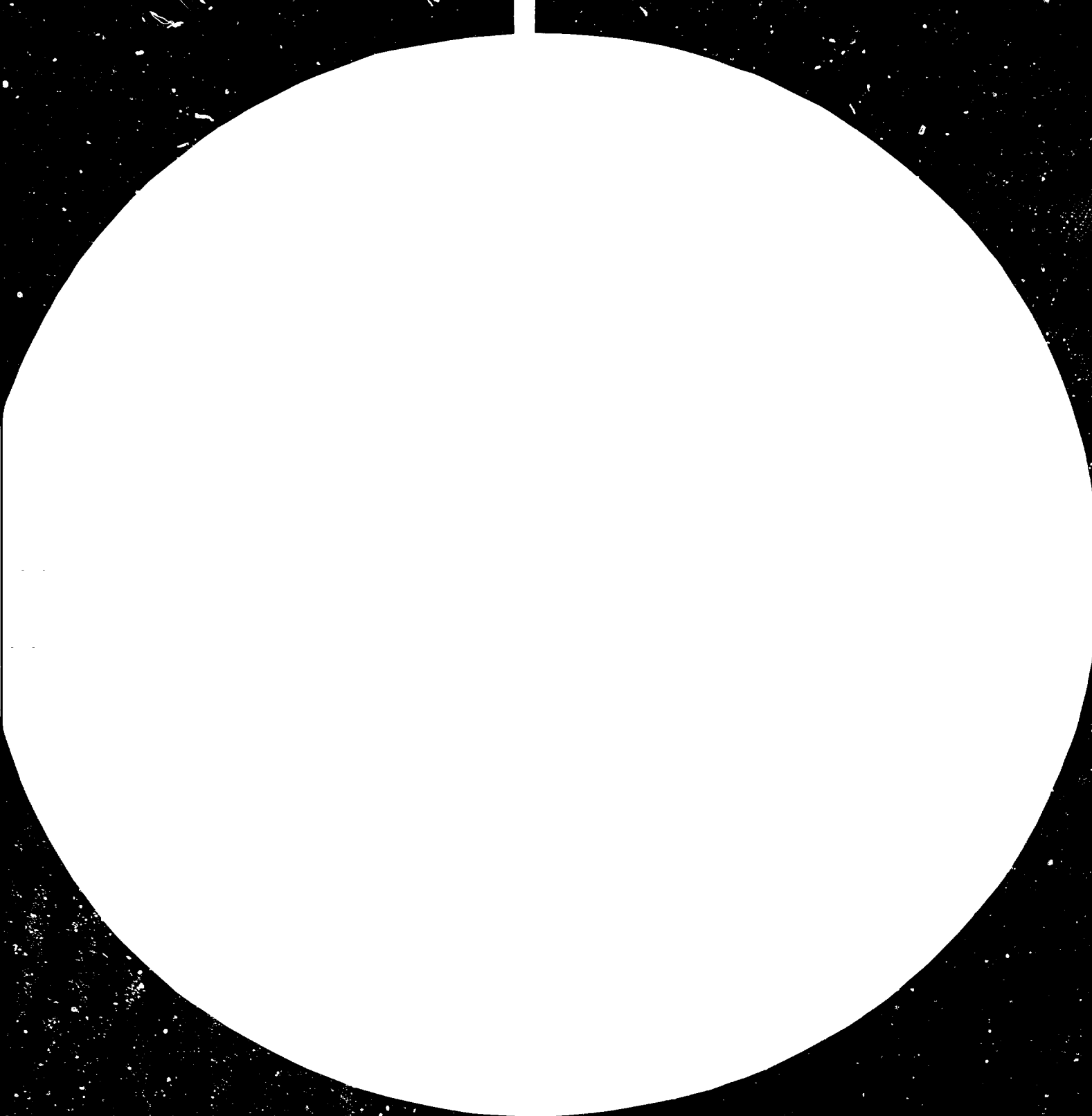
113. These figures have been obtained by weighing the national values of the countries included in the ILO data base. From the results of Table XI as well as from the results of national estimates, there are clear indications that the marginal budget share for food decreases when income per capita rises. The opposite happens, although the evidence is less firm, to the budget shares of rent and transport. Less clear patterns are formed for the budget shares of the other consumption categories. Rural-urban dualism is evident when analyzing the results of Table XI . Significant variations between marginal budget shares probably reflect different sets of preferences and prices as well as different economic environments. Marginal share of food is consistently higher in rural areas, while the composition of non-food expenditure

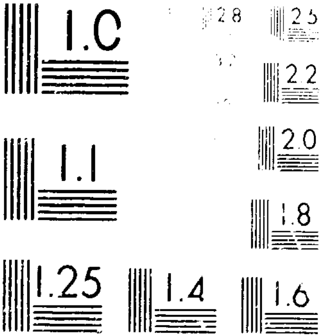
Table XI: Marginal propensities to consume as estimated through a linear expenditure system

	Latin America		Tropical Africa		West Asia		South Asia		East Asia	
	urban	rural	urban	rural	urban	rural	urban	rural	urban	rural
Food	.290	.353	.572	.650	.257	.360	.522	.705	.400	.496
Clothing	.108	.120	.095	.099	.116	.187	.116	.164	.091	.114
Rent	.290	.190	.134	.011	.269	.231	.076	-.085	.165	.140
Furniture	.070	.068	.062	.070	.114	.127	.073	.066	.065	.051
Medical care	.029	.030	.016	.013	.039	.044	.042	.069	.051	.024
Transportation	.073	.113	.054	.098	.081	.070	.038	.005	.056	.034
Education	.089	.068	.027	.036	.026	.037	.077	.024	.121	.103
Miscellaneous	.051	.058	.040	.021	.098	.043	.055	.051	.051	.035

also shows, at the margin, elements of dualistic behaviour. This applies particularly to clothing and rent. On the whole the share of necessities would appear to be higher in the rural than in the urban sector. While it is impossible, at least for the time being, to simulate for the less developed countries the potential effects of a redistribution of income within the household sector, one can simulate the effects of alterations in the rural-urban income distribution.

81 09 29




1.0
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2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

CHAPTER 3

A Trend Scenario

Introduction

114. The "trend" scenario presented in this chapter requires a precise definition which is given in Part I on basic assumptions. As will be seen when selecting trends for exogenous variables, the general orientation has been to take "expected trends" as they are perceived today rather than those of the observation period (1963-75). This applies in particular to the growth rates assigned to the different regions. On the basis of these trends, the system generates a picture of the world economy in 1990, which is given an overall assessment in Part II , while sectoral aspects are described in Part III. Brief conclusions then follow.

115. It should be recalled that the model is a simulation model meant to explore the response of the world system to a set of exogenous assumptions. The future world economy described in such a scenario should therefore not be interpreted as a likely - nor even plausible - future. If the gaps resulting from the assumptions are beyond any "realistic" magnitude, initial assumptions can and should be changed to explore alternative futures. Indeed, the system has been built to test a large variety of assumptions, including three key development issues such as the trade and financial rules of the world system, the institutional patterns regarding the distribution of assets and incomes and the industrial and technological orientation of regions. The interest of the model should therefore be evaluated on the

basis of its capacity to explore the response of regional characteristics and world patterns to changes in these assumptions and not on a single scenario.

116. Why then a "trend" scenario, which is based by and large on conservative assumptions in regional and world policies? The immediate purpose is to allow a comparison of the system's results with those generated by "deterministic" models, i.e. models in which the institutional set up and technology for example, are embodied in econometric equations without a possibility of simulating the impact of changing policies in these areas. The second purpose is to clearly establish the link between the results and the assumptions so as to suggest alternative scenarios; with regard to trade, for example, the deficits observed in the manufacturing sector should be traced up to the assumptions made on protectionism and on the commercial strategies of governments. This, rather than a factual comment on results - which often confirm widely accepted implications - will be attempted in the different sections. The trend scenario can thus be taken as an opportunity to discuss future orientations in the use of the model.[1/]

1/ For the sake of brevity, the names of regions are shortened in the text and in the tables as follows:

Developing regions	Text	Tables
Latin America	same	(LA)
Tropical Africa	same	(TA)
North Africa and West Asia	West Asia	(NE)
Indian sub-continent	South Asia	(IN)
East and South-East Asia	East Asia	(AS)
CPE's, Asia	Other Asia	(OA)
Developed regions		
North America	same	(NA)
Market economies, Europe	Western Europe	(WE)
CPE's, Europe	Eastern Europe	(EE)
Japan	same	(JP)
Other Developed	OD region	(OD)

Regions are geographical entities. Turkey and Yugoslavia are included in European market economies (WE) as in ECE studies. The "Other Developed" regions include Australia, New Zealand and South Africa. The Pacific islands, except Hawaii, are attached to East and South-East Asia, which also includes Thailand, Malaysia, Singapore, Indonesia and East-Asian countries.

I. Basic assumptions of the trend scenario

(i) The world structure

117. Specific assumptions on two broad families of issues, i.e. those governing the world structures and those governing the domestic development policies are given below. The model can then be used to see the combined effects of these two sets of assumptions.

118. As to the world structures, the key choice refers to the type of regulation prevailing at the world level in the fields of trade, finance and money. The assumptions made in the trend scenarios broadly include a continuation of present financing and monetary practices and moderately free trade policies.

119. More precisely, private loans and direct investment are assumed to grow at currently observed rates and to be distributed geographically according to prevailing patterns. In other words the model simulates financing conditions governed by the market with a few priviledged countries having access to international credit facilities, on conditions (maturity, interest rates) which are more related to the economic environment in developed countries than to the long-term industrialization requirements of developing countries. Poor countries are left to the discretion of ODA donators, at rates similar to those observed in the past, well below the 0.7 per cent GNP target for public funds. To sum up, the basic assumption is that no specific attempt is made by the international community to establish a world financing order commensurate to the growth requirements of developing countries.

120. Market forces, on the other hand, are also assumed to dominate the trade environment, with free trade rules being given the current prevailing interpretation. The values given to trade shares and to protection variables can be characterized in the following way:

- No further economic integration has been simulated neither in the North nor in the South. In particular, the model simulates a competition

between North America, Western Europe and Japan. on their own markets of manufactures or on third parties under the same conditions as before. For example, no integrated market for equipment goods has been simulated between North America, Western Europe and Japan.

- In the North-South trade, no further protection is simulated on either side, i.e. a moderate penetration of the South into the Northern market is possible [1], and the protection level observed in the South under past conditions has been extended to the future.

121. Prices on the international markets are reflecting costs in the exporting countries, with two exceptions for agricultural goods and energy

- The relative price of energy exports is assumed to reach in 1990 a level 2.6 times higher than in 1970 (or a level 3.3 times higher than the prices of manufactures).

- The corresponding levels for agricultural goods are respectively 1.25 (relative to tradable goods) and 1.60 (relative to manufactures only). The difference between these international prices and domestic prices is handled in the model as a rent (or an export duty) accruing to the government. These international prices, exogenously given, place a serious handicap on all regions with a low level of agricultural and/or energy resources [2].

(ii) Domestic development policies

122. The growth targets assigned to the various regions have a different meaning for developed and developing regions (see Table 1). The overall growth rate for the North (3 % from 1975 to 1990 for market economies) merely reflects current expectations, taking into account the low performances of these regions from 1975 to 1980. The overall growth rate for the South

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1/ This was obtained by using the gravitational model, with controls, to generate new shares; see Table I and II, pages 60,61.

2/ Another effect of the price treatment refers to manufactures. Imports of developing countries from developed countries reflect the cost of output in the latter group and therefore have a real price 1.4 times higher than imports of developed countries from developing countries.

(5.2 % for market economies) is definitely below the target for the third development decade, but it should not be regarded as a normative figure, since the scenario is meant to assess the feasibility of such a growth under specific conditions. Furthermore there are important regional differences. For two regions (Tropical Africa, South Asia) growth rates around 3.5 are tested, while for three regions (Latin America, West Asia, East Asia), a growth rate around 6 % is put to a test.

123. Two main domestic policies have been simulated concerning institutional changes and industrial technology. On the former aspect, no institutional change affecting the rural-urban income distribution and the distribution of assets in the agricultural sector have been simulated in the model. This is translated in the model in terms of input-intensive technology in the agricultural sector. Furthermore, in two regions, i.e. Latin America, Tropical Africa, the growth rate of agriculture has not been allowed to reach its demand-determined rate, but instead was brought down to an exogenous plausible level derived from the past [1]. The purpose of this change is to test the sensitivity of the trade deficit to this conservative assumption (see Table below).

Table XII Overall growth rates and agricultural growth rates (annual percentage)

Developing regions (market economies)	GDP growth rate	agricultural growth rate	Developed regions (market economies)	GDP growth rate	agricultural growth rate
LA	5.5	3.0 [2]	NA	2.6	1.5
TA	3.7	2.6 [2]	WE	3.0	1.2
NE	5.9	3.0	JP	4.9	3.8
IN	3.5	2.5	OD	3.5	2.7
AS	6.0	4.1			
Centrally Planned Economies [3]			Centrally Planned Economies		
OA	6.0	3.5	EE	4.0	2.0

1/ This has been obtained by parametrizing one coefficient of the import functions for Agricultural Products; see later;

2/ Exogenously determined;

3/ The information on Centrally Planned Economies, Asia, is not sufficient at this stage, to allow the building of a complete model. The growth rate for that region is merely used to determine their imports according to import functions. Their role is purely passive, since there is no feed-back effect on the regional economy.

124. A deliberate (but not exaggerated) attempt was made to simulate an industrial policy oriented in developing regions towards northern technology:

- In the production functions, the exogenous values of the capital-labour coefficients were given their trend values derived from past observations in each region. At the same time, the autonomous productivity trends were allowed to reach their trend values in each region (i.e. the time variable was set at its 1990 value, suggesting that imports of equipment reflected the last technology).

- Furthermore, the input mix within each sector, as embodied in the matrices of input coefficients, was set so as to simulate a move towards "target" sectors in industrialized countries. For this purpose, a somewhat sophisticated treatment was adopted, i.e. making the vector of input coefficients endogenously dependent on the ratio between the capital-labour coefficient of the target technology vector and that of the developing region. It should be noted that the choice of target vectors, for each region, was made, sector by sector, with due consideration of the results of the main component analysis (see para. 40 to 42), i.e. taking into account former technology orientations 1/.

II. An overall assessment of the trend scenario

125. The picture of the world economy emerging in the year 1990 on the basis of the assumptions outlined in section A is not very encouraging. At the international level, the scene seems to be dominated by the persistence of large payment imbalances reflecting consistent resource gaps to finance GNP growth rates which are slightly less buoyant than those experienced in the past. As can be seen in Table XIII, which summarizes the main hypotheses and outcomes of the trend scenario, the imbalances are particularly severe

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1/ This treatment can be compared with that given by Leontief in his world model, where all technologies converge towards the U.S. technology according to GNP per capita. In the UNITAD system, there is an "à la carte" menu of technology which is made consistent with the assumptions on capital intensity.

for Latin America and East Asia, while West Asia and the O.D. region enjoy confortable surpluses, either in absolute terms or as a percentage of their gross domestic product.

126. With regard to the balance of goods and services, trade is almost in equilibrium for Western Europe, Japan and the two CPE regions and to a lesser extent, for North and Latin America. West Asia and the O.D. region enjoy large financial surpluses, while all other developing regions are faced with large trade deficits ranging from 5 to 7 % of their GNP. When factor payments from and to abroad and ODA are taken into consideration, the overall picture appears substantially improved for North America, which, thanks to a hefty inflow of interests and profits, would move from a deficit of over 1 % of its GNP to a small surplus. Other industrialized regions do not show noticeable changes, i.e. their various inflows and outflows tend to balance each other out. For Western Europe, for instance, disbursement and the net inflow of interests on the outstanding credit are of the same order of magnitude.

127.Tropical Africa and South Asia show an overall improvement in their current foreign accounts. These two regions are the largest recipients of ODA and, in the case of South Asia, receive conspicuous migrant remittances. Moreover their indebtedness is low as compared to Latin America and East Asia and interest rates and maturity on their debt are generally negotiated at somewhat more favourable terms. South Asia in particular would see its trade deficit reduced from 6.7 to 3 % of its gross national product. The position of the current balance is much worse for East Asia and, especially, Latin America. There, interest payments on foreign long-term outstanding debt would absorb almost 8 % of the gross national product (about 2 % in 1977), showing the urgency for these regions to control the growth of their foreign debt. Their migrant remittances and ODA are too small to reequilibrate interest payments. As a result of its new lending position, the West Asia

Table XIII - Trend scenario to 1990: main assumptions and outcomes

			REGIONS	North America	West Eur.	East Eur.	Japan	Other D'vpd	Latin America	Trop. Africa	West Asia	S'th Asia	East Asia	CPE Asia
ASSUMPTIONS			GNP growth rate	2.6	3.0	4.0	4.9	3.5	5.5	3.7	5.9	3.5	6.0	6.0
	WORLD TRADE		Protectionism	Same policies as in the observation period										
			Prices oil, agr.-food	2.5 and 1.3 in relative prices										
			Geogr. distribution	Same commercial strategies for each region as in the base year										
	CAPITAL MOVEMENTS		o.d.a. (% of GNP)	0.30	0.45	0.10	0.30	0.70	-	-	2.00	-	-	-
			Commercial flows	-154	-38	13	-28	3	154	13	-36	15	47	11
	TECHNOLOGY		I/O Tables	Increasingly capital intensive techniques with some energy conservat'n					Progressive adoption of northern technology					
			Capital/Labour ratios											
	Institutional changes			Not applicable in the model					No changes envisaged					
OUTCOMES	PRODUCTION FACTOR GAPS	FOREIGN ACCOUNTS	Balance goods & services	-70	-50	11	1	22	-19	-13	173	-18	-28	-
			Current balance	15	-59	2	11	15	-117	-4	196	-8	-57	-4
			Basic balance	14	-105	4	-6	15	-60	1	174	2	-39	-1
			Outstg. debts	800	203	-73	147	-33	-757	-93	199	-127	-267	-45
		Unemployment (millions people)	Urban	16	12	-	9	6	59	30	4	74	27	..
			Rural						16	59	13	160	58	..
		Land Gap (millions hectares)		-	-	-	-	-	+41	+4	+2	+11	+13	-
	OTHER	Accumulation investment rate (current prices)		17.4	23.7	35.0	34.8	24.4	25.8	22.7	21.6	18.2	29.8	..
		Per Capita	GNP (1970 prices)	6510	3210	-	4180	2170	1001	165	610	139	444	-
			GNP growth rate	1.7	2.5	-	4.3	2.4	2.8	0.6	2.9	1.1	3.7	-
			Consump. growth rate	1.1	1.9	-	4.0	0.3	2.1	0.9	3.2	1.0	2.5	-

All figures are in billions of current dollars unless otherwise stated

Symbols: - indicates deficits, debts or outflows
+ indicates excess supply

region witnesses a further improvement when moving from the trade balance to the current account. Its surplus reaches 17 % of its gross national product. In the model, surpluses are assumed to be recycled as short-term capital movement. In practice however, recycling of this order of magnitude has little chance of occurring under present conditions. As mentioned earlier, the scenario assumes a growth rate of market term lending at 12 % a year, i.e. a continuation of present high trends. It is thus possible to assess if the long-term capital flows projected by the model are sufficient to fill the gap of resources necessary to sustain the hypothesized GNP growth rates, or if there is need and scope for additional finance. Were this to be the case for any specific region, the plausibility of the trend scenario for that region would be seriously reduced. An examination of the position of the basic balance (i.e. current balance plus inflows and outflows of long-term capital) shows substantial equilibrium for all regions except Latin America and especially East Asia which would require large amounts of balance of payment financing, in addition to the already large borrowing of long-term capital. For these two regions, a growth rate of output of 6 % is clearly unaffordable under the assumptions made in this scenario. Slower growing Tropical Africa and South Asia (3.5 % GNP a year) would appear to almost equilibrate their payments if the hypothesized amount of finance is made available.

128. Notice that, in this scenario, all developing regions would present in 1990 outstanding debts (long-term capital only) of colossal dimensions and such as to reduce the plausibility of such a scenario. Indeed, East Asia would face in 1990 an outstanding debt equivalent to 64 % of its current GNP (30 % in 1975). Similarly, Latin America, South Asia and Tropical Africa would face outstanding debts somewhere between 32 and 60 % of their gross national product. Even more disturbing is the fact that in 1990 interest payments on current outstanding debt would be as large as the current account

deficits of all developing regions (West Asia excluded). Similarly, interest payments from developing countries would absorb 75 % of their total export earnings of agricultural products and raw materials (energy excluded). Clearly a policy of heavy indebtedness cannot be sustained in the long run under the present conditions regulating world trade and finance.

129. An eneven distribution of deficits and surpluses at the international level is accompanied, in almost all developing and several developed regions, by rising unemployment and by a likely worsening of domestic income distribution. Indeed, the present growth rates of output, the adoption of increasingly capital and input-intensive techniques, the lack of land redistribution measures, together with substantial increases in the size of the working-age population would appear to lead to a situation in which, at times, only half of the labour force would be productively employed. For developing countries, the situation is likely to be worse than illustrated in Table XIII since a substantial amount of underemployment is hidden among the employed, especially in agriculture and services.

130. As already anticipated by numerous other reports, the occupational situation is expected to be particularly grave for the developing world, although the industrialized economies are hit as well. Among the former, only West Asia would appear to experience in 1990 acceptable unemployment levels in both rural and urban sectors. Rural Latin America would probably reach full employment conditions, owing to the very fast rate of urbanization which is likely to prevail in Latin America. and to the possible extension of the arable frontier. There, the unemployment problem which in developing countries is usually more evident in the rural sector, has been transferred to the urban areas. In South and East Asia as well as in Tropical Africa the unemployment problem would appear to become merely untractable. South Asia, for instance, would count in 1990 over 160 million people without a job, in the rural areas alone, whereas about 75 million people would be jobless

in towns. Similarly, in South East Asia and Tropical Africa one would count respectively 85 and 89 million people unemployed.

131. These figures, although highly tentative, are unacceptable even by developing countries standards. In South Asia and Tropical Africa, a low growth rate of income per capita (which would rise respectively at 1.1 and 0.6 % per annum), together with rapidly rising unemployment and underemployment would necessarily result in increased marginalization of the weaker socio-economic groups (agricultural labourers, and quasi-landless farmers, urban lumpenproletariat, etc.) which, in the likely absence of welfare-type income transfers, would see their income and consumption fall in relative and, perhaps, in absolute terms. Needless to say, a situation as that just described might well become intolerable to the point of destabilizing existing economic and political set-ups.

132. Occupational prospects do not look bright in the industrialized world either. There, the growth of employment opportunities would appear to be moderate in comparison with the growth of the labour force. Contained growth rates of output only partially explain such phenomena which should, among others, be attributed to the autonomous growth of labour productivity (even for the reduced rates simulated into the model) resulting from continued innovation and by the adoption of increasingly capital-intensive techniques. If no changes in the organization of production are envisaged, all industrialized economies would experience, by 1990, unemployment levels higher than the current ones. In Japan, where productivity growth has been assumed to remain high, unemployment would appear to reach an extremely high level, owing to the relatively moderate output growth of 5 %. The figures shown in Table XIII, however, do not take into consideration a possible reduction of the work-week and the introduction of part-time jobs (as in the service sector). These adjustments, which are likely to affect an increasing number of workers in the 1980's, might conspicuously ease the situation on the labour market of more advanced economies as described in the Table.

133. With no major changes in the structure of land ownership, and with adoption in agriculture of tendentially more capital and input-intensive techniques, the model generates, in addition to catastrophic unemployment rates, also a non-complete utilization of the land which could be cleared and put to cultivation. This seems to be the case of Latin America and Tropical Africa where a substantial amount of potentially arable land would remain idle. In this respect the model illustrates a strategy focussing on increased use of modern inputs and on the partial extension of the arable frontier to achieve a target growth rate of agriculture. For the regions where further land extension is possible, one could envisage, as one of the alternatives, to increase the land/man ratios, while forestalling the introduction of mechanization and while only gradually increasing the use of intermediate inputs. This might be the subject of an alternative scenario.

134. Unbalanced growth appears to be a third main feature of the trend scenario to 1990. Overall investment rates would increase by 1990 only marginally (see Table XIII) as compared to the base year. Still, with the economy of several regions growing at moderate rates, one would expect, if capital intensiveness of production were to remain constant, slightly declining investment rates, owing to the functioning of the accelerator mechanism. However, this is not the case for most of the regions analyzed. An increased and rapid capitalization of the economy entails that the growth of the sectors producing capital goods and intermediate products should be faster than average and faster than the growth of the sector producing essentials. This would appear to be the situation in 1990 in West, South and East Asia. There, the growth of heavy industry and mechanical equipment outpaces the growth of light industry and processed food sector as well as the growth of agriculture.

135. Yet, the growth of manufacturing does not appear to be excessively high and such as to allow the Lima target to be reached on the geographical distribution of world industrial output. Indeed, the model generates, by 1990, a share of industrial production for the developing countries equal to 12 % of the total, as against a target of 25 % for the year 2000. These results, which are further clarified in the next section, show the need for simulating an alternative scenario where balanced growth would be combined with the achievement of the Lima target.

136. All told the picture outlined above seems to confirm the views of a world economy dominated by a slow growth and by a series of stops and go's of the industrialized economies which are adjusting, by means of deflationary measures, to successive increases in oil prices, as well as to the recrudescence of domestic inflation. Such an adjustment process would inevitably lead to a growth of world trade substantially slower than in the past. Under these circumstances, the economies of developing countries would severely be hit, especially those attempting at sustaining their growth rates of GNP in the bracket of 5-6 % a year. For them, the alternative (which could be simulated in another scenario) is to drastically curtail their growth rate of output or to carry, for several years, very large current deficits; were their response to large deficits to be deflationary policies, the world economy would certainly be affected by a recession substantially more severe than that illustrated in the present scenario.

137. With slow growth in the North, little optimistic expectations for ODA and no fundamental changes in domestic policies, the developing countries, especially the poorer ones, would thus be faced with little improvements in the living conditions, unbalanced growth, intolerable unemployment levels and a likely polarization of the domestic distribution of income and consumption. To conclude, a scenario of this type would appear to offer little prospect for reducing poverty in the Third World, nor for sustaining the growth of world GNP.

III. Industry and Trade

138. The first comment refers to the declining share of agriculture value added in developing countries (from 21.8 % in 1975 down to 15.5 % in 1990), as a consequence of the relatively low rate of growth imposed on agriculture in this scenario, i.e. 2.8 % per annum, as compared to 2.6 % in the 1963-75 period. It should be noted, in this respect, that if controls on agricultural growth were removed in the system, the demand-determined growth rate for agriculture from 1975 to 1990 would be around 3.5 %, i.e. still below the 4 % target of the Third Development Decade. This poor performance, in a fully interrelated system such as the UNITAD model is dependent on the whole set of assumptions but the technology choices are largely responsible for this lack of balance in the growth pattern 1/.

139. The growth performances observed in the manufacturing sector of developing countries are much higher, especially in West Asia (7.1 %), East Asia (6.3 %) and Latin America (6 %). For the group as a whole, manufacturing grows up at an annual rate of 6 %, which yields an elasticity of about 1.2 , relative to GDP, a little less than in the preceding period (1.3), where the overall growth of the economy was definitely higher.

Table XIV: Growth of the industrial sector (1975-1990)
(per cent per annum)

Developing regions	food-agri. processing	basic a/ products	light industry	capital goods ind.	total manufacturing b/
LA	3.1	7.6	6.5	6.4	6.0
TA	1.2	6.1	7.7	6.1	5.6
NE	12.3	12.1	8.8	13.7	7.1 c/
IN	4.9	7.3	1.6	7.6	4.8
AS	3.9	11.3	2.9	7.4	6.7
Total	4.3	8.3	5.5	7.0	6.0
elasticity % GDP	0.8	1.6	1.1	1.4	1.2

1/ A conspicuous example is the case of West Asia, with an overall growth rate of 6 % and a 3 % growth rate for agriculture.

a/ Including primary processing and mining (other than energy materials);

b/ Defined as food processing + refineries + primary processing + light industry + capital goods industry;

c/ Relatively low in view of slow growth of the refinery sector not shown in table.

140. As can be seen in Table XIV, the growth in the extraction and processing of basic products (1.6 times the GDP growth rate) and the capital goods industries (1.4 times the GDP growth rate) is much higher than in the consumption goods industries (food processing 0.8 and light industry 1.1 times the GDP growth rate), as a consequence of the general assumptions in this scenario, and in particular the north-oriented technology. The crucial point is that a high proportion of the output of the former sectors (from 70 to 90 % of domestic demand) is absorbed by the industry itself, either as intermediary consumption or as fixed capital formation. Much lower industrial uses are observed in the light industry sector (4.6 %) and the food processing sector (23 %). This high internal requirement of industrial output, in the basic product and capital goods sectors, illuminates the dynamics of the industrial strategy simulated in this scenario. Clearly this is a case where the industrial growth is a self-sustaining process, as long as the external equilibrium of the economy is not endangered by the process itself (see later). The positive point is that, in an integrated industrial process of this type, technological experience fastly accumulates. The negative aspect is that the industrial growth is obtained at the expense of consumption goods industries and of agriculture, thus creating the imbalance already observed in the structure.

141. The geographical distribution of the manufacturing sector is worth an examination. The position of the South is substantially improving (nearly 12 % of world total manufacturing value added including CPE, Europe), when considering the Lima target (25 % of the manufacturing sector in the South in year 2000). This move is not, however, as high as could be expected, if related to past performances (8.7 % in 1975, in 1970 prices), because of the low growth of two regions (Tropical Africa, South Asia). Altogether, the Lima target is out of reach as long as the overall rate of growth for GDP is 5.2 per annum in the South, compared to 3 in the North 1/.

1/ The Lima target can only be reached with a GDP differential growth rate higher than roughly 4 percentage points between North and South.

When comparing developing regions amongst each other (see Table XV), Latin America still retains more than one half of total manufacturing for DG's as a whole, far ahead of East Asia, West Asia and South Asia. Tropical Africa is way behind the other regions. In 1963 and 1975, the share of South Asia (essentially India) was much higher as compared to East Asia and West Asia, which further improve in this scenario the industrial position established in the preceding period.

Table XV: Geographical share of manufacturing among DG's (in percent)

	1963	1975	1990
LA	55.8	55.2	54.6
TA	4.5	4.9	4.6
NE	10.0	10.2	12.1
IN	19.0	13.4	11.5
AS	10.7	16.3	17.2
Total	100.0	100.0	100.0

142. Manufacturing exports are influenced by assumptions on the growth rate of the different regions and on the share of exporters in each importing region. In this scenario, the low growth of developed countries makes it difficult for an export-led strategy based on that market to succeed, unless the shares move up significantly. When considering the market of developing economies, the opposite conclusion emerges, i.e. a constant share yields a high growth. The export performances of developing countries are described in Table XVI overleaf.

143. The total share of DG's exports, in the world total, is 9.8 % in volume 1/, as compared to 7.3 % in 1975. The progression is even faster on their own market, where their share reaches 12.2 %, as compared to 9.1 % in 1975. Considering the higher volume traded in the market of DD's, DG's exports of manufactures increase at the same rate (7.7 % per annum) whether to DD's or to DG's. These performances differ, however, greatly

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1/ 8.2 in value terms only, on account of lower prices in the domestic market of DG's compared to DD's.

from one region to another. The cases of Latin America and East Asia, in particular, are worth considering further on account of different commercial strategies captured in the extrapolation of shares [1].

Table XVI: Summary Trade Matrix for Manufactures [2] (1990)
(millions of 1970 US$)

	To DD's	%	To DG's	%	To World	%
Exporting region						
DD's [3]	454303	91.1	144630	87.8	598935	90.2
DG's:						
Latin America	10371	2.1	7956	4.8	18307	2.8
Tropical Africa	3507	0.7	1486	0.9	4993	0.8
West Asia	2628	0.5	2061	1.3	4689	0.7
South Asia	3628	0.7	1853	1.1	5481	0.8
East Asia	22193	4.5	4936	3.0	27129	4.1
CPE's, Asia	2080	0.4	1845	1.1	3925	0.6
Total DG's	44407	8.9	20117	12.2	64524	9.8
Total World	498712	100	164747	100	663459	100

144. Latin America, under the "free trade" assumption made in this scenario, would export 43 % of total manufactures to DG's, this proportion being higher for non-durables (44 %) and even more for equipment goods (65 %) and lower for intermediary products (39 %) and consumer durables (21 %). This reflects the continuation for the period 1975-90 of a commercial policy captured during the observation period, in which Latin America was competing vigourously with DD's in Africa, in Latin America itself and in West Asia. This gives a growth rate of 9.3 % for the exports of manufactures of that

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1/ This extrapolation is based on the use of the gravitational model, for the four categories of manufactures; see Chapter 2, para. 75 to 81. Controls have been put to prevent extreme variations in the shares used in the model, in accordance with the assumptions on protectionism.

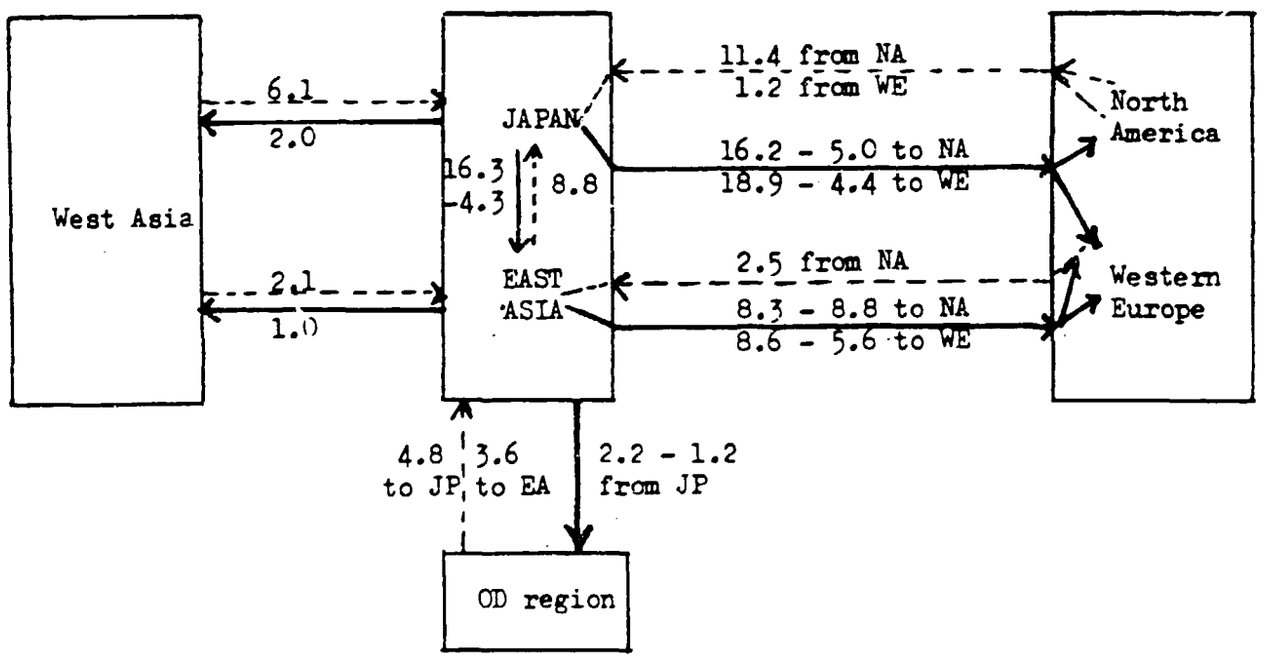
2/ In the analysis above, manufactures include intermediary products (IP), consumer non-durables (ND), equipment goods (EQ) and consumer durables (CD), therefore leaving out processed food.

3/ Including Centrally Planned Economies, Europe.

region to DG's, as compared with 8.7 % to DD's. For equipment goods and consumer durables, exports to DD's grow faster (10-15 %) than to DG's (around 9 %). This pattern may seem optimistic but it shows the dynamics of trade exports of Latin America embodied in past observations.

145. The case of East Asia should be considered jointly with that of Japan. Both have heavy import bills for oil (net imports of $ 7 billion for East Asia and of $ 23 billion for Japan, in value terms), and both regions try to pay part of the bill with exports of manufactures to DD's markets. Their mutual relationship is also of interest: Japan is exporting to East Asia large amounts of equipment and high grade intermediary products, while East Asia directs to Japan primary goods (including Indonesian oil) and some manufactures. The following diagram can be useful in understanding these trade flows:

Chart XVII: 1990 Trade Flow Chart on Japan and East Asia



Symbols: ——→ Manufactures (+ = exports, - = imports)
- - -→ Net primary goods exports (agricultural products, raw materials, energy)

Note: The flows are volume flows. A first idea on the sign of the values terms can be obtained by using a multiplyer of 2 for raw materials, and 3.2 for oil coming from West Asia.

Brief comments on the chart may be in order:

(a) Both Japan and East Asia, under the assumptions made, would improve their shares on DD's markets, e.g. Japan would capture as much as 20 % (14 % in 1975) and East Asia 10 % (7 % in 1975) of the North American market. Yet the Japanese commercial surplus with these markets is small and the East Asian balance is negative.

(b) One obvious adverse factor is the volume (and the price) of primary goods imported by both regions from North America and Western Europe. But the key point is the return flow of manufactures (essentially equipment goods) flowing from these areas towards Japan and East Asia. This is a good illustration of the potential benefits DD countries can expect from the free trade game, admittedly moderate, simulated in this scenario.

(c) Altogether, the balances of Japan and East Asia with North America, Western Europe and the OD region allow another important conclusion, i.e. that the commercial strategies of the 60's and the 70's initiated by Japan and followed by East Asia are no longer successful: at the relative prices of primary goods (including oil) simulated in this scenario, Japan and even less East Asia can hope to pay their import bills for primary goods with manufactures surpluses earned on DD's markets.

(d) One possibility, illustrated by Japan, is to balance its overall trade with exports of manufactures to Latin America and Tropical Africa, but this is not the case for East Asia, which ends up with a heavy deficit.

146. The other side of the balance of manufactures, i.e. import requirements, is worth a close consideration. Here the comparison between Latin America and East Asia is again illuminating. For manufactures as a whole (processed food excluded) the imports of manufactures in Latin America grow more slowly than GDP, with an elasticity of 0.85 relative to GDP, i.e. a rate similar to that found in the observation period. For East Asia, by contrast, the imports of manufactures grow faster than GDP (1.15).

This difference can be traced up to two issues, i.e. the larger industrial base 1/ and the relatively balanced growth of manufactures sub-sectors (see Table XIII) of Latin America compared to East Asia. The comparison therefore seems to suggest that an industrial growth based on basic products and capital goods induces large imports of manufactures in the early stages of the development of these sectors. This, coupled with a high internal absorption of the output of these sectors and with a moderate growth of their exports, yields a large trade deficit.

147. The examination of import requirements strengthens one of the conclusions already reached when considering exports, i.e. the advantages of economic cooperation among developing countries. This cooperation, if conducted in an appropriate way, could solve simultaneously two problems, i.e. a high export growth and a larger industrial base. Such a strategy could and should obviously be quantified in an alternative scenario. The analysis suggests that, failing a reconversion of commercial policies towards more trade and economic cooperation with developing countries, in particular within the region itself, East Asian countries would become increasingly vulnerable to protectionist reactions of DD's economies. The conclusions might as well be extended to other regions.

148. One key issue is the degree of import dependence by manufacturing sector. The model can give some indications in this field. A simple indicator is the ratio of value-added to total supply (value-added plus imports) in each sector 2/. This ratio has been computed separately

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1/ This is reflected in the import equations by a lower elasticity of imports relative to manufactures, as compared to the other regions.

2/ More sophisticated indicators could be computed, with total output rather than value-added, and with imports net of intra-trade. The ratio given here should be considered as a first indication.

for Primary Processing industries (excluding food, and oil refineries) light industry and capital goods industry, for 1970/1975 (observed data) and 1990 (this scenario). Table XVIII can be interpreted as follows:

- The share of domestic supply is increasing in all DG regions from 1975 to 1990 for the capital-good sector, with South Asia (thanks to India), followed by Latin America as leaders in this move. The interpretation in terms of reduction of technology dependence makes this indicator particularly significant.

- All DG regions, including Tropical Africa, also reduce their trade (and technology) dependence in primary processing industries. The level of the indicator is everywhere higher than the ratio for capital goods; India, for example, is, according to this indicator, import dependent for only 5% of its supply, a level similar to North America.

- In the light industry sector, the conclusion is the reverse, all countries are supposed, under this scenario, to increase their trade dependence, which again is an illustration of the low priority given in the scenario to the development of consumption goods industries. A comparison of the 1975-90 scenario figures with observed data for 1970-1975 suggests that such a trend was already underway during the preceding period.

Table XVIII: Domestic share in total supply for main manufacturing sectors (DG's)

Sectors	Year	LA	TA	NE	IN	AS
CAPITAL GOODS	1970	.47	.08	.09	.48	.21
	1975	.51	.06	.04	.60	.25
	1990	.64	.09	.10	.75	.29
PRIMARY PROCESSING	1970	.67	.03	.23	.64	.32
	1975	.65	.02	.16	.93	.48
	1990	.73	.15	.28	.94	.64
LIGHT INDUSTRY	1970	.84	.57	.54	.90	.55
	1975	.81	.57	.23	.80	.54
	1990	.77	.47	.28	.62	.34

Note: Domestic share = value-added/(value-added + imports)

149. An overall evaluation of the trade balance, at current prices, is given in Table XIX.

Table XIX: General trade balance for 1990 - Net exports by commodity groups

in billions of 1990 dollars

Regions		AP+RM	EN	Manufactures	Services	Balance
DD's	NA	+52.3	-83.7	-4.7	-34.0	-70.1
	WE	-2.5	-260.0	+105.4	+107.1	-50.0
	EE	-28.2	+43.3	+2.4	-6.0	+11.5
	JP	-108.8	-123.1	+260.9	-28.5	+0.5
	OD	+54.2	+6.9	-46.9	+7.5	+21.7
Total DD's		-33.0	-416.6	+317.1	+46.1	-86.4
DG's	LA	+27.7	+42.5	-69.4	-20.4	-19.6
	TA	-10.7	+34.3	-33.8	-2.8	-13.0
	NE	+7.2	+377.7	-190.7	-21.3	+172.9
	IN	+0.9	-8.9	-8.4	-2.0	-18.4
	AS	+6.4	+12.7	-45.9	-0.7	-27.5
	OA 1/	+1.5	-41.7	+31.1	+1.1	8.0
Total DG's		+33.0	+416.6	-317.1	-46.1	86.4

1/ Figures for CPE's, Asia (OA) should not be interpreted as significant, since they are obtained as a residual (see also note 3/ of Table XII)

Brief comments on the table are in order. The balance of primary goods (AP+RM)dominated by agricultural products (AP) is positive for three regions, North America, the OD region and Latin America, and highly negative for Japan, with a medium size deficit for both Centrally Planned Economies. Other regions have a surplus or deficit which is not significant except for Tropical Africa. The balance of energy materials (EN), as could be expected, is highly negative for DD's as a whole (with a surplus in Eastern Europe and to a lesser extent the OD region). Small surpluses or deficits are observed in DG regions, with the conspicuous exception of West Asia, which carries the largest surplus. However, this part of the model is tentative since supply capacities in each region would require a further study, as well as other relevant parts of the model. The same remark applies, with less far-reaching implications, to the balance of services (transport and trade margins)

which is characterized by small and medium size deficits in all regions.

149. The balance of manufactures,is worth close attention. Two large surplus countries, Western Europe and even more Japan, are found on one side, and negative balances prevail for all developing regions (the surpluses of centrally Planned Economies are not sufficiently established to be considered significant). The large deficit of West Asia, in particular, reflects its own "absorption capacity" of imports.

150. The table does not include any breakdown of the manufacturing sector but detailed figures confirm that the two subsectors responsible for the deficit of developing regions are basic products and capital goods. The relative importance of the two sectors differ according to regions: South Asia and East Asia have a surplus in basic products, Latin America has almost a balanced trade, against huge deficits for Tropical Africa and West Asia. All regions, perhaps South Asia to a lesser extent, carry a large deficit in capital goods, although, as was suggested by table XVIII, the trade dependence in this field is everywhere decreasing in relative terms.

150. Quite evidently, when looking at the overall trade balance, the magnitude of the energy and manufactures balances largely determine the world pattern. To clarify the issue, it seems relevant to separate West Asia. The figures thus obtained for the remaining part of market developing regions show a surplus for the energy balance (80) and a huge deficit in the balance of manufactures (-158). The energy balance for individual countries is blurred here by the aggregation process, but inevitably, a number of countries are likely to be faced with a large deficit which adds up to the deficit of manufactures. The model, it is hoped, can be used to consider how the latter deficit can be financed at the world level and/or reduced through a different commercial strategy. This is discussed in the next section.

IV. Tentative conclusion and indications for further work

151. Without denying some interest in the results of the trend scenario, its main merit should be to identify the type of issues which can be explored by the UNITAD model. In this respect, this section wishes to draw attention to one common feature of these issues, i.e. the time dimensions of development problems. Next, suggestions are made for four groups of scenarios which would be worth exploring with the system.

152. Perhaps the main originality of the model is not only to inter-relate a number of major development issues - a feature which is to a certain extent shared with several existing world models, inside and outside the United Nations family - but to put these issues on a long-term perspective. The aggregation level of the model (eleven regions, eight sectors) is obviously inadequate to handle short term issues for individual countries or small country groups, but is meant to give a birdeye view on the time dimensions of major world issues within the next 10-20 years. It is a commonplace to say that it takes time to build an industrial base, to provide employment to hundred million workers, to transform agriculture, to control technology, in order to reduce mass poverty. But the real question is to compare the speed and efficiency of various domestic and world policies in reaching these objectives.

153. In this respect, one of the main lessons to be derived from the trend scenario, which is dominated by market mechanisms, lies in the illustration of their potential adverse long-term effect in the next decade. The model, in particular, draws attention to the severe negative effects of the world trade and financing mechanisms, which are clearly short-sighted and unable, when put on a long-term perspective, to support the targets of the Third Development Decade. These are in no way speculative issues but urgent matters facing governments today.

154. Another side of the same problems is obviously the type of adjustments which would be required both at the domestic level and in world structures to improve the gloomy picture - altogether not artificially pessimistic - given by the trend scenario. The following paragraphs put forward four groups of alternative scenarios, which might be simulated for further exploration - in an attempt to alleviate some or all of the most negative features of the continuation of present trends.

155. The first obvious suggestion concentrates on a possible reflation of the economies of the North. It can be argued in fact, that the industrialized countries, because of their weight in the world economy, should maintain higher GNP growth rates and import growth, recognizing that this may involve large payment deficits, especially in the short run. Adjustment to increases in oil prices should not entail deflationary measures and recycling, but restructuring and keeping the growth rates tendentially balanced. Although a faster growth in the North would not change the basic situation of dependence of the developing market economies countries, it would immediately ease the situation of the trade and current accounts of several less developed economies. Some of them could then either choose to reduce their foreign debt (the service of which absorbs enormous resources), or to accelerate their growth rates. In the latter case, the world economy would be likely to reach an equilibrium position at a higher growth rate than that illustrated in the trend scenario. Notice that a policy of reflation in the North could be sustained by the existence of large outstanding credits and foreign asset holdings by the industrialized countries (a rough estimate of total outstanding debt of developing countries in 1980 is somewhere around 500 billion dollars). If these debts are to be reimbursed, the creditors countries, i.e. industrialized and oil producing nations, have to allow the non oil-exporting countries to achieve, sooner or later, an adequate trade surplus.

156. Many claim, however, that there are several reasons for advocating a moderate growth in industrialized countries. Firstly a rapid resumption of their growth would likely push the prices of oil and other raw materials further up. Even assuming that industrialized countries would be ready to carry large deficits, the joint effect of increasing import prices and of domestic overheating of the economy, it is argued, would determine a new wave of inflation with all its undesirable effects in terms of domestic inequality and unstable exchange rates. Secondly, a slow growth of industrialized economies would be recommendable for environmental reasons. It would, in fact, make physically available to developing regions (as well as to future generations) a larger amount of oil-and other non-renewable resources. Thirdly, a slower growth would force the more advanced countries to tackle their problems in the area of income distribution, marginalization and perhaps help in evolving towards new lifestyles. As seen above, moreover, the enemployment problem could be manageable, provided that the length of the working week is progressively reduced and that part-time jobs are introduced along with progressive extension of automation. With moderate growth in the North, and with the same international trading relations, however, a sustained growth in the South, has been shown to be confronted with practically unmanageable financing and recycling problems. If a scenario of this type was simulated, it would be necessary therefore to assume an adequate financing framework capable of providing a transfer of concessional and non-concessional funds on a very considerable scale. A doubling, for several years, of ODA together with substantial additional lending, at quasi-market terms (i.e. with interest rates and maturity more favourable than at present, perhaps under the auspices of the World Bank and other international lending agencies), would allow the developing economies to sustain rates of growth in the 5-6 per cent bracket. The substantial stepping-up of the imports from developing countries would have

positive spill-over effects on the industrialized economies. In this way, it is argued, the world economy would enter in a virtuous circle, as opposed to the vicious circle of deflation and recession.

157. A third alternative which could be explored finds its support in the conviction that, in the absence of a massive transfer of resources, the desired growth rate of the South cannot be maintained under the present conditions regulating international trade and finance if the industrialized economies continue to restrain economic activity. So, if direct integration on world markets is clearly no guarantee of a sufficient and stable growth, developing countries might progressively strengthen trade and economic cooperation among themselves. This may not mean necessarily trade diversion from North to South, although this may also be the case, but it should induce South-South trade creation similar to that witnessed in the North during the observation period. A strategy of this type appears at present more feasible than years ago. Indeed the objective conditions for large scale industrial cooperation have substantially improved, while, nowadays, the developing world is composed of widely different economies with increased complementarities in the agricultural, industrial and financial areas. Although collective self-reliance will only partially reduce the dependence of the Third World upon Western technology, it might substantially improve the prospect for growth and enhance living conditions, especially for the poorest countries. The same considerations also apply to a fairly large array of consumer and intermediate goods, which can already be manufactured efficiently in several developing countries. All told, it would appear that there are strong inducements for developing countries to engage in collective self-reliance. The success of such a strategy, which could be simulated with the UNITAD system of models, implies a high degree of political cohesion of the Third World, and a supportive attitude of surplus oil-producing countries.

158. A fourth possible alternative may focus on the trade effects and growth prospects of policies emphasizing the satisfaction of the fundamental needs of the population, by means of the adoption of redistributive measures. It is now widely acknowledged in fact, that, in several developing regions, the joint objective of fast growth and satisfaction of fundamental needs cannot be achieved in the absence of profound changes in the domains of land reform, income distribution, adoption of appropriate techniques and adequate policies in the area of public services (education and health, for instance). If measures of this type were adopted, the overall structure of demand and production would change significantly, as well as the import requirements of the developing world. Policies of this type would likely require both a high degree of protectionism and an increased cooperation with other developing countries.

159. Each of the four scenarios outlined above might provide a general orientation for the world system but many specific variants could be derived within each group. For example, there is room to test the impact of alternative technologies and output mixes, especially in the last two scenarios. Again, the model might be used with another algorithm, i.e. fixing targets for one of the gaps - whether finance, employment or land - and allowing the model to select the growth rates compatible with the assumptions. There is also a possibility of simulating various strategies for the specific regions, e.g. experimenting on the regions with the lowest per capita income, Tropical Africa and South Asia.

ANNEX

ANALYTICAL EXPRESSION

OF

THE UNITAD MODEL

Contents

GEOGRAPHICAL AND SECTORAL BREAKDOWNS

1. Geographical breakdown (R space)

Developed regions (DD)			Developing regions (DG)		
(1)	(NA)	North America	(6)	(LA)	Latin America
(2)	(WE)	Western Europe	(7)	(TA)	Africa (South Sahara)
(3)	(EE)	CPE, Europe	(8)	(NE)	North Africa and West Asia
(4)	(JP)	Japan	(9)	(IN)	Indian Subcontinent
(5)	(OD)	Other Developed	(10)	(AS)	East and Southeast Asia
			(11)	(OA)	CPE, Asia

2. Producing sectors (I^P space)

(1) Agriculture (ISIC 1, 3132)
(2) Agri-Food processing (ISIC 311/3/4)
(3) Energy (ISIC 210, 220, 353/4, 410/420)
(4) Basic products (ISIC 230, 290, 371/2, 341, 351/2, 361/2/9)
(5) Light industry (ISIC 321/2/3/4, 331/2, 342, 355/6, 381)
(6) Capital good industry (ISIC 382/3/4/5, 390)
(7) Construction (ISIC 5)
(8) Services (ISIC 6,7,8,9)

3. Utilizing sectors (I^u space)

(1) Agriculture (see $I^P(1)$)
(2) Agri-Food processing ($I^P(2)$)
(3) Oil extraction (ISIC 220)
(4) Utilities (ISIC 4)
(5) Coal mining (ISIC 210)
(6) Other mining (ISIC 230, 290)
(7) Oil refineries and coal products (ISIC 353/4)
(8) Primary processing (ISIC 371/2, 341, 351/2, 361/2/9)
(9) Light Industry (see $I^P(5)$)
(10) Capital good Industry (see $I^P(6)$)
(11) Construction (see $I^P(7)$)
(12) Services (see $I^P(8)$)

4. Manufacturing (I^{mu} space)

ISIC 311/3/4, 353/4, Primary processing, Light industry, Capital good industry

5. Trade sectors (I^t space)

	SITC Number (Rev.1)
1. Agricultural products	0, 1, 2 (excl. 251, 266, 27, 28), 4
2. Non-agricultural raw materials	27, 28 (excl. 286)
3. Energy	286, 3, 515, 688
4. Intermediate products	251, 266, 5 (excl. 515, 54, 55), 61, 621, 63, 541, 65, 66 (excl. 665, 666), 67, 68 (excl. 688), 691, 692, 693, 694, 698, 81
5. Consumer non-durables	54, 55, 62, (excl. 621), 642 665, 666, 696, 84, 85, 89 (excl. 891, 896, 897)
6. Equipment	695, 71, 72, (excl. 724, 725), 73 861
7. Consumer durables	667, 697, 724, 725, 82, 83, 86 (excl. 861), 891, 896, 897, 9

6. Private consumption categories (I^c space)

(for definition, see Yearbook of National Accounts)

(1) Food, Beverages, Tobacco
(2) Clothing and footwear
(3) Gross rent, fuel and power
(4) Furniture, furnishing and household equipment and operation
(5) Medical care and health
(6) Transport and Communication
(7) Recreation, entertainment, education and cultural services
(8) Miscellaneous goods and services

7. Specific classifications for Centrally Planned Economies (Europe)

Industry ($I^{indu} \subset I^u$)

- Agrifood processing (ISIC 311/3/4)
- Oil refineries and coal products (ISIC 353/4)
- Primary processing (ISIC 371/2, 341, 351/2, 355/6, 361/2/9, 390)
- Light Industry (ISIC 321/2/3/4, 331/2,342)
- Capital goods (ISIC 38, including 381)
- Construction (ISIC 5)

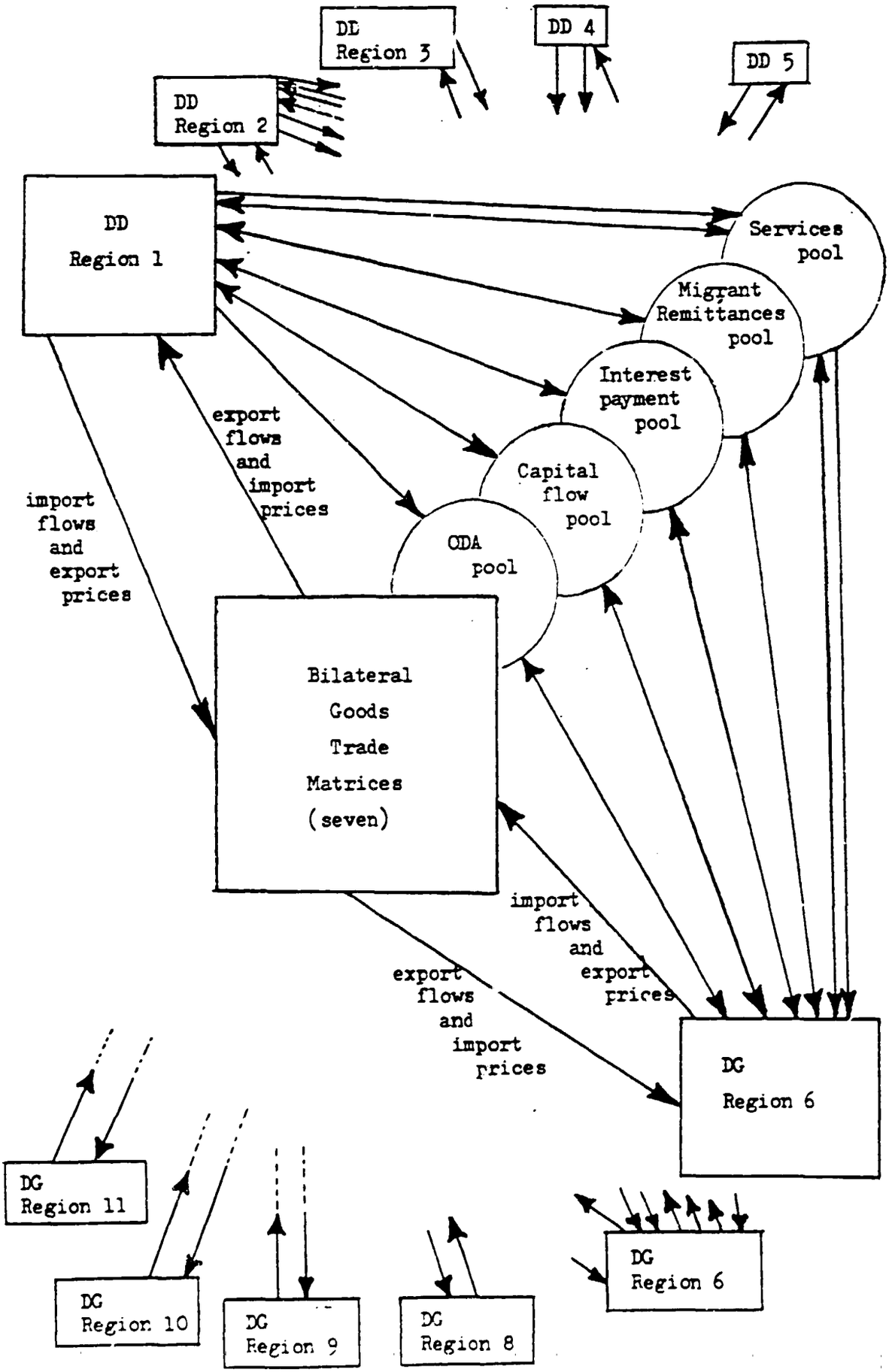
Mining and Utilities ($I^{min} \subset I^u$ space)

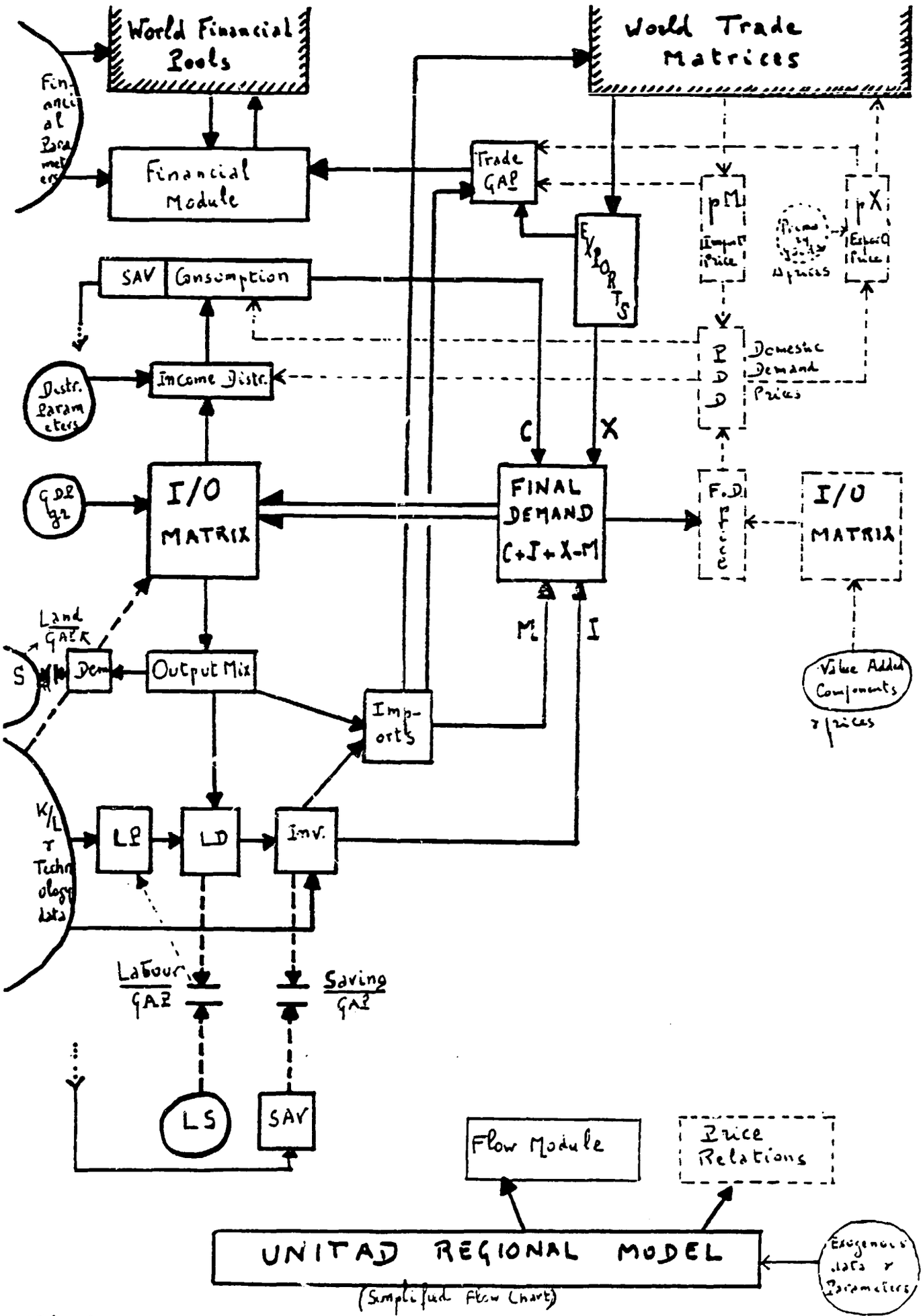
- Oil extraction (ISIC 220)
- Utilities (ISIC 4)
- Coal mining (ISIC 210)
- Other mining (ISIC 230, 290)

Private consumption categories

- Excludes non material services

THE STRUCTURE OF THE WORLD MODEL





(Simplified Flow Chart)

- Feb. 1981 -

NOTATIONS AND SYMBOLS

- Endogenous variables are designated by upper case letters;

- Pre-determined (exogenous and lagged endogenous) variables and parameters are designated by lower case letters;

- VA(i) indicates the i-th element of a vector, while [VA(i)] designates the whole column vector. [VA(i)]' represents the same vector written in line;

- If $CP^{kc}(i,j)$ is the element of the i-th line and j-th column of a matrix, $[CP^{kc}(i,j)]$ designates this matrix, and $[CP^{kc}(i,j)]'$ the transposed matrix;

- I and i designate respectively the unit matrix and vector, i.e.

$$I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \qquad i = \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}$$

- $[\hat{FD}(i)]$ designates the diagonal matrix which has on the diagonal the elements of vector [FD(i)]. For instance I = i. $[a(i,j)]^{-1}$ designates the inverse matrix of [a(i,j)];

- All the variables (unless specified) refer to the same time period. Only in few cases a time-lag (e.g. 15 years) is indicated by a subscript (e.g. -15);

- All the variables refer to the same region except in the linkage equations where the regions are denoted by the subscript r;

- The main control variables are denoted "cv" in the margin.

- General note:

Regional models can be closed either by fixing the growth rate of GDP (in which case the employment gap, the land gap and the saving gap are endogenously determined) or by fixing one of the gaps (and generating GDP and the other gaps). More generally, an objective function of the GDP growth rate and of the gaps can be build up, allowing the model to determine GDP and the gaps by minimizing the objective function. Equation (1) illustrates the first opportunity, which was used in the trend scenario, while Equation (2) illustrates the use of an objective function.

GENERAL MODEL

I. PRODUCTION AND LABOUR PRODUCTIVITY

(in constant prices)

Serial number	Number of equations	
(1)	1	$GDP = gdp_{-15}(1+gdpgr)^{15}$ (trend scenario)
or (2)	1	$W = w(GDPGR, LB, TAGA, NAREGA)$ (objective function)
(3)	8	$[VA(i)] = [\widehat{ivyco(i)}][I-A]^{-1}[FD(i)]$, $\forall i \in I^P$
(4)	11	$[VA^u(i)] = [\overline{bmu}][VA(i)]$, $\forall i \in I^u$
(5)	1	$VAM = \sum_i VA^u(i)$, $\forall i \in I^{mu}$
(6)	7	$LP^u(i) = f[tnp(i), ivyco(i), [le(i), caple(i), du]$, $i \in \{2,4 \text{ to } 9\}$
(7)	1	$LP^u(3) = lpoil$, $u = 3$
(8)	2	$LP^u(i) = lps(i)\left[1 - \frac{LS-LD}{LS}\right]LPM$, $i = 10,11$
(9)		i) <u>For developed regions</u>
	1	$LP^u(1) = VA^u(1) / LD^u(1)$
		ii) <u>For developing regions</u>
	3	$LP^u(1,i) = f\{lala(i) * cri(i), caple(i), [1-ivyco(i)]\}$, $\forall i \in I^a$
(10)	1	$LPM = \sum_i \frac{LD^u(i) * LP^u(i)}{\sum_i LD^u(i)}$, $\forall i \in I^{mu}$
(11)	1 dv	$LIMA = \sum_{r \in R^{DG}} VAM(R) / \sum_{r \in R^w} VAM(R)$

II. Labour Demand, Labour Supply and Unemployment

(12) 1 $POP = pop_{-15}(1+popagr)^{15}$

(13) 1 $POPR = rur\ POP$ } for developing regions only

(14) 1 $POPU = (1-rur)\ POP$ } for developing regions only

(15)

For developed regions

1 $LD^{u}(1) = [f(VA^{u}(1)/GDP)] * LD$

ii) For developing regions

3 $LD^{u}(i) = VA^{u}(i) / LP^{u}(i)$, $\forall i \in I^{a}$ and $\forall i \in \{2 \text{ to } 11\}$

(16) 1 $VA^{u}(1) = \sum_{i} VA^{u}(i)$, $\forall i \in I^{a}$

(17) 1 $LD = \Sigma' [LD^{u}(i)]$, $\forall i \in I^{u}$

For developing regions

(18) 1 $LSMR = wapmr * prmr$

(19) 1 $LSFR = wapfr * prfr$

(20) 1 $LSMU = wapmu * prmu$

(21) 1 $LSFU = wapfu * prfu$

(22) 1 $LS = LSMR + LSFR + LSMU + LSFU$

(23) 1 av $LBR = LSMR + LSFR - LD(1) * dwoty/dwtwoty - b \sum_{i=2}^{11} LD^{u}(i)$

Serial number	Number of equations	
(24)	1 cv	$LBU = LSMU + LSFU - (1-b)\sum_{i=2}^{11} LD^{u}(i)$

For developed regions

(22bis)	1	$LS = wapm * prm + wapf * prf$
(23)	1	$LB = LS - LD$

III. Land Demand, Supply and Land Gap, for $r \in R^{DG}$ only

(24)	3	$TDA(i) = lala(i) * LD(1,i)$, $\forall i \in I^{a}$
(25)	1	$TSA = tsa_{-15} + ta \cdot r$
(26)	1 cv	$TAGA = TSA - \sum_{i} TDA(i)$, $\forall i \in I^{a}$

IV. Investment Requirements

(in constant and current prices)

(27)	9	$IR^{u}(i) = ir^{u}_{-15}(i) * \exp[((caple(i) * LD^{u}(i)/15) - ir^{u}_{-15}(i)) * 2]$, $i = 2, 3, \ldots, 10$

Serial number | Number of equations

(28) i) For developed regions for $\forall i \in \{1, 10, 11\}$ and for developing regions for $i \in \{10, 11\}$

3/3 $IR^{u}(i) = ir^{u}_{-15}(i) * \exp[((capva(i) * VA^{u}(i)/15) - ir^{u}_{-15}(i)) * 2]$, $\forall i \in \{1, 10, 11\}$

ii) For developing regions

1 $IR^{u}(1) = ir^{u}_{-15}(1) * \exp[((\sum_{i \in I^{u}} caple(i) * LD(i) + tex * costex - \Delta cri * coscri)/15) - ir^{u}_{-15}(1)) * 2]$

(29) 1 $IR = \sum_{i} IR^{u}(i)$, $\forall i \in I^{u}$

(30) 8 $[IR^{p}(i)] = [\overline{bmi}]\,[IR^{u}(i)]$, $\forall i \in I^{p}$

(31) 8 $IRCU(i) = IR(i) * PIR(i)$, $\forall i \in I^{p}$

(32) 1 $PIR = (\sum_{i} PIR(i) * IR(i))/IR$, $\forall i \in I^{p}$

V. Exogenous Income Distribution

(in current prices)

For developed regions

(33) 1 $GDPCU = \sum_{i} VA(i) * PVA(i)$, $\forall i \in I^{p}$

(34) 1 $GNPCU = GDPCU + XCU^{\sigma} + XCU^{ip} + XCU^{mr} - MCU^{\sigma} - MCU^{ip} - MCU^{mr}$, $\forall i \in I^{p}$

(35) 1 $GNPCUC = GNPCU + \sum_{i} X^{p}(i)[PX^{p}(i) - PDD(i)]$, $\forall i \in I^{p}$

(36) 1 $LI = \sum_{i} VA(i) * PVA(i) * w\sigma(i) * pw / (w\sigma(i) * pw + nw\sigma(i) * pnw)$, $\forall i \in I^{p}$

Serial number	Number of equations	
(37)	1	$KI = GDPCU - LI - IT$
(38)	1	$KIH = \alpha_1 KI$
(39)	1	$KIE = \alpha_2 KI$ with $\sum_{k=1}^{3} \alpha_k = 1$
(40)	1	$KIG = \alpha_3 KI$
(41)	1	$DTH = t.r.h.\,(NDIH + DTH)$
(42)	1	$DTE = t.r.e.\,(GDIE + DTE)$
(43)	1	$IT = i.t.r.\,GDPCU$
(44)	1	$NDIH = LI + KIH - DTH + XCU^{mr} - MCU^{mr}$
(45)	1	$GDIE = KIE - DTE + XCU^{ip} - MCU^{ip}$
(46)	1	$NDIG = KIG + DTE + DTH + IT + \sum_{i \in I^P} X^P(i)[PX^P(i) - PDD(i)] + XCU^{\alpha} - MCU^{\alpha}$

For developing regions

(47)	1	$RURIN = VA(1) * PVA(1) + b \sum_{i=2}^{8} VA(i) * PVA(i)$
(48)	1	$URBIN = GDPCU - RURIN$

Serial number	Number of equations	
(49)	1	$LIR = VA(1) * PVA(1) * w\sigma(1) * pw / (w\sigma(1) * pw + nw\sigma(1) * pnw) + b \sum_{i=2}^{8} VA(i) * PVA(i) * w\sigma(i) * pw / (w\sigma(i) * pw + nw\sigma(i) * pnw)$
(50)	1	$KIR = RURIN - LIR - ITR$
(51)	1	$LIU = (1-b) \sum_{i=2}^{8} VA(i) * PVA(i) * w\sigma(i) * pw / (w\sigma(i) * pw + nw\sigma(i) * pnw)$
(52)	1	$KIU = URBIN - LIU - ITU$
(53)	1	$KIRH = \alpha_1 KIR$
(54)	1	$KIUH = \alpha_1 KIU$ with $\sum_{k=1}^{3} \alpha_k = 1$
(55)	1	$KIE = \alpha_2 (KIR + KIU)$
(56)	1	$KIG = \alpha_3 (KIR + KIU)$
(57)	1	$DTHR = t.r.h. (NDIHR + DTHR)$
(58)	1	$DTHU = t.r.h. (NDIHU + DTHU)$
(59) (v.42)	1	$DTE = t.r.e. (GDIE + DTE)$
(60)	1	$ITR = i.t.r. RURIN$
(61)	1	$ITU = i.t.r. URBIN$

Serial number	Number of equations	
(62)	1	$NDIHR = LIR + KIHR - DTHR + \frac{1}{2}(XCU^{mr} - MCU^{mr})$
(63)	1	$NDIHU = LIU + KIHU - DTHU + \frac{1}{2}(XCU^{mr} - MCU^{mr})$
(64) (v.45)	1	$GDIE = KIE - DTE + XCU^{ip} - MCU^{ip}$
(65) (v.46)	1	$NDIG = KIG + DTE + DTHR + DTHU + ITR + ITU + \sum_{i \in I^p} X^p(i)\,[PX^p(i) - PDD(i)] + XCU^{\sigma} - MCU^{\sigma}$

VI. SAVINGS, SAVING GAP AND CONSUMPTION

(in constant and current prices)

(66)	1	$GSE = GDIE$
(67)	1	$GCCU = f(NDIG)$
(68)	1	$NSG = NDIG - GCCU$
(69)		<u>For developed regions</u>
	1	$CPCU = f(NDIH/POP) * POP$
		<u>For developing regions</u>
(70)	1	$CPCUR = f(NDIH/POPR) * POPR$
(71)	1	$CPCUU = f(NDIU/POPU) * POPU$
(69 bis)	1	$CPCU = CPCUR + CPCUU$

Serial number	Number of equations	
		For developed regions
(72)	1	$NSH = NDIH - CPCU$
		For developing regions
(73)	1	$NSHR = NDIHR - CPCUR$
(74)	1	$NSHU = NDIHU - CPCUU$
(72bis)	1	$NSH = NSHR + NSHU$
		All regions
(75)	1	$GNPCUC^{*} = CPCU - GCCU + IRCU + XCU - MCU$
(76)	1 [a/]	$GNPCUC^{*} - GNPCUC = f(pola_{ij}, caple_{i}, \ldots ndig, dut_{i}, t_{nj}, wo_{i}, pw, pnw, pva_{i}, pz_{i})$
(77)	1	$GDP = CP + GC + IR + X - M$
		For developed regions
(78)	8	$CP^{c}(i) = POP * f(CP/POP, PCP^{c}(i)) \quad , \forall i \in I^{c}$
		For developing regions
(79)	8	$CPR^{c}(i) = POPR * f(CPR/POPR, PCP^{c}(i)) \quad , \forall i \in I^{c}$
(80)	8	$CPU^{c}(i) = POPU * f(CPU/POPU, PCP^{c}(i)) \quad , \forall i \in I^{c}$

a/ Slack variable to be minimized through an adequate combination of parameters and exogenous variables.

Serial number	Number of equations	
		All regions
(81)	1	$CP = \sum_i CP^r(i) \quad , \forall i \in I^r$
(82)	8	$[GCCU(i)] = [gc(i)] * GCCU \quad , \forall i \in I^g$
(83)	8	$GC(i) = GCCU(i) / PGC(i) \quad , \forall i \in I^g$
(84)	1	$GC = \sum_i GC(i) \quad , \forall i \in I^g$
(85)	1 cv	NAREGA = GSE + NSG + NSH - IRCU
(86)	1 cv	BACR = SOL * POP / (CP + GC)

VII. The Foreign Sector

(in constant and current prices)

(87)	7	$[AV(i)]'$: see Annex1 $\quad , \forall i \in I_7^t$
(88)	7	$M^t(i) = f[AV(i), PM(i)/PX(i), dut) \quad , \forall i \in I_7^t$
(89)	7	$PM^t(i) = \sum_{r=1}^{11} t(r,j,i) * PX^t(i,r) \quad , \forall i \in I_7^t \; ; \; j = 1,2,\dots,11$
(90)	7	$MCU^t(i) = M^t(i) * PM^t(i) \quad , \forall i \in I_7^t$

Serial number	Number of equations	
(91)	1	$MCU^t(8) = f(GDPCU, \sum_{i=1}^{7} MCU^t(i))$
(92)	1	$M^t(8) = MCU^t(8) / PM(8)$
(93)	1	$PM^t(8) = \sum_{r=1}^{11} PX^t(8,r) * \Delta$
(94)	7	$X^t(i) = \sum_{r=1}^{11} t(r,j,i) * M^t(i,r)$, $\forall i \in I_7^t$; $j = 1, 2, \ldots, 11$
(95)	7	$XCU^t(i) = X^t(i) * PX^t(i)$, $\forall i \in I_7^t$
(96)	1	$XCU^t(8) = \Delta \sum_{r=1}^{11} MCU^t(8,r)$
(97)	1	$X^t(8) = XCU^t(8) / PX^t(8)$
(98)	1 cv	$BAGOSE = \sum_{i=1}^{8} XCU^t(i) - \sum_{i=1}^{8} MCU^t(i)$
(99)	1 cv	$TOTOT = XCU * M / MCU * X$

VIII. The Capital Movement Module

(in current prices)

(100)	1	$MCU^{\sigma} = \sigma da * GDPCU$
(101)	1	$MCU^{lt,i} = ir^{lt} * ODEB$

Serial number	Number of equations	
(102)	1	$MCU^{sti} = ir^{st} * STCAP * \frac{1}{2}$
(103)	1	$MCU^{ip} = MCU^{lti} + MCU^{sti}$
(104)	1	$MCU^{mr} = mcu^{mr}$
(105)	1	$XCU^{\sigma} = \sigma \sum_{r=1}^{11} MCU^{\sigma}(r)$
(106)	1	$XCU^{lti} = (ODEB / \sum_{r=1}^{11} ODEB(r)) \sum_{r=1}^{11} MCU^{lti}$, for ODEB > 0
(107)	1	$XCU^{sti} = (STCAP / \sum_{r=1}^{11} STCAP(r)) \sum_{r=1}^{11} MCU^{sti}$, for STCAP > 0
(108)	1	$XCU^{ip} = XCU^{lti} + XCU^{sti}$
(109)	1	$XCU^{mr} = mr \sum_{r=1}^{11} MCU^{mr}$
(110)	1cv	$CUBA = BAGOSE + XCU^{\sigma} + XCU^{ip} + XCU^{mr} - (MCU^{\sigma} + MCU^{ip} + MCU^{mr})$
(111)	1	$RES = \frac{1}{4} \sum_{i}^{t} MCU(i)$, $\forall i \in I_7^t$
(112)	1	$\Delta RES = (RES - res_{-15}) * \frac{1}{15}$, for all regions expect region 1 (NA)
(113)	1	$MCAPLT = mcaplt$
(114)	1	$XCAPLT = c \sum_{r=1}^{11} MCAPLT$
(115)	1	$ODEB = f(odeb_{-15}, xcap_{-15}, XCAPLT, n)$

Serial number	Number of equations	
(116)	1	$RIMBA = ODEB/m$
(117)		$REPA = [ODEB \quad / \sum_{r=1}^{11} ODEB(r)] * \sum_{r=1}^{11} RIMBA(r)$, for $ODEB < 0$

For all regions except NA (region1)

(118)	1cv	$STCAP = CUBA - \Delta RES + XCAP - MCAP - RIMBA + REPA$

For the NA (region1)

(118bis)	1cv	$STCAP = \sum_{r=2}^{11} STCAP(r)$
(112bis)	1cv	$\Delta RES = CUBA - STCAP + XCAP - MCAP - RIMBA + REPA$

IX. Prices and the Definition of Final Demand by Producing Sector

(119)	5	$PVA^{*}(i) = wo(i) * pw + nwo(i) * pnw$, $\forall i \in I^{P}_{5}$ and with $wo(i) + nwo(i) = 1$
(120)	8	$[PVA(i)] = [pva(1), PVA^{*}(i), pva(3), pva(8)]$, $\forall i \in I^{P}$
(121)	8	$[PFD(i)] = [I-A]^{-1} \widehat{ivyco}\,[PVA(i)]$, $\forall i \in I^{P}$
(122)	8	$[PGC(i)] = [PDD(i)]$, $\forall i \in I^{P}$

Serial number	Number of equations	
(123)	8	$[PIR(i)] = [PDD(i)] \quad , \forall i \in I^p$
(124)	8	$[PCP^p(i)] = [PDD(i)] \quad , \forall i \in I^p$
(125)	8	$[PCP^c(i)] = [\overline{bmc}]' [PCP^p(i)] \quad , \forall i \in I^c$
(126)	7	$[PX^t(i)] = [\overline{bmt}]' [PDD(i)] + \Delta px^t(i) \quad , \forall i \in I_7^t$
(127)	8	$[CP^p(i)] = [\overline{bmc}] [CP^c(i)] \quad , \forall i \in I^c$
(128)	8	$[X^p(i)] = [\overline{bmt}] [X^t(i)] \quad , \forall i \in I^p$
(129)	8	$[M^p(i)] = [\overline{bmt}] [M^t(i)] \quad , \forall i \in I^p$
(130)	8	$[FD(i)] = [CP^p(i)] + [GC^p(i)] + [IR^p(i)] + [X^p(i)] - [M^p(i)] \quad , \forall i \in I^p$
(131)	8	$[FDCU(i)] = [\widehat{PFD(i)}] [FD(i)] \quad , \forall i \in I^p$
(132)	8	$PX^p(i) = [\overline{bmpt}]' PX^t(i) \quad , \forall i \in I^p$
(133)	8	$PM^p(i) = [\overline{bmpt}]' PM^t(i) \quad , \forall i \in I^p$
(134)	8	$XCU^p(i) = X^p(i) * PX^p(i) \quad , \forall i \in I^p$
(135)	8	$MCU^p(i) = M^p(i) * PM^p(i) \quad , \forall i \in I^p$
(136)	8 a/	$FDCU(i) = [PDD(i)][CP^p(i) + IR^p(i)] + [GCCU(i)] + [XCU(i) - MCU(i)] \quad , \forall i \in I^p$

a/ Drawing FDCU (i) from equation (131), this equation defines PDD(i).

REGIONAL MODEL FOR CENTRALLY PL. ED ECONOMIES, EUROPE

(in constant 1970 prices, except section V.)

Serial number	Number of equations	
		I. PRODUCTION
(1)	1	$GMP = gmp_{-15}(1+gmpgr)^{15}$
		II. CONSUMPTION AND FINAL DEMAND
(2)	1	$LPMP = GMP/LEMP$
(3)	1	$LENM = lenm$
(4)	1	$LD = ls$
(5)	1	$LEMP = LD - LEMN$
(6)	1	$LPMPGR = (LPMP/lpmp_{-15})^{-15} - 1$
(7)	1	$AWGR = \delta\, LPMPGR$
(8)	1	$WMP = wmp_{-15}(1+AWGR)^{15}$

Serial number	Number of equations	
(9)	1	$LI = WMP * LEMP$
(10)	1	$EI = GMP - LI$
(11)	1	$DEI = EI - EXNET + SAVING$
(12)	1	$EXNET = exch \sum_{i} (x^{t}(i) - M^{t}(i)) \quad , \forall i \in I^{t}$
(13)	1	$LINOM = LENM\ (1 + \chi AWGR)^{15}\ wnm_{-15}$
(14)	1	$SOCI = (POP - LD)\ (1 + \chi AWGR)^{15}\ Soci_{-15}$
(15)	1	$POPI = LI + LINOM + SOCI$
(16)	1	$SAVING = f(POPI, AWGR)$
(17)	1	$GFCFMP = i\ GFCF$
(18)	1	$GFCFNM = (1-i)\ GFCF$
(19)	1	$PC = POPI - SAVING$
(20)	8	$PC(i) = pc(i) * PC \quad , \forall i \in I^{p} \quad , \text{ with } \sum_{i \in I^{p}} pc(i) = 1$
(21)	8	$GFCF(i) = gfcf(i) * GFCF \quad , \forall i \in I^{p} \text{, where } \sum_{i \in I^{p}} gfcf(i) = 1$
(22)	1	$STOCK = \beta\ GMP$

Serial number	Number of equations	
(23)	8	$STOCK(i) = st(i) * STOCK \quad , \forall i \in I^p \text{ , with } \sum_{i \in I^p} st(i) = 1$
(24)	7	$M^t(i) = f[AV(i)] \quad , \forall i \in I^t$
(25)	7	$X^t(i) = \sum_{r=1}^{M} t(r,j,i) * M^t(i,r) \quad , \forall i \in I^t \quad , j = 1,2,\ldots,11$
(26)	8	$[x^p(i)] = [\overline{bmt}][\widehat{exch}][x^t(i)] \quad , \forall i \in I^p$
(27)	8	$[M^p(i)] = [\overline{bmt}][\widehat{exch}][M^t(i)] \quad , \forall i \in I^p$
(28)	1	$CC = DEI - (LINOM + SOCI + GFCF + STOCK)$
(29)	8	$CC(i) = cc(i) * CC \quad , \forall i \in I^p \text{ , with } \sum_{i \in I^p} cc(i) = 1$
(30)	8	$FD(i) = CC(i) + PC(i) + GFCF(i) + STOCK(i) + X^p(i) - M^p(i) \quad , \forall i \in I^p$

III. PRODUCTION STRUCTURE

(31)	8	$GO(i) = (I-A)^{-1} FD(i) \quad , \forall i \in I^p$
(32)	8	$VA(i) = GO(i) * ivj(i) \quad , \forall i \in I^p$
(33)	11	$[VA^u(i)] = [\overline{bmu}][VA(i)] \quad , \forall i \in I^u$

Serial number	Number of equations	
		IV. INVESTMENT AND PRODUCTIVITY
(34)	6	$LP(i)_{new} = f_{new}[k(i)/l(i), t]$, $\forall i \in I^{indu}$
(35)	6	$LP(i)_{old} = lp(i)_{old}[1 + lpgr(i)]^{15}$, $\forall i \in I^{indu}$
(36)	4	$LP(i)_{min} = f_{min}[k(i)/l(i), t]$, $\forall i \in I^{min}$
(37)	1	$LEMIN = \sum_i GO(i)/LP(i)_{min}$, $\forall i \in I^{min}$
(38)	1	LEAGR = leagr
(39)	1	LESERV = leserv
(40)	1	LEINDU = LEMP - LEMIN - LEAGR - LESERV
(41)	1	$LEINDU = \sum_i LE(i)_{new} + LE(i)_{old}$, $\forall i \in I^{indu}$
(42)	1	$[LE_{new}(i)] = [\hat{\Gamma}][LE_{old}(i)]$, $\forall i \in I^{indu}$
(43)	6	$GO(i) = LP_{new}(i) * LE_{new}(i) + LP(i)_{old} * LE_{old}(i)$, $\forall i \in I^{indu}$
(44)	6	$KNEW(i) = [k(i)/l(i)] * LE_{new}(i)$, $\forall i \in I^{indu}$
(45)	6	$KOLD(i) = [k(i)/l(i)] * LE_{old}(i)$, $\forall i \in I^{indu}$

Serial number | Number of equations

(46) 6 $$GFCFINDU(i) = \lambda\ KOLD(i) + \frac{KNEW(i)}{10}\ ln\left[\frac{KNEW(i)}{\alpha_i\ cap_{-10}(i)}\right] +$$

$$+ \lambda\left\{KNEW(i) - \frac{KNEW(i)}{10}\ ln\left[\frac{KNEW(i)}{\alpha_i\ cap_{-10}(i)}\right]\right\}, \forall i \in I^{indu}$$

(47) 6 $$RET(i) = \frac{KOLD(i)}{10}\ ln\left[\frac{(1-\alpha_i)\ cap_{-10}(i)}{KOLD(i)}\right], \forall i \in I^{indu}$$

(48) 1 $$GFCFAGR = gfcfagr_{-10} * exp\left\{\left[(capvagr * VA(R/10) - gfcfagr_{-10}\right] * 2\right\}$$

(49) 1 $$GFCFSERV = gfcfserv_{-10} * exp\left\{\left[(capvserv * VASERV/10) - gfcfserv_{-10}\right] * 2\right\}$$

(50) 4 $$GFCFMIN(i) = \frac{K(i)}{10}\ ln\left(\frac{K(i)}{cap_{-10}(i)}\right) + \lambda\left[K(i) - \frac{K(i)}{10}\ ln\left(\frac{K(i)}{cap_{-10}(i)}\right)\right], \forall i \in I^{min}$$

(51) 1 $$GFCFMP = GFCFAGR + GFCFSERV + \sum_{i \in I^{indu}} GFCFINDU + \sum_{i \in I^{min}} GFCFMIN$$

V. FINANCIAL SUB-MODEL

(in current prices)

(52) 1 $$STMCAP = CUBA - \Delta RES + XCAP - MCAP - RIMBA + REPA$$

GENERAL MODEL (MARKET ECONOMIES)

ENDOGENOUS VARIABLES

AV(i)	7	Activity variable associated with trade sector i (see Annex 1) (I^t)
BACR	1	Basic consumption ratio
BAGOSE	1	Balance of goods and services
CP	1	Total private consumption at constant prices
$CP^c(i)$	8	Private consumption expenditures on the i^{th} consumption category (I^c)
$CP^p(i)$	10	Private consumption demand for the i^{th} producing sector (constant)(I^p
CPCU	1	Total private consumption at current prices
$CPCU^c(i)$	8	Private consumption expenditures on the i^{th} consumption category (current)
$CPCU^p(i)$	8	Private consumption demand for the i^{th} producing sector (current)
CPCUR	1	Total private consumption at current prices rural, only for DG region
CPCUU	1	Total private consumption at current prices urban, only for DG region
CPR	1	Total private consumption at constant prices rural, only for DG regions
$CPR^c(i)$	8	Private consumption expenditures on the i^{th} consumption category (I^c) rural, only for DG regions
CPU	1	Total private consumption at constant prices urban, only for DG regions
$CPU^c(i)$	8	Private consumption expenditures on the i^{th} consumption category (I^c) urban, only for DG regions
CUBA	1	Current payment balance
DTE	1	Direct taxes enterprises
DTH	1	Direct taxes households
DTHR	1	Direct taxes households rural
DTHU	1	Direct taxes households urban
FD(i)	8	Final demand for the i^{th} producing sector (constant) (I^p)
FDCU(i)	8	Final demand for the i^{th} producing sector (current) (I^p)

GC	1	Total public consumption expenditures at constant prices
GC(i)	8	Public consumption demand for the i^{th} producing sector (I^P) (constant prices)
$GC^P(i)$	4	Public consumption demand, by category (I^E)
GCCU	1	Total public consumption, current prices
GCCU(i)	8	Public consumption demand for the i^{th} producing sector (I^P) (current prices)
GDIE	1	Gross disposable income of enterprises
GDP	1	Gross domestic product at market prices (constant)
GDPCU	1	Gross domestic product at market prices (current), see also GDPCUC
GNPCU	1	Gross national product (current)
GNPCUC	1	Gross national product at market prices (current), adjusted by adding up income (positive or negative) accruing on account of exogenous export prices. This income is inputed to Government (see NDIG)
GSE	1	Gross saving of enterprises (including depreciation)
IR	1	Total investment requirement at constant prices
$IR^P(i)$	8	Investment demand addressed to the i^{th} producing sector (constant) (I^P)
$IR^U(i)$	11	Investment requirement of the i^{th} utilizing sector (constant)(I^U)
IRCU	1	Total investment requirement at current prices
IRCU(i)	8	Investment goods demand addressed to the i^{th} producing sector (current) (I^P)
IT	1	Indirect taxes
ITR	1	Indirect taxes, rural, only for DG regions
ITU	1	Indirect taxes, urban, only for DG regions
KI	1	Capital income
KIE	1	Capital income enterprises
KIG	1	Capital income government
KIH	1	Capital income households

KIR	1	Capital income, rural, only for DG regions
KIRH	1	Capital income, rural, households, only for DG regions
KIU	1	Capital income, urban, only for DG regions
KIUH	1	Capital income, rural, households, only for DG regions
LB	1	Total labour balance (man-years)
LBR	1	Labour balance in rural areas expressed in man-years
LBU	1	Labour balance in urban areas expressed in man-years
LD	1	Total labour demand (man-year)
$LD^u(i)$	11/3	Labour demand for i^{th} utilizing sector (man-year) (I^u), (I^a)
LI	1	Labour income
LIMA	1	Control variable indicating the relative share of developing countries in the world production of manufactures. Can be computed with or without China
LIR	1	Labour income, rural, only for DG regions
LIU	1	Labour income, urban, only for DG regions
$LP^u(i)$	11	Labour productivity per man-year in the i^{th} utilizing sector I^u
$LP^u(1,i)$	3	Labour productivity per man-year in agriculture, only for DG regions, (I^a)
LPM	1	Labour productivity, manufacturing sector (I^{mu})
LS	1	Total labour supply (man-year)
LSFR	1	Labour supply, female, rural (man-years), only for DG regions
LSFU	1	Labour supply, female, urban (man-years), only for DG regions
LSMR	1	Labour supply, male, rural (man-years), only for DG regions
LSMU	1	Labour supply, male, urban (man-years), only for DG regions
M	1	Total imports of goods and services (constant prices)
$M^p(i)$	8	Imports of goods or services of the i^{th} producing sector (constant prices) (I^p)
$M^t(i)$	7	Imports related to the i^{th} trade category (constant prices)(I^t) (any one region)
$M^t(i,r)$	7x11	Same as $M^t(i)$, with regional suffix r (constant prices) (I^t)

MCAPLT	1	Long-term capital movement (outflow)
MCU	1	Total imports of goods and services (current)
MCU^{ip}	1	Total interests and property income paid to the rest of the world
MCU^{lti}	1	Interest and property income paid to the rest of the world (long-term)
MCU^{mr}	1	Migrant remittances paid to the rest of the world
MCU^{o}	1	Official Development Assistance provided by the region (only for DD regions)
MCU^{sti}	1	Interest and property income paid to the rest of the world (short-term)
$MCU^{p}(i)$	8	Imports of goods or services of the i^{th} producing sector (current)(I^{P})
$MCU^{t}(i)$	8	Imports related to the i^{th} trade category (current)
NAREGA	1	National resources gap
NDIG	1	Net disposable income of government, including additional income (positive or negative) originating from exogenous export prices
NDIH	1	Net disposable income of households
NDIHR	1	Net disposable income of households, rural, only for DG regions
NDIHU	1	Net disposable income of households, urban, only for DG regions
NSG	1	Net saving of government
NSH	1	Net saving of households
NSHR	1	Net saving of households, rural, only for DG regions
NSHU	1	Net saving of households, urban, only for DG regions
NWAR	1	Non-working age population, rural, only for DG regions
NWAU	1	Non-working age population, urban, only for DG regions
ODEB	1	Outstanding debt
$PCP^{c}(i)$	8	Price deflator for i^{th} private consumption category (I^{C})
$PCP^{p}(i)$	8	Price deflator of private consumption for producing sector i (I^{P})
PDD(i)	8	Price deflator of domestic demand for producing sector i (I^{P})
PFD(i)	8	Price deflator of final demand addressed to the i^{th} producing sector (I^{P})

PGC(i)	8	Price deflator of government consumption for the i^{th} producing sector (I^p)
PIR	1	Price deflator of total investment requirement
PIR(i)	8	Price deflator of investment required by the i^{th} producing sector (I^p
POP	1	Total population
POPR	1	Population, rural, only for DG regions
POPU	1	Population, urban, only for DG regions
$PM^p(i)$	8	Price deflator of imports of goods (services) of the i^{th} producing sector (I^p)
$PM^t(i)$	8	Price deflator of imports of goods (services) of the i^{th} trade category (I^t)
PVA(i)	8	Price deflator of value added of the i^{th} producing sector (I^p)
$PX^p(i)$	8	Price deflator of exports of goods (services) of the i^{th} producing sector (I^p)
$PX^t(i)$	8	Price deflator of exports of goods (services) of the i^{th} trade category (I^t)
REPA	1	Repayments of outstanding credit received by creditor country
RES	1	Reserves
ΔRES	1	Change in reserve
RIMBA	1	Reimbursement of a fraction of outstanding debt by debtor country
RURIN	1	Gross rural income (total)
SOL	1	Standard of living (defined as per capita consumption expenditures on food, housing, health and education)
STCAP	1	Short-term capital movements
TAGA	1	Land gap, only for DG regions
TDA(i)	3	Land demand, only for DG regions
TOTOT	1	Total term of trade
TSA	1	Land supply, only for DG regions
URBIN	1	Gross urban income (total), only for DG regions
VA(i)	8	Value added of the i^{th} producing sector (I^p)
$VA^u(i)$	11	Value added, i^{th} utilizing sector (I^u)

VAGR(i)	8	Value added growth rate of the i^{th} producing sector
VAM	1	Value added of manufacturing (I^{mu})
VAS(i)	8	Value added share, i^{th} producing sector (I^{P})
X	1	Total exports of goods and services (constant)
$X^{P}(i)$	8	Exports of goods or services of the i^{th} producing sector (constant) (I^{P})
$X^{t}(i)$	8	Exports of the i^{th} trade category (constant) (I^{t})
XCAPLT	1	Long-term capital movement (inflow)
XCU	1	Total exports of goods and services (current)
XCU^{ip}	1	Total interest and property income received from the rest of the world
XCU^{lti}	1	Interest and property income received from the rest of the world (long-term)
XCU^{mr}	1	Migrant remittances received from the rest of the world
XCU^{o}	1	Official Development Assistance received by the region (only for DG regions)
XCU^{sti}	1	Interest and property income received from the rest of the world (short-term)
$XCU^{P}(i)$	8	Exports of goods or services of the i^{th} producing sector (I^{P})
$XCU^{t}(i)$	8	Exports of goods or services of the i^{th} trade category (current) (I^{t})

GENERAL MODEL (MARKET ECONOMIES)

PRE-DETERMINED VARIABLES AND PARAMETERS

α_i	3	Capital allocation parameter
a(i,j)	8x8	Input-output coefficient, i.e. intermediate consumption of products of the i^{th} sector by unit of production of the j^{th} producing sector
A		Matrix A = [a(i,j)] i,j = 1,2....., 8
b	1	Share of non-agricultural employment in the rural sector
$\overline{bmc}(i,j)$	8x12	Share of the j^{th} private consumption category supplied by the i^{th} producing sector in current prices; (a bar over the symbol indicates constant prices)
$\overline{bmi}(i,j)$	8x8	Share of the j^{th} sector required investments supplied by the i^{th} producing sector (constant)
$\overline{bmt}(i,j)$	8x8	Share of the j^{th} traded goods (or services) category produced by the i^{th} producing sector (constant)
$\overline{bmtp}(i,j)$	8x8	Share of the j^{th} producing sector consisting in the i^{th} trade category (constant)
$\overline{bmu}(i,j)$	12x8	Share of the j^{th} producing sector supplied by the i^{th} utilizing sector (constant prices)
c	1	Share of the pooled capital outflow allocated to the region
caple(i)	9/3	Proxy for capital labour ratio, defined as the total gross investment over ten years iivided by employed labour for the final year with a lag of two years (I^u), (I^a)
capva(i)	3	Proxy for capital value added ratio for 3 utilizing sectors (i=1 agriculture, i=10 construction, i=11 services) defined as the total gross investment over ten years divided by the value added of the final year with a lag of 2 years
coscri	1	Cost per hectare to increase cropping intensity
costex	1	Cost of the extension of a hectare of land
cri(i)	3	Cropping intensity
Δcri	1	Increase in cropping intensity
du	1	Dummy variable
dut(i)	7	Trade policy variable for i^{th} producing sector (I^t)
dwoty	1	Days worked over the year in rural areas
dwtwoty	1	Days wanted to work over the year in rural areas

$gc(i)$	8	Structure of government expenditure (current prices) (I^P)
gdp_{-15}	1	GDP of the previous horizon year
gdpgr	1	GDP growth rate
ir^{lt}	1	Interest rate on outstanding debt (long-term)
ir^{st}	1	Interest rate on outstanding debt (short-term)
$ir^u(i)_{-15}$	11	Investment requirement, utilizing sector i, for base year (I^u)
incaptl	1	Long-term capital movements (outflow)
ivyco(i)	8/12/3	Share of value added in gross output of producing sector i (constant prices) I^P, I^u and I^a
i.t.r.	1	Indirect tax rate
lala(i)	3	Land per worker
lpoil	1	Labour productivity, oil extraction sector
lps(i)	2	Maximum ratio of labour productivity in utilizing sector i (i=10 construction, i=11 services) to labour productivity in the manufacturing sector
lti	1	Long-term interest (suffix)
mcaplt	1	Long-term capital movement (outflow)
$mcaplt_{-15}$	1	Long-term capital movement (outflow), base year
mcu^{mr}	1	Migrant remittances (outflow)
mr	1	Migrant remittances pool
n	1	Maturity of outstanding debt
nwo(i)	8	Share of non-wage into value added (I^P) (note: $wo(_i) + nwo(_i) = 1$) (constant prices)
o	1	Share of total pooled Official Development Assistance allocated to the region (for DG only)
oda	1	Official development assistance/GDP ratio (for DD only)
odeb	1	Outstanding debt of horizon year
$odeb_{-15}$	1	Outstanding debt, base year
pnw	1	Price of non-wage component of value added
$pola_{ij}$	8x8	Input-output coefficient used for policy purpose (can be any a(i,j))

pop_{-15}	1	Population of the previous horizon year
popagr	1	Population growth rate
popmoy	1	Average population per country (weights = population figures)
prf	1	Participation rate, female
prfr	1	Participation rate, female rural
prfu	1	Participation rate, female urban
prm	1	Participation rate, male
prmu	1	Participation rate, male urban
pva(i)	3	Exogenous price of value added for 3 producing sectors (agriculture, energy, services) I^p
pw	1	Price of wage component of value added
$\Delta px(i)$	3	Exogenous part of the prices for the first three trade categories (agriculture, raw materials, energy) (I^t)
res_{-15}	1	Reserves, base year
rur	1	Proportion of rural population in total population, DG countries
s	1	Share of export of services in the world pool
sti	1	Short-term interest (suffix)
t(i,j,k)	11x11x7	Share of imports of the k^{th} traded goods category by the j^{th} region from the i^{th} region (evaluated at constant prices)
tex	1	Maximum land extension between 1975 and 1980
tle(i)	1	Labour size of plant, sector (i), I^u
tnp(i)	9	Technical neutral progress for i^{th} utilizing sector I^u
t.r.e.	1	Tax rate on enterprises
t.r.h.	1	Tax rate on households
tsa	1	Land supply for base year
$va(i)_{-15}$	8	Value added of the i^{th} producing sector of the previous horizon period
wapf	1	Working age population, female
wapm	1	Working age population, male
wapfr	1	Working age population, female, rural
wapmr	1	Working age population, male, rural

wapfu	1	Working age population, female, urban
wapmu	1	Working age population, male, urban
wo(i)	8	Share of wage and salaries into value added (I^P), constant prices
$xcap_{-15}$	1	Long-term capital movement, base year (inflow)

REGIONAL MODEL FOR CENTRALLY PLANNED ECONOMIES

SPECIFIC ENDOGENOUS VARIABLES*

AWGR	1	Growth rate of average wages in material production sectors
CC	1	Collective consumption
$CC_{(i)}$	8	Collective consumption, i^{th} supplying sector
DEI	1	Domestic entrepreneurial income
EI	1	Entrepreneurial income
EXNET	1	Net exports or (-) imports
GO	1	Gross output
$GO_{(i)}$	8	Gross output, i^{th} producing sector
$GFCF_{(i)}$	8	Gross fixed capital formation in i^{th} sector
GFCFAGR	1	Gross fixed capital formation in agriculture
GFCFINDU	1	Gross fixed capital formation in sectors I^{indu}
GFCFMIN	1	Gross fixed capital formation in sectors I^{min}
GFCFMP	1	Gross fixed capital formation in material production sectors
GFCFNM	1	Gross fixed capital formation in non-material production sectors
GFCFSERV	-	Gross fixed capital formation in material service sectors
GMP	1	Gross material product
Γ	6	Vector of proportions between employment in old versus new technologies (I^{indu})
LP(i)	12	Labour productivity (gross output per worker) I^{u}
LEAGR	1	Employment in agriculture
LEINDU	1	Employment in sectors I^{indu}
LEMIN	1	Employment in sectors I^{min}
LEMP	1	Employment in material production sectors
LENM	1	Employment in non-material production sectors

* For other variables, see General Model

LESERV	1	Employment in material services
LI	1	Total labour income
LINOM	1	Labour income in non-material service sectors
$LP_{min}(i)$	4	Labour productivity, (I^{min})
$LP_{new}(i)$	6	Labour productivity in new technology sector i, (I^{indu})
$LP_{old}(i)$	6	Labour productivity in old technology sector i, (I^{indu})
LPMP	1	Labour productivity in material production sectors
LPMPGR	1	Growth rate of labour productivity in material production sectors
$KNEW_{(i)}$	6	New capital (with modern technology), 1st January of year t, (I^{indu})
$KOLD_{(i)}$	6	Old capital (with out-dated technology), 1st January of year t (I^{indu})
PC	1	Private consumption
$PC_{(i)}$	8	Private consumption, i^{th} supplying sector
PCPI	1	Population's income
$RET_{(i)}$	6	Amount of old capital withdrawn on year t
SAVING	1	Total savings
SOCI	1	Social incomes
STOCK	1	Total stock increase
$STOCK_{(i)}$	8	Stock increase in sector i
STMCAP	1	Short-term capital flows
VAGR	1	Value added, agricultural sector
VASERV	1	Value added, services sector
WMP	1	Wages in material production sectors.

REGIONAL MODEL FOR CENTRALLY PLANNED ECONOMIES

SPECIFIC PRE-DETERMINED VARIABLES AND PARAMETERS*

α_i	6	Proportion of new capital, in total stock, base year (I^{indu})
β	1	Proportion of annual stock increase in GMP
$capvagr_{-10}$**	1	capva coefficient for agriculture, base year
$capvaserv_{-10}$**	1	capva coefficient for services, base year
$cap(i)_{-10}$	6/4	Total capital stock for i^{th} sector, base year (I^{indu}, I^{min})
cc(i)	8	Share of the i^{th} sector in collective consumption
σ	1	Ratio wage growth rate to labour productivity growth rate, material production sectors
exch	1	Ratio of internal to international prices
gmp_{-15}	1	Gross material product in base year
gmpgr	1	Rate of growth of gross material product
$gfcf_{(i)}$	8	Share of the i^{th} sector in gross fixed capital formation
$gfcf_{agr}$	1	Share of the agricultural sector in gross fixed capital formation in base year
$gfcf_{oser}$	1	Share of the material service sector in gross fixed capital formation in base year
i	1	Ratio of GFCF in material sphere to toal GFCF
k(i)/l(i)	1	Capital/labour coefficient (I^{indu}) (I^{min})
λ	1	Annual replacement rate of capital
leagr	1	Projected agricultural employment, 1975-198C
lenm	1	Projected non-material service employment, 1975-1990
leserv	1	Projected employment in material services, 1975-1990
lpgr(i)	6	Labour productivity growth rate of old technology sector i, $i \in I^{indu}$
$lpmp_{-15}$	1	Labour productivity in material production sectors in base year
$lp_{old}(i)$	6	Labour productivity of old technology sector i in base year, $i \in I^{indu}$
ls	1	Projected labour supply, 1975-1990

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* Further variables, see General Model

** See definition of capva(i) in pre-determined variables for General Model

mcu^{mr}	1	Migrant remittances to the rest of the world
$pc_{(i)}$	8	Share of sector i in private consumption
$Soci_{-15}$	1	Social income per head of non-active population in base year
$St_{(i)}$	1	Share of stocks in NMP in base year
wmp_{-15}	1	Wages in material production sectors in base year
wnm_{-15}	1	Wages in non-material sectors in base year
χ	1	Elasticity of wages in non-material sphere to wages in material spheres