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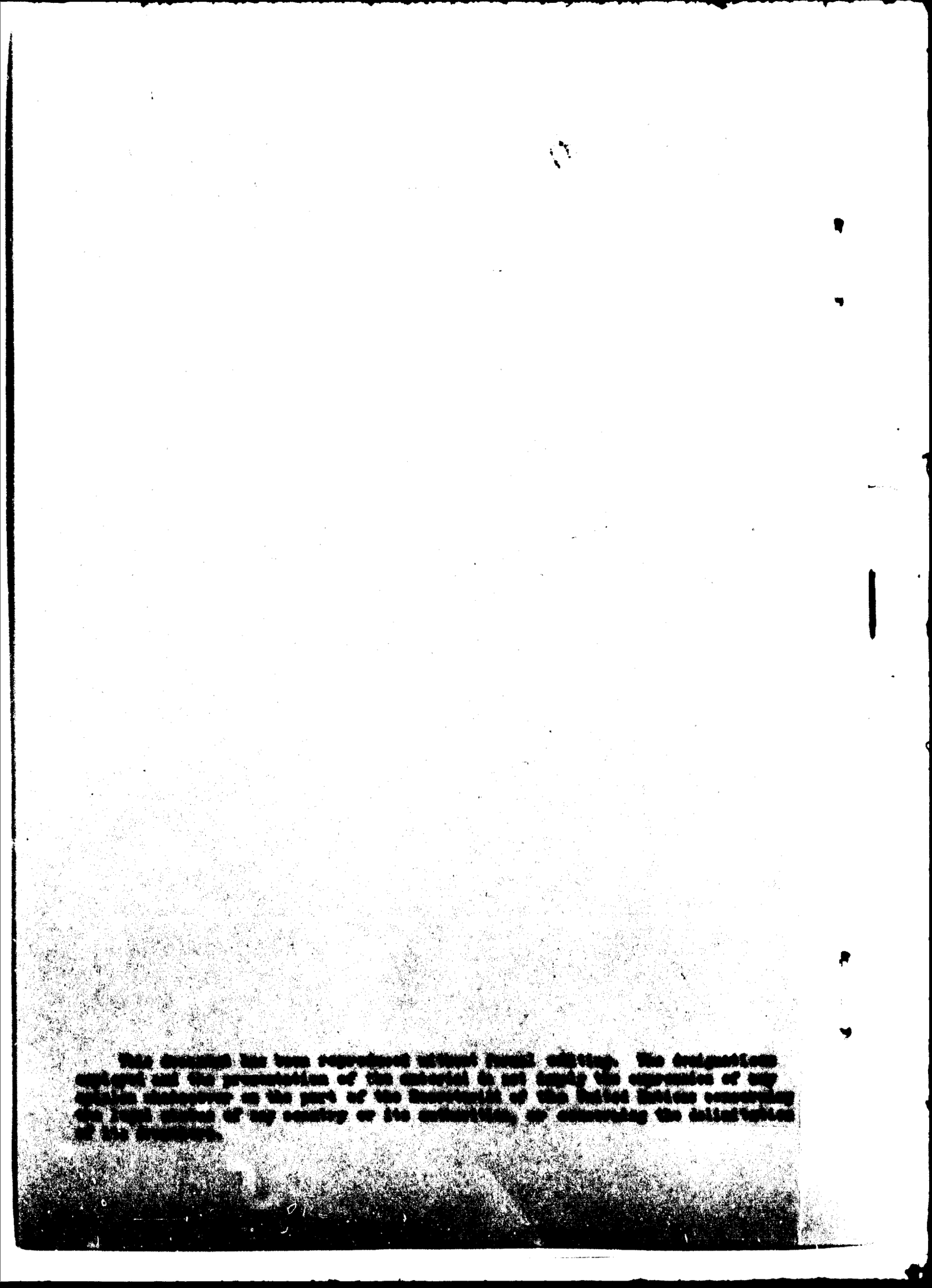
CONSTRUCTING THE UNIDO WORLD INDUSTRY CO-OPERATION MODEL

A Progress Report

PREPARED BY THE

INTERNATIONAL CENTRE FOR INDUSTRIAL STUDIES



CONTENTS

Introduction

The present document is based on an internal report produced at the end of 1976 on the first year's work on the construction of a UNIDO World Industry Co-operation Model by the International Centre for Industrial Studies. As the original report consisted of four volumes totalling over 1,000 pages, its reproduction and distribution would have been extremely costly and unwieldy. However, we are reproducing the present document, in substance the principal part of the original report, as it contains a fairly complete description of the proposed model, its scope and direction, and gives some idea of the work done so far. The complete report[1/] is available for consultation in the UNIDO library.

It is stressed at the outset that the envisaged model will not duplicate the efforts of other world models, of which there would appear to be a spate. Rather, it is intended as a framework to which selected components of different models can be fitted. Further, we are endeavouring to construct a system which can make use not only of other world models, but of various national models. It is intended as a tool which can be used both by UNIDO and by individual countries.

International negotiations on the subject of industrial development are complicated by a lack of information regarding the side or consequent effects of any steps that may be taken. The sectors of different countries are linked in such a way that action in one will invariably have consequences in others. In this respect, the model described in this report is designed to assist by providing information on such possible repercussions.

As the involvement of national planning and policy-making bodies in developing the model is of vital importance, it is intended in the coming year to form initial links with relevant national planning and policy-making bodies in order to begin work on incorporating their models and procedures into the UNIDO model system. It is hoped that the present report will be helpful in providing basic information on this exercise.

1/ First Annual Report and Description of the UNIDO World Industry Co-operation Model; Annex I - Regionalized Macro Simulations and Structural Changes for the Lima Target; Annex II - The Lima Target and Basic Human Needs (the Results of the Bariloche-UNIDO Model; and Annex III - An Optimum Time Path for the Lima Target, Iteration Results.

It is important to appreciate, too, that the model is not being designed merely to attempt to predict the future; it must be sufficiently flexible to allow us to contemplate a number of possible futures! The very nature of the task that UNIDO is trying to undertake demands that we be able to consider a profound transformation of the present world economy. The model therefore has to let us see what the consequences will be not only of present trends, but of the fundamental changes in orientations which individual countries could make to achieve the target set in the Lima Declaration. As a necessary step in this process, various analyses of the Lima target have been carried out, and these are described in the present report.

The work carried out so far must be seen as only a first step, and a very modest one at that, towards construction of the model. The resources available for allocation to the project have been little and only two full-time staff members can be spared for the work. Constructing the model will be, therefore, essentially a long-term project, and increased resources, together with the active collaboration of national bodies, will be necessary to complete it.

This doument presents the state of the model project as at the close of 1976. As such, it must not be taken as a final statement or even one of an initial position. Since its completion, thinking has already changed on several points. In particular, the procedure by which trade direction is determined will be re-examined from a linear programming point of view. In addition, various mathematical properties of the international consistency model are now becoming apparent which suggest that alternative formulation is possible. Partly in consequence of these points, respecification and reprogramming will commence early in 1977. No doubt other revaluations will be necessary, and suggestions in this respect will be greatly welcome.

The contribution of the following to the project in 1976 is hereby acknowledged: P. F. Ahammer, K. Mauler and M. Oettle (Wirtschaftsuniversität, Vienna); R. Bauer (IBM, Austria); H. and E. Scolnik (formerly of Fundación Bariloche); J. Sivak (National Planning Institute, Hungary); J. Skolka (Institut für Wirtschaftsforschung, Vienna); and M. Weisser (University of New England, Armidale, Australia).

Chapter I

CONSTRUCTING THE UNIDO WORLD INDUSTRY CO-OPERATION MODEL: A SUMMARY

The basic philosophy behind the UNIDO World Industry Co-operation Model is discussed in Chapter II of this document. The two working assumptions, "modularity" and "policy-orientation" are also described. Briefly, by "modularity" is meant the flexible character of a system of distinct yet inter-connected parts. The usefulness of such an approach, in which the work may be undertaken in stages, is demonstrated and linkages with other systems examined. The stress on policies as characteristic variables in the system is also dealt with. Finally, the relevance of the model system to the mission of UNIDO, with special reference to seven areas of direct interest, is explored in this chapter.

Chapter III describes the over-all model system and explains the two-tier approach adopted. The system will consist of two layers of sub-models: an outer and an inner. The outer layer is a heterogeneous set of components designed to process "scenarios" which are then transmitted to the inner layer, which carries out analyses and adjustments in terms of the economic implications of the scenarios.

Chapter IV describes in general terms the structure of the model's central system. It shows how the components of the inner layer are linked, and emphasizes the circular nature of the information flow within the layer. Intervention, i.e. the way in which national planners, individually or collectively, can use the structure, is then examined. The model system is seen to be one that can be used repeatedly to learn from, and to plan and compromise, once the implications of one's own decisions and those of others have been demonstrated.

Chapters V and VI are technical chapters that give a fairly full account of the components of the inner layer, particularly the national policy model and the international consistency (compromise) model. Trade determination procedures are also described.

Chapter VII features a flow chart of a demonstration model. It shows the potential user the step-by-step procedure for feeding in questions and answers relating to his policy decisions. The flexibility and variety of options possible in the model are indicated by these, which can also serve as a description, in practical language, of an operational version of the system.

Chapter VIII contains quantitative analyses of the Lima target. Some conceptual problems associated with the definition of the Lima target are considered. How meaningful is it to have an average annual, or annually fluctuating, growth target?

How do these compare to an optimally programmed (optimum time path) target? Is it worthwhile breaking the Lima target down for individual countries? What does the target entail in terms of "basic human needs"? This chapter also contains a set of projections for Africa, Asia, Latin America and the Middle East, as well as for the developed regions, worked out on the model.

In 1977, efforts will be directed towards linking the UNIDO Model to "Project 2000" of the United Nations Department of Economic and Social Affairs (ESA) which recently published Leontief's Future of the World Economy. We shall seek access to the Leontief model in planning the Lima target scenarios. ESA, however, has recently expressed the desire to see a world model that would be policy-oriented and modular in construction, thus combining in an integral way the setting-up of quantitative targets through which concerted action could be decided. This would require "... flexible models especially geared to the long term and able to incorporate exogenous targets and to simulate wide ranges of situation and policies". It is hoped that the present report will represent some contribution to the exercise.

Chapter II

PURPOSE OF THE UNIDO WORLD INDUSTRY CO-OPERATION MODEL

General orientation

Before beginning to describe the progress made so far in this project, we must define (a) what we mean by a world model and (b) its relevance to the work of UNIDO.

A world model has for us a precise meaning: it is an attempt to describe the world economy in quantitative terms; thus, the word "economic" is implied in it. We are not concerned with natural resources (as is the "Limits to Growth" model), nor with manpower (as are the ILO BACHUE models). We do not consider explicitly energy and environmental factors (as does the Leontief model) or socio-economic variables (as does the Latin American Model of the Fundaçion Bariloche). We restrict ourselves in this way because (a) the subjects are already being considered elsewhere; and (b) in the initial stages of this project it is necessary to agree to an achievable target for the short term.[1/]

We have chosen to use "world" rather than "global" because we wish to deal with the component parts of the world rather than with broad aggregates. General concepts are only generally interesting: while a national planner would naturally be glad to receive data on a topic such as "Total world energy supplies", he would have to do a good deal of work before he could apply it to his own studies. Furthermore, it is not really possible to recognise planning other than on the national level: without a global government, there cannot be global targets, and global policies in that sense. The world is composed largely of independent States, and a world model, if it is to be concerned with goals and policies, must recognise this fact. There is no point, therefore, in trying to find out what policies - if all countries were to follow them - would give the maximum level of GNP for the world. Not everyone would agree on the target. Even if they did, not everyone would accept the policies or carry them out.

1/ The implication here is that we are more likely to agree on what sort of <u>economic</u> model we should build on than another kind: thus "exports" is a concept on whose definition a consensus is more probable than that of "health" or "pollution".

So when we speak of a world model, we mean an economic model which distinguishes the component countries. And as it is a UNIDO model, obviously it must deal particularly with economic activities of most concern to the Organization. Industries must be dealt with, therefore, at a level of detail sufficient to have practical application in the Organization's other work. This does not mean that other sectors cannot also be considered in detail: the interconnections between sectors may indeed make it necessary.

In describing the working assumptions made in the construction of the model, it is hoped that the answer to the question of relevance to the work of UNIDO will become clear. Two assumptions are made: (a) the model will be policy-oriented; and (b) it will be modular in form.

A policy-oriented model

The primary purpose of the UNIDO model is not so much to produce a fixed plan of world-wide action as to provide an institutionalized forum for planners and policy-makers from various countries to examine the attitudes and policy postures of other countries, and on the basis of this to search for and study a common basis for joint action.

Our notion of a policy-oriented model is thus quite general. If we study the implications of policies, we are doing so not just for the sake of the immediate lessons to be drawn, but in order to set the scene for something other than blind independent national action. This is not to suggest that independent action should not still take place; if, however, we have an analytical framework in the form of a world model, we are armed with additional information. This knowledge of the international effects of national actions would therefore be available for the policy-maker to take into account if he wished to. Thus, it could be conducive to co-operation in the search for a joint policy to be adopted with other policy-makers. (From this it follows that the model must be capable of being used by more than one person at once.)

The emphasis, then, is on the user learning from the model. If a policy-maker increases investment for import substitution purposes, what effect will it have on the balance of payments of countries other than his own? What effect will an increase in his exports of chemicals have on the numbers employed in another country's chemical industry? We have said that more than one policy-

maker may be using the model at the same time. Suppose that each one is trying out an independent policy, but because of the contradictions between them, neither policy-maker is reaching his target. This information is given by the system, and, as a result, a context is established for negotiations between the two in order to find some policies which will satisfy the minimum requirements of each. We therefore envisage a repetitive use of the model, in the course of which the policy-makers will try out their ideas, study the implications and, as a consequence, try out new ideas. In the beginning, this will be a set of individual actions: in the end it will become collective action. At a later stage we may talk of a different kind of emphasis, of a more active role on the part of the model itself. This may sound a little ominous, but all it means is that guidance will be provided. Not only learning, but teaching will be available. If, for instance, targets are not reached because of conflicting policies, the model may conceivably carry out the analyses necessary to indicate the policies that will bring the users nearer to their goals, which would be preferable to their proceeding on a purely trial-and-error basis.

This, however, raises important questions which are beyond the immediate scope of this study. It is easy enough for planners and policy-makers to state their targets, but not so easy for them to disclose the minimum values which would, in practice, be acceptable to them. Indeed, they may not even know them, or have formed an idea merely by perception of another country's minimum.

The UNIDO model is policy-oriented. We believe that this system is not only convenient in minimising the risk of duplicating other world model efforts, but is intellectually superior, given the reality of the world and the pragmatic nature of the solutions it is seeking. The UNIDO model, therefore, predicts the consequences of policy decisions, rather than the policy decisions themselves. It explores policy alternatives. Consideration of any one solution, or an optimum solution, means simply that the suggested solution serves as a reference point; no more. All policy analysis models are essentially medium-term. Thus, the UNIDO model, which uses a five-year reference period, will have to be programmed to generate predictions to the year 2000.[1/] The developers of the UNIDO model are convinced that long-term forecasting of the doomsday type is by definition either

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1/ So far the UNIDO model is a comparative static model. Any recursive programming is therefore limited to a simple 'period analysis' using unidirectional data updated to link consecutive periods. The task of making the UNIDO model fully dynamic will be undertaken later.

self-fulfilling or self-defeating, depending on how much the analyst himself assumes the role of policy-maker. Long-term forecasting is largely normative (instead of exploratory), to the extent that it internalizes much of the thinking and discussion which legitimately forms a part of the political process. The UNIDO model on the contrary, while having as its primary aim the initiation of a new political process of discussion, strives to be as apolitical as possible.

This argument for a value-free model should not be taken as meaning, however, that we ignore the importance of long-term forecasting. In fact, we believe that any policy analysis carried out without a long-term perspective results in a myopic solution. We perceive three major functions for long-term forecasting. The first is the creation of a vision or image of the future - be it utopian or otherwise - which allows us to question the basic values underlying human society. The second is projection and planning through which the conceivable or desirable future is logically explained. The third is the sensitizing of world opinion to the urgency of certain objectives or to the predicament of mankind.

The modular approach

In constructing the model, we shall proceed on the basis of separate components or "modules" which can be developed independently and then linked together. Four reasons exist for adopting this approach.

First, there are conceptual reasons. Because the world is a complicated economic system, and in order to provide a point from which our modelling process may begin its development, we try to consider it as a set of linked parts. The difficulties at the conceptual level of modelling a part of a system are obvious. It is clear there must be a connexion with the system as a whole. Economic modelling, in particular, is usually an attempt to fly in the face of the adage that "everything depends on everything else". Thus, in a model of a national economy, those elements whose interdependence with the system under consideration are either unknown or held to be insignificant are treated as exogenous. For instance, world demand and a national economy are interrelated, but by assuming that the national economy does not affect world demand significantly we may treat the latter as exogenous. Using such assumptions, a national economic model can be built.

It follows that the construction of a world economic model is a different matter. The variables previously treated as exogenous in a national model now have to be considered as endogenous, and the relationships that determine them have now to be taken into consideration. World demand, after all, cannot be regarded as being exogenous for all countries. Is then the construction of such a model a new task, or does it bear some relation to the preceding one? In 1970, the share of exports in world GDP was about 12.5 per cent: it is clear, therefore, that the world is not one fully integrated economy, because 87.5 per cent of GDP was either consumed or involved in capital formation within the country of its origin. One approach to the problem of construction, therefore, is to form such a model for a series of connected national models. In other words, the links between countries would seem to be strong enough to demand some consideration of them, but weak enough to allow some decomposition of the problem; that is, some breaking down to the level of the national economies which make up the world.

Secondly, there are theoretical justifications for the modular approach. International economic relationships are not the same thing as national ones, and ought to be considered differently. For instance, at an international level the links between economic sectors are affected by a whole complex of tariff, transportation, quota and monetary systems which do not directly affect the intersectoral relationships within a country. Therefore, the subjects ought to be treated distinctly in our model.

Thirdly, there are practical considerations which encourage such an approach. In a world model of any detail, the construction process will inevitably be refined over a period. If the model is composed of a sufficiently loosely linked system, we can replace different parts of it at different stages, and so gradually improve it, rather than have to dismantle the whole structure and start again.

Finally, and most important, there are operational considerations. In view of the uses to which the UNIDO model would be put, the modular framework is the best one to adopt. A connected system of heterogeneous components makes it a good deal easier for the user to connect with other model systems. This means that not only can we avoid duplicating other modelling work, we can feed the output from other models into ours in order to consider the implications of forecasts and projections. Similarly, we can use our model's output as an input to other models. The flexible structure afforded by the modular approach means that many different kinds of linkages and modifications are possible.

Chapter III

RELEVANCE OF THE MODEL TO THE WORK OF UNIDO

The issues with which the Secretariat of UNIDO is concerned are too great and too urgent to allow for research that cannot be translated into some kind of useful action. Thus, any theoretical advances made in the course of this project will not have been looked for. The object is to construct a system capable of answering specific questions in seven areas of concern to UNIDO: technical assistance; consultations and negotiations; technology for the achievement of the Lima targets; basic human needs; the physical and socio-cultural environment; debt servicing; and non-sophisticated goods for a common market.

Technical assistance

The technical assistance provided by UNIDO in the past has taken many forms: those most relevant to the present subject are in the area of national planning and programming. The establishment or enhancement of a plant or infrastructure component is usually but one part of a country's programme for the progress of a particular industrial sector, which in turn is only one element in the planning of industry as a whole. It is with respect to these subjects, sectoral and national industrial planning, that a UNIDO model can make a contribution to the technical assistance with which the Organization is concerned. Industrialization strategies can be analysed for their sectoral implications in terms of investment employment, imports and intermediate inputs. Similarly, postulated exports can be analysed for their impact on world supply and national market shares. The aggregates of national planning can also be examined within this framework.

Consultations and negotiations

The nations of the world clearly prefer that the New International Economic Order be achieved by peaceful means, and if possible by agreements freely arrived at, in which the indivisibility both of the world economy and of economic justice are recognized. This task is immense, and it is clear that the steps already taken, while great, represent only the beginning of a solution. Conferences to clarify the issues involved, and negotiations between countries to resolve them,

now form an almost continuous process, and one which will endure for some time to come. In this process, a certain use for a model may be seen: any agreements reached will have quantitative implications (and may also be quantitatively expressed). In arriving at an agreement, we can envisage the initial bargaining positions of the negotiations being gradually modified in order to arrive at a common position which, while not fully achieving all the initial demands of the participants, will nevertheless meet them to a satisfactory level. If the full implications of the initial positions and of any suggested compromise can be made available to those concerned, it would reduce the time taken to analyse alternatives. It would also reinforce the strength of any agreements finally arrived at, because the full facts would have been known in advance. For instance, the effects of a proposed commodity price agreement could be examined for all countries concerned, that is, for both the producer and the consumer nations. This might take the form of an offer by the consumers of a guaranteed price for a number of years, the benefits of which the producers could analyse on the basis of various scenarios of demand and supply, and thus decide whether or not to accept.

Technology for the achievement of the Lima targets

As mentioned before, the flexibility of the model system means that the actual structure can be changed if desired, and this, from the point of view of UNIDO's work, is pertinent to such questions as technology transfer, long-term (autonomous) technological changes, and appropriate technology. If we have, as components of our model system, detailed models of the sectoral production structures within each country, it will be possible to examine these issues in the following ways:
(a) Technology transfer: the production structure of "best-practice" countries can be transferred to a particular country under consideration and the over-all effects on its economy seen. This amounts to a simulation (in a broad sense) of the relocation of an industry, its moving from a developed to a developing country.
(b) Technological change: once the model structure has been dynamised, it will be possible to consider the effects of technological change in an explicit way. By dynamisation we mean the incorporation within the model system of our knowledge and experience about the way in which the relationships between economic variables change as time passes. This means that observed and projected trends in such technological variables as capital and labour output ratios can be included, and

their effects upon the economies analysed. (c) Appropriate technology: in addition to the effects of technology transfer from "best-practice" countries (however defined), it may be desirable to study the effects of the incorporation of other technologies (which may not, in fact, be in use anywhere at the time) which may seem to make more use of the resources of the country under consideration. This means that in case of a shortage of indigenous energy supplies, a less energy-intensive production process may be examined. Similarly, a shortage of capital (or a surplus of labour) might suggest a labour-intensive technology, rather than the capital-intensive production process of a developed country. A detailed sectoral breakdown allows the consideration of these issues and the selection of the most appropriate technology, taking account of initial and continuing capital investment and its effects on the balance of payments, and the availability of labour, both skilled and unskilled, as well as other natural resources.

Basic human needs

There is a two-way connexion between this subject and that of industrialization. In the first place, any industrial development policy must be examined for its effect, if any, on the attainment of national targets set for nutrition, health, housing and education. Industrial investment programmes may be seen to have an unacceptably severe effect on other public works, such as the construction of schools and hospitals. Secondly, industrialization may be envisaged simply as a means towards achieving goals in terms of basic human needs: such a strategy must be evaluated with respect to its suitability for this end. A model is needed, therefore, which explicitly focuses on such variables as the health and education of the population. However, as it is not our desire to duplicate the work of other model constructors in the field of basic human needs, arrangements are being made to develop linkages between the UNIDO model and the Latin American World Model of the Fundaçion Bariloche, an authoritative model system already in existence and under continuous development. Thus, scenarios of development, which amount to economic configurations, may be provided as input to the Latin American World Model, and their implications in terms of basic human needs examined. (Preliminary work involving such data transfers has already been undertaken, and the results are reported in Chapter VIII of this report).

Physical and socio-cultural environment

It has been said that underdevelopment is not so much an economic condition as a state of mind. This is to put in an extreme form the point that levels of economic variables are only important in that they determine what people do and the quality of the life that they lead. Therefore, in addition to the topics considered under the heading of basic human needs, which consist of minimum targets for the individual in terms of food, shelter and education, we may consider social aggregates such as unemployment, physical variables such as the level of resource depletion, and environmental variables such as the level of pollution. Some of these, e.g. the level of unemployment, are relatively easy to incorporate into an economic model. The approach we adopt with respect to others is to consider them in the context of the "outer layer" of the model system. We foresee, therefore, links between the UNIDO system and models that already consider the variables in which we are interested. In this respect, it is expected that a connexion will be made with the Leontief Model, which explicitly treats environmental factors. Various global resource models would also be linked to the UNIDO system.

Debt servicing

Borrowing by countries, either from other countries or from multilateral sources, is usually for two purposes: to provide investment capability and to finance balance-of-trade deficits. When we consider the ultimate interrelatedness of these two purposes (for investment now determines what capital goods will be imported, and also what import substitution will take place in future as a consequence of the additions to productive capacity), and the consequences for the balance of payments of any industrialization process in developing countries, the necessity for explicit consideration of these issues in quantitative terms becomes clear. The debt problems of the developing countries are already severe enough without the additional ones that new investment programmes will entail. In the UNIDO model system, balances of payments and trade and investment gaps are considered. The incorporation of foreign reserves will provide the basic framework for an analysis, over time, of the implications of debt repayment rescheduling and interest rate changes, among other issues, for the economies of the countries concerned.

Non-sophisticated goods for a common market

The term "non-sophisticated" is perhaps rather misleading. What is meant is that the developing countries might reduce their import requirements from developed countries if they themselves were to produce goods (mainly consumer goods) without frills or over-elaborate finish but which would fulfill their needs adequately. To ensure a sufficient market for such production, common markets in these goods could be formed among the developing countries. It is a concept that might be called "appropriate production", as a concomitant of "appropriate technology". For the question then becomes one of what goods to produce, rather than how to produce them. The selection is clearly dependent on many factors: one will be the extent to which the goods are already consumed in the potential common market; another will be the cost in foreign exchange of the imported equivalent goods; a third will be the question of the level of investment needed to begin and continue production of the non-sophisticated goods. This last question demands consideration of completely new technologies, since the products themselves are new; hence, detailed technical studies will be called for. However, the sectoral identification of present demand for the goods to be replaced is a task to whioh the model system can be adapted, and the changes in trade patterns, and thus in the balances of payments, of the countries concerned can be examined within the system framework.

Above we have considered seven topics of direct importance to the work of UNIDO, and have tried to indicate the manner in which the model can be used to analyse questions related to them. At its present state, the model is nearer to considering some of the questions in more detail than others. Nevertheless, if through discussion and research the questions are re-formed and priorities assigned, the development of the model can be carried out in such a way that all of them can be answered. The questions, as raised above, can be considered either in one or both of the two layers of the model, as can be seen from the rough classifioation given in Figure 1.

Figure 1. Examination of selected topics by the UNIDO model

	Inner Layer	Outer Layer
Technical assistance	*	
Consultations and Negotiations	*	
Technology	*	
Basic Human Needs		*
Physical and Sociocultural Environment		*
Debt servicing	*	
Non-sophisticated goods	*	*

Chapter IV

CENTRAL SYSTEM OF THE UNIDO MODEL

In this chapter an attempt is made to describe the conceptual framework of the model, by which we mean not only the parts already constructed and implemented, but also those parts that, while not complete, are also conceived of in the context of the system as a whole; for we envisage one framework formed by different and diverse components. Since perspectives and aspirations change over time, there will not be a single moment when the construction will be absolutely complete. Nevertheless, it is possible to say that construction of the system as presently conceived has already begun. It is also possible to indicate which of the components of the system have already been implemented, to describe the other components, and to indicate where possible lines of development are foreseen both in the system itself and in its links with other systems.

Figure 2 shows the organization of the modular approach referred to earlier. The grouping of the various detailed but linked components can be suggested by this circular form in which there is an outer and an inner ring a number of different segments. The system and its surroundings can be divided into four parts: the user; the inner layer; the outer layer; and the environment.

The user

Starting at the centre of the diagram, we see that the user has been placed there, which stresses the operational emphasis we have tried to keep and shows that the user, in practice, can have control of the whole system. At the moment, the system can have only one user at a time; this will be modified at an early date, however, to allow simultaneous use by a number of persons. The only limitation then will be the number of computer terminals available. The computer, it is emphasised here, is merely a device for calculating and handling the data. The model as such is the set of mathematical relationships that we have decided upon and used as a computer programme. Thus, we envisage the user himself putting questions to the system and receiving answers, on the basis of which he can put revised questions. The computer programme for the model is written with such a process in mind. Two types of user are envisaged:

(a) The national user, who uses the model from a national point of view, whether for the economy as a whole or for a sector or sectors within that economy. This user would be someone concerned with planning or programming at the national level who wishes to use the model to assess the implications of his projections or proposed policies.

(b) The global user, who wishes to carry out analyses involving more than one country, or even all countries, in which case the word "global" would be completely accurate. Such a user might be UNIDO itself, or some other component of the UN system. When a few countries only are involved, the user might be a planner or policy-maker of a regional grouping; and since this sort of use could amount to a summation of some national uses, the diagram shows the global user as dominating the national user. However, this is a technical, not a political, relationship.

The envisaged users therefore include those who make and implement policies, those who contribute to joint policy formulation, and those who have no direct influence on policies at all. In all cases, however, policies and their consequences are of immediate interest to the user, and the model provides a framework in which these can be examined and revised.

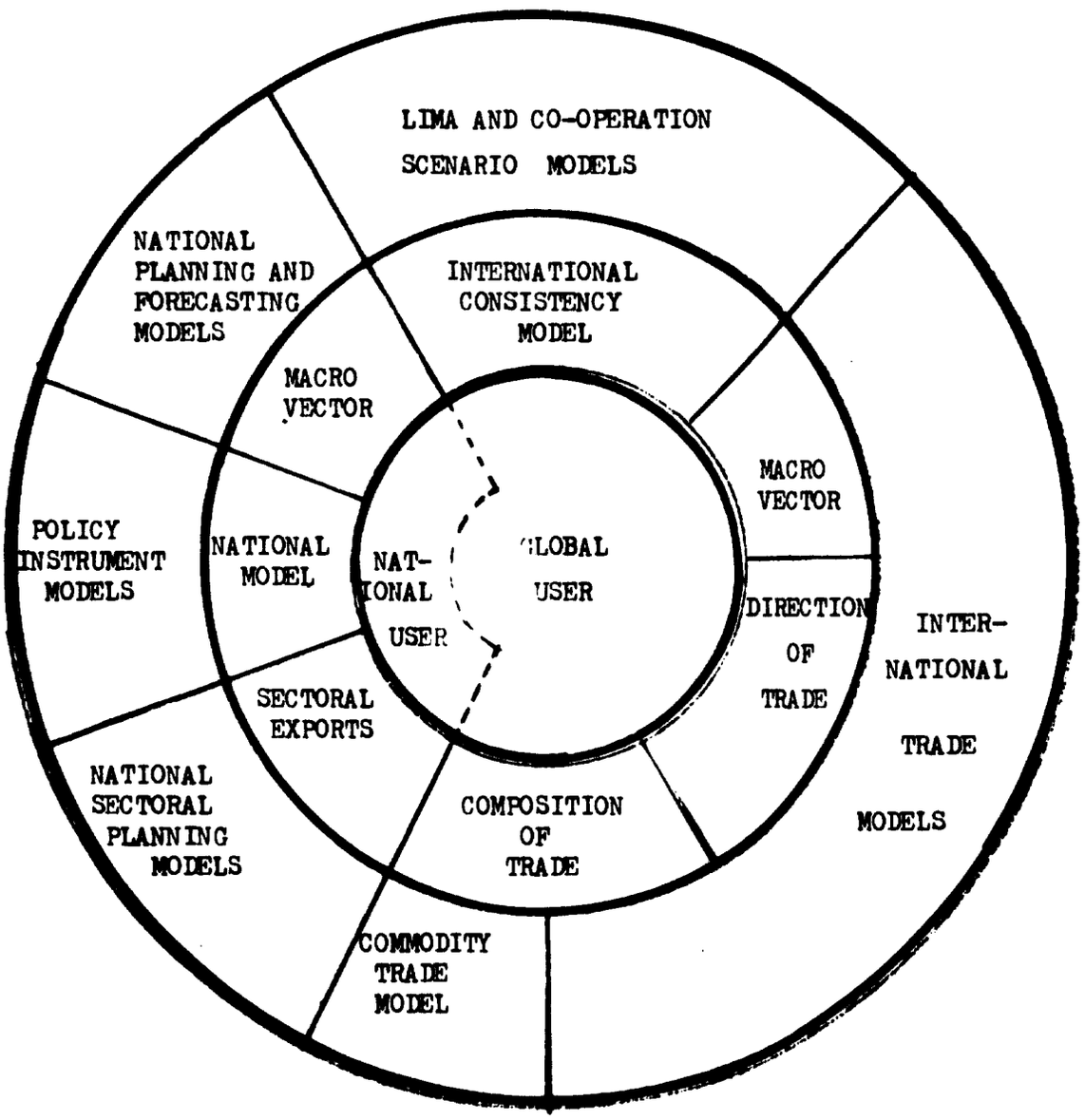
The inner layer

By this we mean the ring of segments labelled "international consistency model", "macro-vectors", etc. outside the user circle. They represent different components which deal with separate subjects, separately developed, but linked together. This takes the form of an information flow; that is, data is passed from one component to the next. The direction of the flow within the inner layer is clockwise.

An example of this process is as follows: a "national model" on the left-hand side of the inner layer is an economic model of a particular national economy. It can produce as output a macro vector, that is, a set of the usual macroeconomic variables which together give the configuration of the economy at the particular time, under the conditions given to the national model. This vector in turn acts as initial information input for the next component, the "international consistency model".

In general, the macro vector is the link between the national and the international model, but because we are trying to adopt a flexible approach it is more useful to regard it as a component of the system in its own right. For in one sense all the components act as links with the others.

Figure 2. The central system of the UNIDO model



The inner layer has been developed within UNIDO. The different components have been programmed and appropriate sample data been provided for them. The result is an interactive system which, while not the final version of the inner layer, and still less of the system as a whole, is nevertheless operational. (The flow chart in Chapter VII of this report gives an indication of the possibilities of the system proposed.) This part of the system has been constructed within UNIDO for two very practical reasons: (a) it is the part which can most readily give an impression of the whole, and (b) it is the core of the system and must be maintained in UNIDO because only in this way can all the outside work be directed towards a common goal and the strands of separate efforts be drawn together to form the pattern of the whole system. By outside work is meant the construction or adaptation of other model systems to be linked with the UNIDO model. Clearly not all the work involved in a world model system can be done within the house. Nevertheless, the inner layer is that part of the envisaged system that is closest to being completed. It amounts, in a sense, to an analytical framework in that it can carry out an examination of information originating elsewhere, i.e. in the outer layer; conversely, it can supply information to that layer.

The outer layer

Describing the part of the envisaged system represented by the outer circle is less easy. The inner layer in its present conception is complete in its outline and has already been implemented. Moreover, the boxes of the diagram represent distinct components of the inner layer. The outer layer, however, is at a less advanced stage of completion, and its conception is more generalized. This means that the compartments of the diagram refer to families of models and procedures. The sources of these are various, some being constructed outside UNIDO and some within. Yet others amount to independent outside work adopted to link into the UNIDO system. The information flow is radial, to and from the centre. For instance, the segment "Lima and co-operation scenario models" is to be seen as exchanging information with the "international consistency model". The components of the outer layer are in general more closely linked to the adjacent components of the inner layer than to one another.

The principal reasons for having an outer layer at all, let alone one so heterogeneous in nature, are both to avoid a determinist position and to formalize the questions being asked of the inner layer. By a determinist position we mean the construction of the typical forecasting model which seeks to answer the unqualified question "How will things be in such-and-such a year?" This is not an uninteresting question, but it is not one for us to examine. In order for it to be answered by the UNIDO model, we would have to know implicitly all the policies followed and thus all the events up to that time (and, indeed, the additional effects if any, of the prediction itself). Our interest lies rather in the set of questions beginning "How will things be if ...?" In other words, we wish to examine the consequences of various hypotheses and in particular the implications of different policy decisions being taken at different levels. And so the outer layer is a variable flexible framework in which we can include many different models. The inner layer is at present value-free: it is a formal structure intended to analyse, to adjust and to reconcile. But we must look elsewhere for the matter with which it is to deal, the prospects it is to review and the conflicts it is to resolve.

The hypotheses provided by the outer layer are produced by forecasting models and also by what we call scenario models, a scenario being a set of values of the relevant variables which is consistent with a given view of the future. The purpose of a scenario model is to translate this vision. Why is such a translation necessary? For two reasons: first, the view of the future, whether predicted or simply wished for, may not be expressed in terms of the economic variables in which we are interested; secondly, the view may not be unambiguous enough to give unique value to these variables.

Let us give a concrete and familiar example of this (which we consider in much more detail in Chapter VIII of this report). Explicitly quantitative long-term targets have been set for a restructured world economy by bodies such as the Lima Conference, which set a target share of 25 per cent of world industrial production for the developing countries by the year 2000. Now, this says nothing about the share in 1990, nor about the distribution of the 25 per cent among the developing countries, nor about the actual value, the share of which is to be 25 per cent. Thus, the Lima target, as expressed, does not provide a complete scenario, though clearly it is an important statement of principle. The details have to be filled in if the implications in terms of costs and pursuable policies are to be known. Therefore, some of the components of our outer layer are scenario models which translate the broad principles of the economic future into a form suitable for analysis by the inner layer.

Among the components of the outer layer are models developed independently of the UNIDO system, but which can be adapted in order to connect with it. Once the adaptation has taken place, the connexion will be two-way: the other models can deliver information to be analysed by the inner layer, and the analyses carried out by the inner layer can be transmitted to the outer. Global models can be analysed for their regional and national implications and the effects of world commodity trade projections can be considered for each country and for the sectors concerned. Similarly, the inner layer can supply the necessary economic information to models which concentrate on such other aspects as manpower, national resources and manpower models. The difficulties of such adaptations vary: it seems best initially to concentrate upon the incorporation into the outer layer of two types of existing models: global or world regional (e.g. Leontief or the Fundación Bariloche) and national planning and policy.

As regards national models, the intention is to incorporate, where possible, the detailed planning models which many countries use for budgetary and programming analyses. Since we do not wish to duplicate the effort in the construction of such models, and since in addition, they often contain detailed policy instruments which represent the actual monetary, social and political framework of the particular country concerned, we feel that a special effort must be made to include these models in our model structure. This will allow the consideration, to the fullest extent that is at present possible, of specific national planning and policy implementation procedures into a world economic analysis.

Other models which will form part of the outer layer include global or world regional models dealing with specific commodities or industries. Analyses and projections of demand for oil, for instance, may be made by highly aggregated and yet useful models, and the output of these will be material for detailed analysis by the inner layer. Any projection of world demand for oil and its supply can then be examined in terms of the consequent trade between pairs of countries, balance of payments, and implications for investment. Similarly, energy, resource, and manpower models can be regarded as potential components of the outer layer.

In general, this part of the system amounts to a set of models which form a natural complement to the inner layer in that they formulate questions to be asked of it, or else answer questions from it in areas which, while being outside the scope of an economic model as such, are nevertheless intimately connected with economic questions.

The environment

In concluding this introductory description of our model system, one area, which is not shown in Figure 2, but which may be taken as implicitly surrounding it, should be mentioned briefly: it is the context in which a study such as the present one was initiated - a world of inequality, deprivation, fear and struggle. The international organisations sometimes appear impotent before the vastness and complexity of the problems with which they are engaged. And yet the work which they do is a response to the world: it is the consequence of their perception of it. It may seem presumptuous to suggest that a reverse effect may take place, that this perception can be altered, even in the long-term, by any development of the present project; but without such an intention the work is better left alone.

Chapter V

DESCRIPTION OF THE INNER LAYER

Information flow

The information flow pattern shown in Figure 3 is a simple one. Nevertheless, it is possible to simplify it even further, and in so doing make the fundamental point about the whole inner layer: it modifies national variables in the light of international considerations. We can thus see the system as an adjustment mechanism which carries out, at an international level, the reconciliations necessary between national outputs.

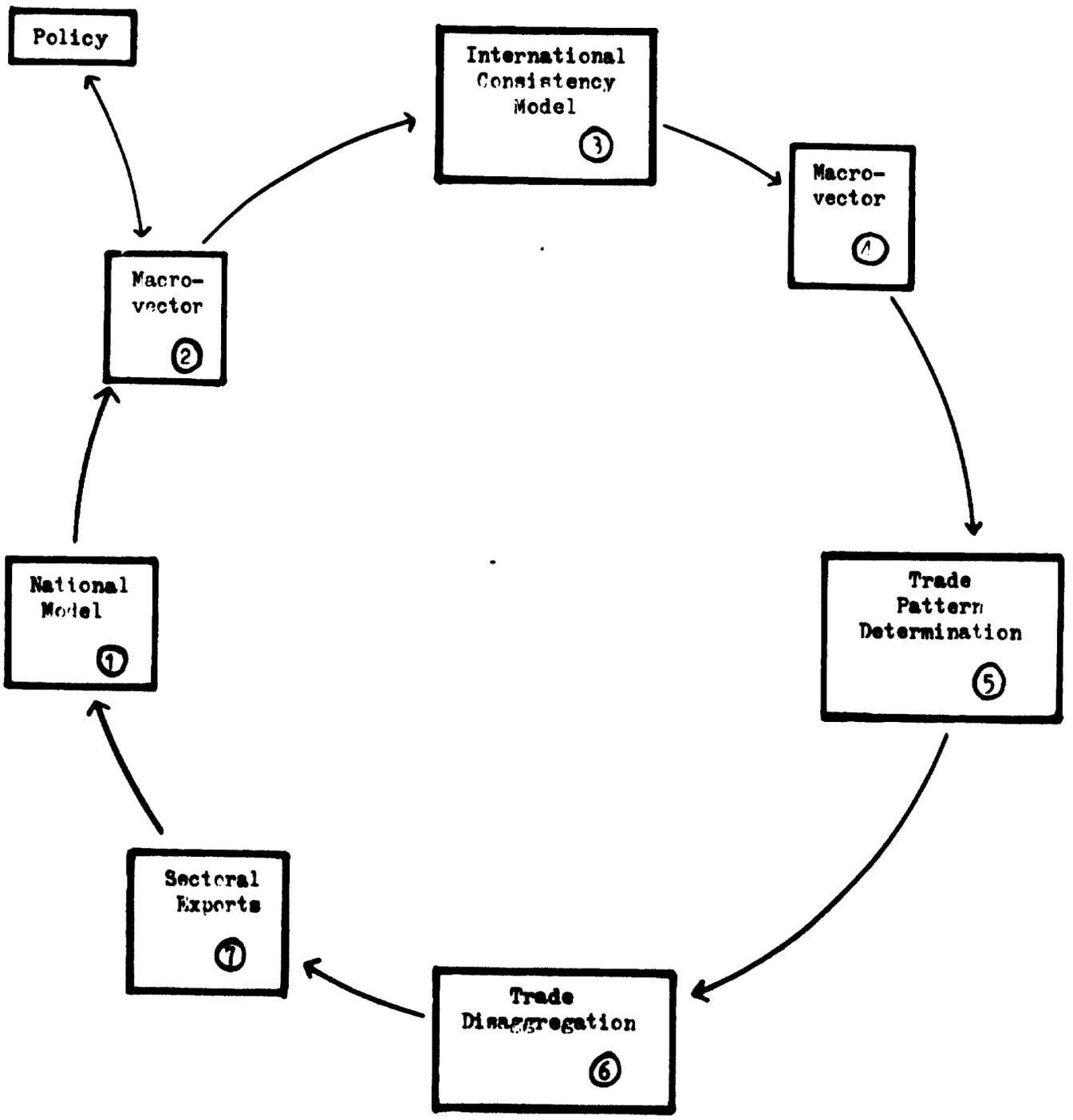
What are these national figures that need to undergo this adjustment? Governments, in preparing economic programmes, often produce a macro-vector, that is, a set of figures describing the projected or target conditions of the economy at the end of the programme period. GDP, investment, export and import figures may be given, possibly with a sectoral breakdown of these, and perhaps also including numbers to be employed. The set of figures amounts to a certain configuration of the economy which it is intended to achieve or it is believed to be likely.

These macro-vectors may arise from a national economic model and as such are assumed to be consistent internally insofar as the relationships within the economy are neglected within the model. Or, they may arise from formal planning and estimation procedures. Many regional and international organizations produce country forecasts or projections in this form.

The UNIDO model takes such information and reconciles it, through the "international consistency model", which uses a linear programming framework to adjust each set of goals or projections in the light of the others. It produces for each country supplying macro-vectors a new vector which is consistent at the international level.

This new vector may be consistent not only with respect to trade; many other constraints exist at an international level. Again, it may be desired to impose new conditions on the world and thus new upper and lower limits to both world and regional totals. The system, in this component, allows for the study of many different economic orders and perspectives.

Figure 3. The inner layer



The new macro-vectors contain consistent export and import totals for each country, and the model system can carry out a detailed analysis of trading relationships based on them. First of all, the direction of trade is analysed. For a given country the export total will not tell us to which other countries the exports go; we therefore break the figures down into a matrix of trade flows. The result is a table, with a row and column for each country; each row shows the exports of that country to each of the others; correspondingly, each column shows the imports of that country from each of the others.

Briefly, this breakdown is carried out by approximating to a given pattern of trade, which we call a normative pattern because it represents something towards which the solution strives. This pattern can be either a projection or a target; that is, it may be a forecast of the direction of trade, or some desired new pattern of trade.

This produces a picture of bilateral trading relationships, i.e. the trade between all pairs of countries. The system now disaggregates each of these figures, i.e. establishes the sectoral composition of the trade relationships. The export total of country A to country B is broken down to show the commodities that make it up. At present, this is done using fairly simplified assumptions, the number of commodity groups distinguished by the process being seven.

As we thus have the figures necessary to calculate the commodity composition of the total exports of each country, we can now return to the national model to study the implications of this bill of exports for each sector. For, depending on the composition of these exports, the production requirements and thus the investment needs and employment impacts will vary. If the original macro-vectors have assumed certain policies, then these new figures will demand that they be reviewed.

In this exposition of the general system, we have deliberately refrained from detailed examination of the components in order to bring out more clearly the essential features of the flow of information through it. A diagramatic representation of this flow is given in Figures 4 - 7, and its technicalities are explained in detail in Chapter VI.

Figure 4. Information flow: Plan formation at national level

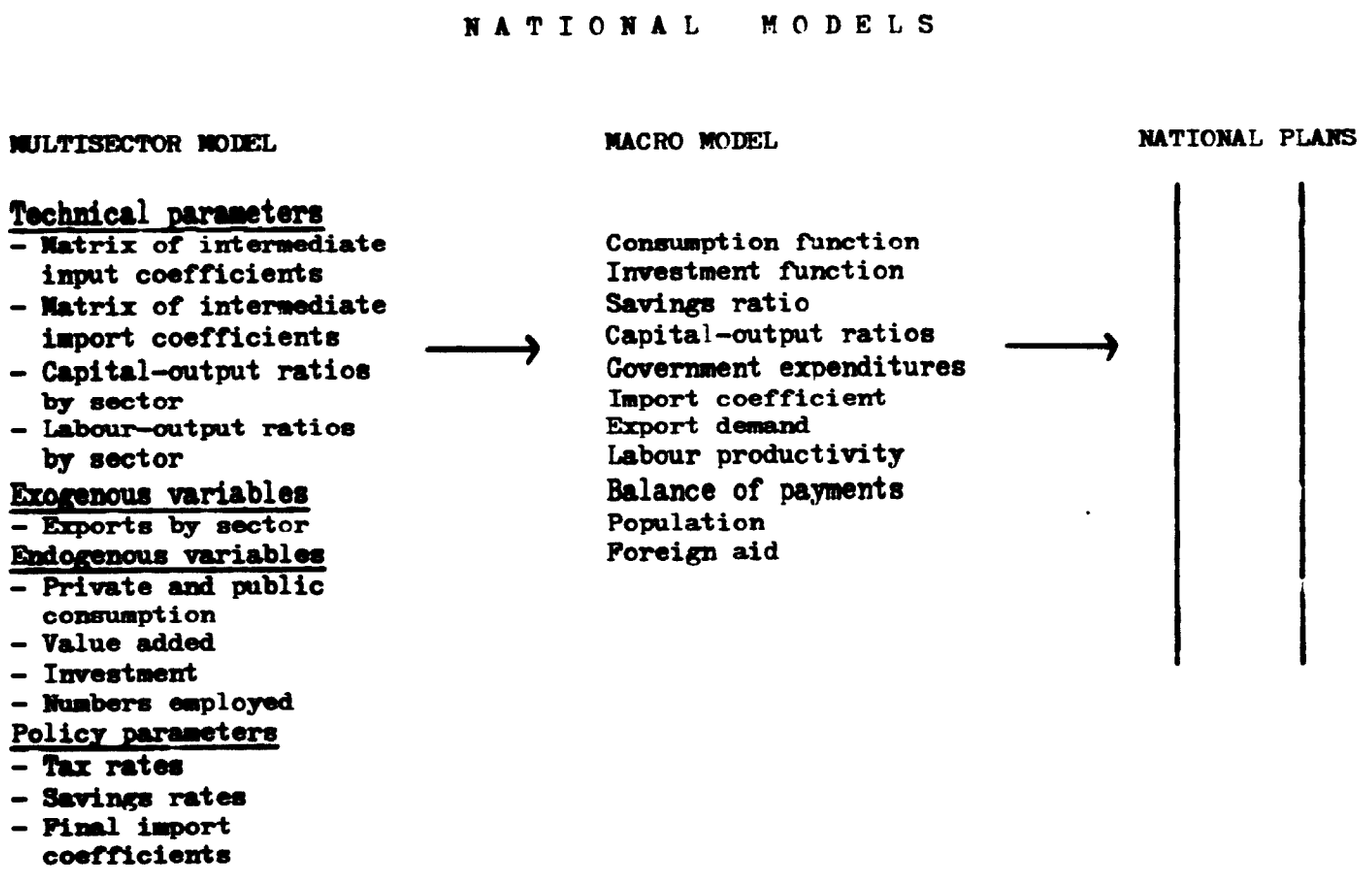


Figure 5. Information flow: Reconciliation of plans at international level

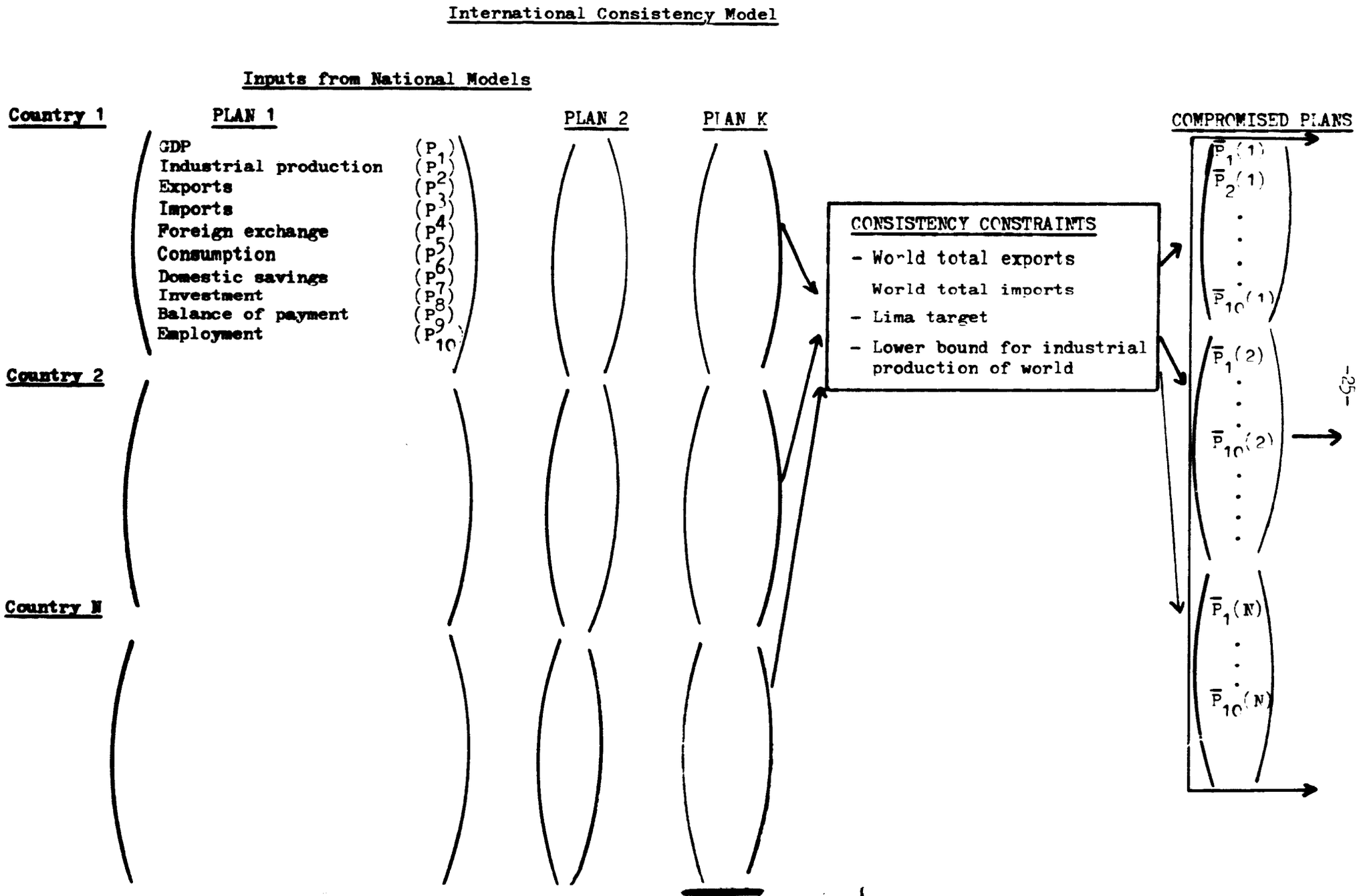


Figure 6. Information flow: Bilateral implications of reconciled plans

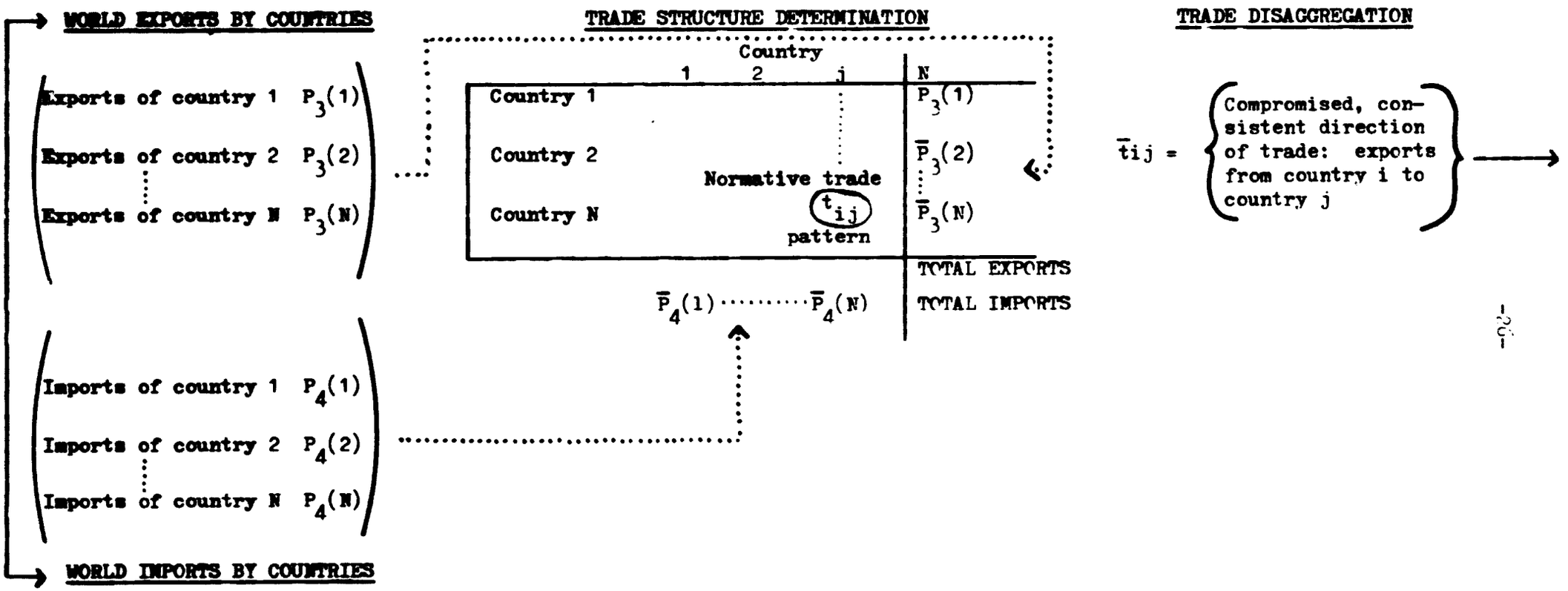
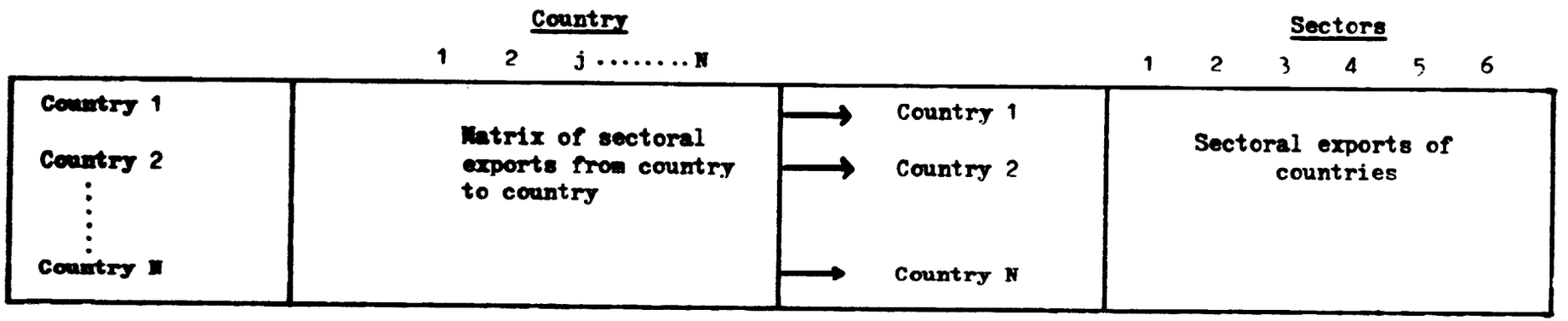


Figure 7. Information flow: Sectoral (commodity) implications of bilateral relations

MATRIX OF SECTORAL SHARES OF EXPORTS OF COUNTRIES



The user: intervention possibilities

The model system as outlined above is composed of a number of disparate parts, each of which receives and provides information in what is essentially a single, circular direction. Some indication has been given also of another level of flexibility: not only is the modular structure heterogeneous in its composition, but the parts which go to make it up are themselves open to alteration. This openness to intervention from outside makes possible the kinds of uses described below.

The possible uses of the model may be classified under three headings: forecasting, simulation and control.

Forecasting

This is one specific use of the model structure - to find out what will happen if present trends continue and present patterns are maintained. Nevertheless, it is an area of less than immediate interest to us: for we regard the present world as a starting point only, and the forecast world as something to be avoided if possible. The aim should be to alter present trends and patterns.

Simulation

We use this term to cover something more than its normal meaning. We take it to mean not only the solution for different given sets of variable levels, but the solution when the structure itself is changed under different assumptions.

Control

Under this heading are considered the regulatory aspects of the model system, i.e. those aspects which are not a part of the set of equalities and identities which make up a simple mathematical model. We thus include upper and lower limits, targets, and objective functions as types of control.

These three uses of the model are not, of course, wholly distinct. Yet, the classification has been made. Its usefulness may be seen more clearly when we proceed to consider specific examples of the possible operation of the model. Before doing so, however, it is necessary to study the model system once more, from the point of view of the components which can be altered, that is, the points of intervention in the system.

We have said above that the system passes information "in what is essentially a single circular direction". We may amplify this by making two points. First, the user may start the information flow at any point in

the circle and end it at any point. Secondly, the user may alter the model structure at any point in the circle.

Beginning and end

Figure 1 does not make clear the somewhat arbitrary numbering of the different components. For though their order on the circle must be maintained, it is not important which should appear in the number one position. There is thus no initial position, no one component whose output is necessarily the first stage of the information flow. This flow can begin at any point.

With reference to Figure 3, though the national model is first treated in the description and bears the number 1, the trade pattern determination (number 5) could just as easily bear that number (in which case the national model would bear the number 4). The information flow nevertheless follows the same path, which is predetermined: only the starting point has changed.

The implication of such a variation is that the choice of initial conditions for any simulation is not limited to those available for the national model. When we say that we can examine the consequences of hypotheses about an economic configuration, we may be referring to assumptions about a national economy or economies, international aggregates, or the direction or composition of trade. The starting point can be freely chosen: this amounts to a selection of the initial conditions for a simulation, or, more precisely (since initial conditions can be given in several different places simultaneously) to a decision regarding the subject matter of the hypotheses to be tested and reconciled within the framework of the model system. As well as being able to start at any point within the system, we may stop at any point, i.e. we may study the implications of our starting hypotheses as far as we choose to.

Since the system outlined is circular, it may be asked what would be the significance of a second or subsequent passage around it? The answer is best seen in the light of a general statement as to what is, and is not, implied by the system. It is by no means an analogue of economic life; the flow of information through it is not intended to be interpreted as, for instance, the flow of goods and services, or other economic variables. In this sense, then, though it can carry out simulations, it is not <u>per se</u> a simulation model in its solution process. The circular operation of the system is a continuous examination of the implications of each step as far as the next step is concerned. It makes no difference which cycle we are on; the

concern is only with the immediate succeeding stage. When and where the information flow began is not important. At another level, however, there is an important qualitative difference between the first and all subsequent cycles: in the first, we are examining the implications of our hypotheses in all the different subject areas with which our system deals; therefore, any subsequent cycle amounts only to an adjustment procedure, and can be seen as part of the solution process (of the system) by a series of successive approximations.

At this point, it may be objected that, while it is easy to see how a policy set might be applied to a national model and the outputs passed on, it is more difficult to visualise initiating the information flow at another place in the circle. How, for example, does one begin with element 5? The direction of which exports and imports do we begin by determining? The simplest answer is that the system itself will supply this information if the user does not: thus, if no other information is available, exports and imports for the period in question are projected automatically, according to an extrapolation of past trends, and the material for an analysis of the direction of trade to be carried out by the user presented. Generally, the system will always make up for any deficiency in the information necessary for its use. Initial conditions and assumptions are supplied at all points where needed, leaving the user free to concentrate on the specific implications of the hypotheses he himself has put forward, in the knowledge that he does so in a rational context; that is to say that reasonable anterior hypotheses have been provided in order to set out fully the environment in which the user's policy simulations may take place.

Levers employed

We have classified the uses to which the system may be put as forecasting, simulation and control, and indicated that intervention is possible at a number of points. In considering these points of intervening and the form they take, we may follow the order given in Figure 3, though this again is only a convention.

The national model

This component has four variable (all policy) elements. In actual countries, these policies would be achieved by various means such as monetary and fiscal instruments. In the national models of the UNIDO system, we consider the policy variables themselves: at a later stage of the system development, the instruments

specific to the form of government in a particular country can be incorporated. Here, however, a standardised model form has been adopted using policy variables common to [illegible] as follows:

(a) Savings ratio. The proportion of household income to be saved, hence the proportion available for investment, can be decided by the user. In fact, all private savings are assumed to be invested.

(b) Rate of income tax. The proportion of household income appropriated by the government. A single average rate is used. It is not the same as the fiscal instruments that form part of a progressive system of personal taxation, but it provides the model with the essential concepts. (Variables (a) and (b) thus determine, as a residual, the proportion of household income actually consumed.)

(c) Rate of profit tax. This is intended to cover all non-personal taxation, including indirect taxes (which can be regarded as net inputs into the production process). (The application of (b) and (c) determines the level of government income.)

(d) Import substitution. Several variables fall under this heading. They are a way of altering the proportions between domestically- and foreign-produced goods in each sector of final consumption. It is only in the area of final goods that competition is assumed: the imports used as intermediate inputs to the domestic production process are regarded as non-competitive, and cannot be altered. (This is, of course, a simplification.) The user is given the present breakdown of final consumption in each sector (as between domestically produced goods and imports) and allowed to give new values for the breakdown. He might be told that in the country under consideration agricultural final consumption is divided .6 and .4; i.e. that 60 per cent is domestically produced and 40 per cent imported. He can then either test the implications of a policy to bring about import substitution in the sector, perhaps leading to a .5 to .5 decision, or he may decide to let the existing figures stand.

The macro-vector

The user is free to supply any of all of the vector's components, that is, to give actual values for any or all of the countries treated in the system for the following macro variables: GDP; Manufacturing (as a component of GDP); Exports; Imports; Foreign trade balance; Total consumption; Domestic savings; Investment; Balance of payments; and Labour force.

This means that the inputs into the international consistency model (the next stage) can be provided directly by the user at this point, rather than being generated by means of the national models. There are at least two reasons why such a course might be followed:

(a) National models might not be available within the system for the countries to be studied; the construction of the national model has quite specific data requirements, particularly with respect to input-output data. Thus, while at the preliminary and intermediate stages of construction, national models will not be available for all countries, the modular construction will allow the system as a whole to operate in such conditions.

(b) Aspects with which the national models deal might not be of immediate interest to the user. The national model considers sectoral aspects of the economy, and allows for the use of policy variables. It might be desired, however, to carry out an analysis initially only at the macro level; or, an analysis of macro variables and their international implications in which the sets of variables form the hypotheses, the data given being without any previous assumptions as to the policy variables that will bring them about. Thus, a set of GDP targets or trade forecasts can be examined; also, the configuration of the end year of a national plan can be tested in the climate of the world economy.

The international consistency model

It is to this component that the macro-vectors discussed above are delivered. There are, however, two other areas of intervention in which the structure of the model can be specifically altered by the user: constraints and objective functions.

(a) Constraints. As the international consistency model is of a linear programming form, the adjustment of the individual vectors within the constraint represents the imposition of a rational order upon the independently arrived at components of the world economy. However, the idea of rationality has some flexibility; there will therefore be some constraints which it may be wished to change. It might seem that the identities, at least, would remain unaltered by any user; but this is not necessarily so. The idea that world exports must equal world imports is a beguiling one, but no empirical statistical data will ever verify it. For the goods exported in one measured time period are not necessarily counted as imports in the same period. This constraint, therefore, may be removed by some user who distrusts it, and perhaps replaces it with one stating that the discrepancy between world imports and exports is to be no larger than a given upper limit.

In practice, however, those constraints which are not identities are most likely to be altered by the user. This is because they fall within the ambit of the third type of use ("control") of the model. We are endeavouring to provide norms for economic configurations and upper and lower limits for economic variables. Clearly, even with the macro-vectors described (containing but eleven variables), it is possible to imagine an enormous number of possible constraints: if all countries are distinguished within the model, the number of regional groupings and related constraints is great. Additional conditions to be fulfilled might include:

- GDP of developing countries to be greater than or equal to a given minimum figure;

- GDP arising from "manufacturing" in African countries to be not less than a minimum share of total GDP arising therefrom;

- Exports of EEC countries to be not greater than a given maximum share of world exports;

- World labour force to be not greater than independently projected labour availability;

- Balance of payments deficit of non-oil-producing developing countries to be no larger than a given target figure.

The question of where the user derives the constraints is discussed fully below in the section dealing with scenarios. For there is an almost infinite variety of them, and a great number of possible solutions. It is the function of the so-called "outer layer" of the system to provide an analysis of goals and hypotheses stated too generally to be introduced directly into the inner layer of models. Such an analysis amounts to the generation of scenarios, in which broad economic aims are described in terms of the inputs to the model system over time.

(b) The objective function. In a traditional linear programming model, an important distinction is made between the objective function, that which is to be maximized, and the constraints, the limitations within which this maximization is to be carried out. The maximization is the goal of the analysis, and the constraints result from a study of those aspects of the structure which determine the region in which the solution may be found. But in this international consistency model, the distinction between constraints and objective function is made largely for operational convenience; there is no underlying qualitative difference between them. It is the user who determines the constraints, and they are just as much goals and targets as the objective function. The objective function can be supplied by the user also, though perhaps the standard objective of the model, i.e. the maximization of the total GDP, is as useful as any. Choosing it serves to initiate the computational procedure which carries out the reconciliation of the different national macro-vectors within the framework of the constraints supplied.

The macro-vectors

These are the vectors delivered by the international consistency model. Two elements of each serve as inputs to the fifth step, which is that of the analysis of the direction of trade. The elements are, of course, the total exports and imports for each country, rendered consistent by the previous model. However, it is not essential that this be the source of such figures; the user can supply his own. These might be derived from an independent trade model which has projected national figures according to some general level of world trade index, or they might be an adjustment deliberately made by the user to the output of the international consistency model. In any case, the figures supplied do not necessarily have to be consistent. The trade pattern determination procedure (step 5) creates a country-

to-country matrix whose row totals are the national exports and whose column totals are the national imports. Step 3 will have produced a set of exports whose sum is consistent with that of imports. But if one begins at step 4, one can supply a set of exports, a set of imports, or both, provided the totals are equal. Consideration of step 5 shows that where there is user intervention at step 4 of the form in which only one of the two sets of exports and imports are supplied, the system itself will supply the other. If at step 4 there is intervention of the form in which both exports and imports are supplied, the system will check if the totals are consistent and report accordingly. Thus, an analysis of trade patterns can proceed on the basis of figures independently arrived at, as well as those provided by the model system. The figures, if supplied, do not have to be complete. If the user wishes to introduce particular export or import figures, he does not have to do so for all the countries considered by the system, for all deficiencies in these are noted by the system, reported, and made up.

Trade pattern determination

In this step the exports and imports of step 4 are broken down into a set of bilateral transactions; that is, the total exports of country i are broken down into the component exports of country i to country j. One could also say that, correspondingly, the imports are broken down. The result is a country-by-country matrix which gives the trade flows between pairs of countries. There are two areas of intervention:

(a) The normative trade pattern. This is the pattern to which the solution (the actual pattern based on the supplied totals) will approximate as closely as possible. It is expressed in the form of export shares: that is, a matrix of coefficients, each row of which totals unity. Coefficient i. j gives the proportion that exports of country i to country j form of total exports of country i to all other countries. The solution process preserves these proportions as far as possible, that is, as far as is consistent with the total exports and imports of each country which are determined or supplied on a separate basis. Thus, the process strives towards a distribution of exports between countries which approximate to the normative pattern. When the user supplies a pattern, or alters the one provided by the system, he gives a new distribution of trade towards which the system will find a solution. Intervention takes the following form:

- The user is asked if he wishes to supply a new pattern;
- If he does not, he is asked if he wishes to change the present one;
- The form of such changes is specified - i.e. to a single row or rows, or a collective change to a group of rows.

In the case of specific changes to particular elements within a row, the other elements are adjusted proportionately if necessary.

If the existing row were

.2 .3 .4 .05 .05

and the third element were changed to .6, the new row would become

.1333 .2 .6 .033 .033

What this means is that the user, having considered the distribution of exports of the country to which the row refers, has decided that he wishes to replace the share going to the third country (.4) by a new share (.6). This figure may be one which he considers is more likely than the one supplied by the system; alternatively, it may be a figure the consequences or feasibility of which he wishes to examine. If he is interested in the feasibility of a certain share of the country's exports going in a certain direction, examination of the solution offered will show how far the target can be realized within the constraints of the export and import totals and the other shares provided. The change seen in the other elements of the row of coefficients is simply an adjustment to preserve the row total at unity. The interpretation is that, in the absence of additional information, the proportions between the other shares are maintained. Thus, the user makes a statement about a specific market for the country's exports: this country is presumed to take a larger share of the total of exporting country's goods, but this is the only change considered.

This, of course, is not the only change that can be examined. If substitution in export markets is to be considered, the user simply provides numerical values for the coefficients in which he is interested (or, more accurately, on which he has information to provide), and the system adjusts the unspecified coefficients. For example, if the user considered that not only could the third country take .6 of the exports, but that this change would be balanced by a corresponding fall in the share absorbed by the second country, the result of his supplying the two figures would be the row of coefficients:

.2 .1 .6 .05 .05

In general, it can be said that replacing some coefficients in a single row of the matrix will result in a row in which the coefficients which have not been referred to will be scaled by whatever factor is necessary to maintain the row total at unity. Though in the numerical example given an increase in selected coefficients was postulated, it could equally well have been a decrease, in which case the remaining coefficients would all have been increased by the appropriate factor.

A second type of intervention is possible within the normative trade pattern: in this case, the user is considered as operating above the level of a national planner, i.e. at a regional or global level. It is the type of use appropriate to a trade block or economic community in the investigation of policy changes and also to an international body for analytical purposes. The user can change more than one row at a time: if he is concerned with the joint trading policies of a group of countries, he will wish to change all the appropriate rows simultaneously. In such a case, he will be more concerned with the imposition of uniform goals for the countries of the group. Specification of the numerical values of the coefficients concerned would be inappropriate since they are all to be incremented in the same proportion: the model

system therefore provides a facility whereby the user can specify a particular factor (or factors) to be applied to selected coefficients. This will then be applied to the coefficients in each row of the group of countries being considered. The coefficients which have not been referred to will be adjusted proportionately, as described above. If it is desired to increase the share of trade within a group of countries by a certain percentage, the entire sub-matrix composed of the intersection of the rows and columns of the countries concerned will have its coefficients multiplied by the same factor, and the remaining coefficients will be reduced accordingly, in order to preserve all the row totals at unity. Thus, the system translates a general target for multi-lateral action into changes in the coefficients of the normative trade pattern.

(b) The positive trade pattern: As indicated, the export distribution coefficients form a pattern which in the solution is adhered to as far as possible. This pattern is thus a goal or target, and the actual values may differ from those desired. The user can also intervene in another sense at this point, however: he can provide values for subsets of the elements of the matrix which will be adhered to, and preserved in the final solution. This facility is provided for two reasons:

(i) Owing to the solution process adopted by the system (minimization of the sum of squares) it is possible, if extreme values for exports and imports are given (values highly inconsistent with the normative trade pattern), that we may find individual components of the solution to be negative, i.e. that some of the elements of the direction of trade matrix are less than zero. Such an occurrence, however unlikely, is mathematically correct: but it means that negative trade flows are implied between countries. The system therefore incorporates an interactive procedure whereby the user can add additional conditions to the solution process: if some negative elements appear in the solution, they can be constrained to retain the value zero, and the solution will then be recalculated. This provides an interactive procedure for the removal of anomalous components of the trade matrix being sought.

(ii) There is no need to restrict ourselves to zero as the necessary value of any elements of the matrix. The user may have a particular view of the numerical value of a trading relationship and wish to examine the implications. In this case, he can simply insert this value and it will be preserved in the final solution, which will minimize the difference between the actual and the normative trade patterns, subject to the row and column totals and the supplied value of individual elements.

The facility also allows the user to give values (which will be adhered to) for the total of a group of elements, that is, not just the value of one element, or the separate values of separate elements, but the sum of a block of any size or shape within the direction of trade matrix. This facility is likely to be employed by the national or regional planner. The user at the national level may incorporate a numerical value for the total of his trade with a selected group of countries,

whereas the user at the multinational level may insist on a predetermined value for a selected block of the matrix; thus, the exogeneous values (perhaps from another system) of the trade of groups of countries with other groups can be included as specific constraints in the solution process.

The distinction made then between the normative and positive types of intervention is clear: one represents what is negotiable, the other what is not. The normative pattern is expressed in coefficient form, the positive in absolute values of the flows concerned. This distinction is made partly for computational purposes, and partly as a reflection of the more qualitative distinction between the hypothesized and the actual, which the two different types of intervention represent. There is thus almost an excess of choice for the user which might make it somewhat confusing for him to decide upon the precise form his intervention will take. This part of the system is particularly flexible and open to change: this means that it can be used repeatedly if for no other purpose than to assist the user in deciding what he wants to do with it. It is in the examination of the solutions provided by the system that the final distinctions can be drawn. The choice whether an intervention should be in the normative or the positive trade pattern is not fraught with fatal consequences: whereas in life it may be perilous to confuse desire and reality, in our model system it does not matter.

Trade disaggregation

The previous step yielded a matrix giving the volume of total exports between countries. This step breaks each transaction down into its component parts, that is, into the commodities which make it up. A set of coefficients, derived from observation of historical trade patterns, give the breakdown. The assumption is that exports from country A to country B, irrespective of their total, are always a bundle of different commodities in constant proportions to one another. The model supplies these coefficients, which are based on observations of the actual patterns of such composition. At a later stage in the development of the system, it is intended that the "outer layer" will supply other, similar sets of coefficients, based on a pattern-of-trade model which will explicitly take price/quantity equilibria into consideration. For the moment, however, the historical composition of trade is the basis for the system's set of coefficients. It is still possible for the user to intervene at this juncture, should he wish to change the coefficients provided; for example:

(a) He may wish to change individual coefficients. This may be on the basis of specific information regarding the value of one or more coefficients in a row (though "row" is somewhat misleading since we are discussing a three-dimensional array). The numerical example given earlier for determining the direction of trade will serve to illustrate the present point. The figures

.2 .3 .4 .05 .05

are now taken to give the breakdown of the total trade between country A and country B. The first commodity forms 20 per cent of the total trade, the second 30 per cent, and so on. If the user decides that the third commodity, which at present represents 40 per cent of his total exports to country B, should increase its share to 60 per cent, the new row of coefficients will be

.1333 .2 .6 .033 .033

Once again the other elements of the row have been adjusted to preserve the row total at unity: once again, in the absence of additional information, the proportions between the coefficients not explicitly referred to have been maintained. Thus, the user can incorporate specific targets or forecasts for the composition of his trade with one or more countries, and see the implications in the next stage.

(b) He may decide to change the composition of all his exports. This step, which is analogous to the preceding one, means he will make a general alteration to the coefficients referring to his trade with all the other countries. His intervention will take the form of expressing a percentage change that all his coefficients, referring to one or more commodities, are to undergo. A general adjustment, similar to that given above, will then be made to all the coefficients not referred to. For instance, if a user decides that the composition of his exports is not satisfactory as between capital and final consumer goods, he can specify the percentage changes he wishes to see, or believes will happen. The coefficients will be adjusted by the amounts specified, as far as capital and final consumer goods are concerned, and the coefficients relating to other goods (e.g. intermediate goods) adjusted accordingly.

(c) He may not be a national planner, but one concerned with the common policies and projections of more than one country. In this extension of (b) above, he can apply changes to the supplied coefficients, but to all the countries of the group with which he is concerned. He thus acts over all three dimensions of the array of trade decomposition coefficients.

Sectoral exports

This is the last step before the return to the national model. The intervention takes place if the user has his own set or sets of sectoral exports which he wishes to analyse. A set of exports will be expressed as the figures for the value of exports from each economic sector in the national economic model.

If the information flow begins here, the user will supply the export figures for the country with which he is concerned, and the national model will then give him the implications in terms of employment, investment, balance of payments and so on. This means that alternative sectoral export scenarios, which will be derived from the outer layer of the system, can be examined for their national implications in the next step.

Chapter VI

THE SUB-MODELS

The national model

Although in Figure 3 the national model is shown as a single component of the system, this is somewhat misleading, for two reasons.

First, the system will contain a number of models referring to various countries; the ultimate intention will be to have a model for each country distinguished. As stressed previously, since we regard analyses concerned with finding global optima as ultimately unrealistic, our use of maximization procedures in the international consistency model is principally for computational reasons. The "real" world can be seen as the sum of the results of the pursuit of individual optima by individual countries, the achievement of these optima often being determined by the actions of other countries pursuing their own targets. Consequently, the system we are constructing will have a model of each economy in the world system as a characteristic component. While acknowledging the difficulty of completing such a task, we nevertheless adopt this target because of the fundamental role which we attach to national policy within the world system. Concepts such as co-operation and joint action for the achievement of a New International Economic Order may be said to transcend purely national action; yet they can be seen as the sum of national actions, with collective agreement being reached on the individual policies to be followed.

Second, for any one country, the system may contain more than one model. Because different national models can answer different questions, and in order to offer the user as much flexibility as possible in his analyses, the system may include a whole family of models for one country. Some of these will be constructed within the house or by subcontractors and be specifically built for the UNIDO model. Others, already constructed by outside bodies, will be modified as necessary to fit into the definitional framework of the UNIDO model.

One area of the latter category is worth mentioning in a little more detail. Economic models are now an important part of the governmental process in many countries, being used for budgetary analysis, economic forecasting, and planning in a wide sense. These models can range from the simple macro-economic model with

half a dozen equations to detailed systems capable of examining, through hundreds of equations, any area of economic or social activity for which data can be found in the country concerned. In all cases, however, they are employed to evaluate policies on which decisions are taken at a national level. Since it is our intention to provide an international framework upon which the full consequences of such policies can be analyzed, formal links will be established with the appropriate institutions which will allow studies to be carried out concerning the adaptation of national models to the UNIDO model. Such links would also serve to adapt the UNIDO model in order to meet the needs of national planners and policy-makers.

Within the framework of the present system, two broad categories of national models exist which, because of their different emphasis, are used at different stages of the operation. First come the macro-models, which deal with broad categories of the national economy. The essential feature of these is that they treat all economic activities as one; they do not distinguish sections such as manufacturing, but deal with the aggregate concepts of GDP, consumption, investment and the like. These models are useful in the context of broad economic forecasting; many economic data are available in these terms, and national and regional plans are often expressed in them. Thus, the macro-vectors used as input to the international consistency model of the UNIDO system can be generated by such models. This means that, given GDP, for instance, the value of consumption can be calculated by substitution within the equations of the macro model. The model can also be used for national consistency checking, which amounts to an examination of the various elements of a macro-vector for internal contradictions. For instance, if a projection of GDP and investment are supplied by a user, the macro model can be used to see whether a certain output can be attained using the level of investment specified. In other words, it would be possible to assess the feasibility, at a national level, of a projected set of macro variables, before examining them in an international context.

Although macro models take a wholly aggregated view of economic activity, they are often quite detailed with respect to consumption and investment. Models used for national planning purposes often incorporate a wide range of policy instruments, that is, those variables which the policy makers themselves can change, such as tax and tariff rates, and monetary variables. Since policy instruments are usually specific to the political and socio-economic structure of an individual country, there are clear advantages in incorporating such models within the UNIDO framework.

The disadvantages are also clear, and they are common to multi-sector models which attempt a general sectoral breakdown of the economy. These models are not

detailed enough to answer, adequately, precise questions with which policy makers and planners are faced, questions such as investment allocation. Nor can problems of manpower allocation, technological change and import-substitution be studied explicitly by such models. Attention, therefore, must be given to a second class of models in which economic sectors are dealt with in more detail, and in which the interrelationships between those sectors are also taken into account. The typical model of this class will be based on an input-output framework.

The input-output approach is based on the assumption that a transaction between two industries can be seen from two points of view: that of the buyer and that of the seller. Fertilizers bought by the agricultural industry represent an input into agriculture. For the chemical industry, however, the transaction represents a distribution of its output. The circularity of this system may be seen by considering the coal and the steel industries: coal is needed to operate foundries, which in turn produce the materials and implements needed for the operation of coal mines. In fact, in most economies all industries are linked together, directly or indirectly. Thus, projected demand for the products of one industry has implications for the others.

We regard this inter-industry approach as essential in examining the sectoral implications of economic changes. However, input-output analysis per se is rigid in its assumptions, and demanding in its data requirements. It does not deal directly with many aspects of economic life that are of interest, such as capital investment and labour requirements for production. The traditional equations of the open static input-output model give the relationship between final demand and total output of the sectors of the economy; the assumption these equations make, however, is one of constant returns to scale. This assumption is emodied in the so-called "technical coefficients" of input-output analysis. As a "flow" concept is employed, capital involved in the production process must be considered separately. We must look, therefore, for some modification of the input-output analysis as a basis of a national model and some adequate and explicit treatment of both capital and labour.

In view of the above discussion, a national model that would be appropriate for incorporation into the UNIDO system would be one whose variables would be both related to those of the general framework described and of direct interest to those users for whom the completed model system is intended; viz:

(a) Sectoral disaggregation. The number of sectors distinguished should be enough to enable the principal sectoral policy measures to be analyzed in detail.

(b) Inter-industry analysis. The interconnexions between the different economic sectors should be taken into account through the use of input-output techniques.

(c) Sectoral analysis of capital and labour employed in production. National aggregates of these variables are clearly inadequate in considering questions such as investment allocation. The homogeneity of capital and labour (and thus the extent to which these can really be moved about between sectors is a subject which should be examined under this heading.

(d) Detailed treatment of imports. The imports used in each industry should be clearly distinguished, as should the various components of final demand. These imports should also be identified as either competitive or non-competitive goods: only on such a basis can questions of import-substitution be examined.

(e) Detailed treatment of final demand. Consumption components such as households, government and exports must be identified, together with components of investment, gross fixed capital formation and stock changes. Account must be taken of the fact that patterns of demand, i.e. the proportions in which the outputs of different sectors are absorbed by each of these components, differ from one to the next.

(f) Detailed treatment of value added. Wages and salaries, taxes and profits in particular should be distinguished.

(g) Closing the model. As an inter-industry analysis traces the output requirements necessary to meet a given bill of final demand, the connexions between the various industries are thus taken into account. Also to be considered is the value added arising from the increased production referred to, which will again be distributed either as consumption or investment: these links should also be included in the model, preferably with some assumptions which go beyond simple linearity.

(h) Policy variables. As well as investment allocation and the partly related subject of import-substitution, the policy variables available to the user in the country to which the model refers should be represented. These include import tariffs and quotas and various taxation rates, as well as the appropriate monetary variables.

(i) Prices. In view of the complexity of the subject and the specificity of price systems to each country, much work will be necessary to incorporate prices explicitly in a national model. (Prices will probably be first introduced into the UNIDO model at an international level.)

In giving this outline of the more important features of the standard national policy model, which, other things being equal, we intend to construct, we emphasize that, where adequate national models, although of different form, are already

operational, we intend to seek the co-operation of the constructors in adapting their work to ours, thus avoiding unnecessary duplication. This will not be easy because uniformity among national models is as rare as uniformity among countries: the differences in political systems and economic structures will inevitably be reflected in the national models that we employ.

Closed national policy model

A closed national policy model is being constructed and incorporated into the computerized version of the UNIDO model (described in Chapter VII). It is being fitted with some crude data for Kenya for the year 1971 and is intended principally to demonstrate the questions that can be answered by such a model when more refined data has been collected.

Figure 8 shows in a simplified form the outline of the closed model, so called because all the economic variables discussed are determined within it; the only variables decided outside are the levels of exports for each sector. The arrows indicate causality, and the only box with a single arrow (leading from it) is the "Exports" box. Exports are determined elsewhere: they can be the results of previous calculations in the international consistency model and the directions and composition of trade analysis which is discussed elsewhere.

Production takes place as a result of this demand for exports. The consequence of this is that households receive means, governments receive taxes, and in some economies entrepreneurs receive profits, as shown by the boxes to the right of "Production". The "Capital" box is a special simplification, since several accounts are kept by the model, and other links are not shown. Broadly speaking, the capital needed for increased production comes from household savings, government income and foreign borrowing.

The horizontal arrows illustrate that interaction or feedback is taking place. The household income will be partly spent on increased domestic consumption. The government income will also be partly spent on consumption, though the pattern will be different. Finally, the increased investment will also cause more production, since it represents a demand for investment goods.

It may be objected that there is no end to this way of thinking, since new increased production will yield more household income, which will in turn cause new demand, and so on. It is true that it is an infinite process in mathematical terms.

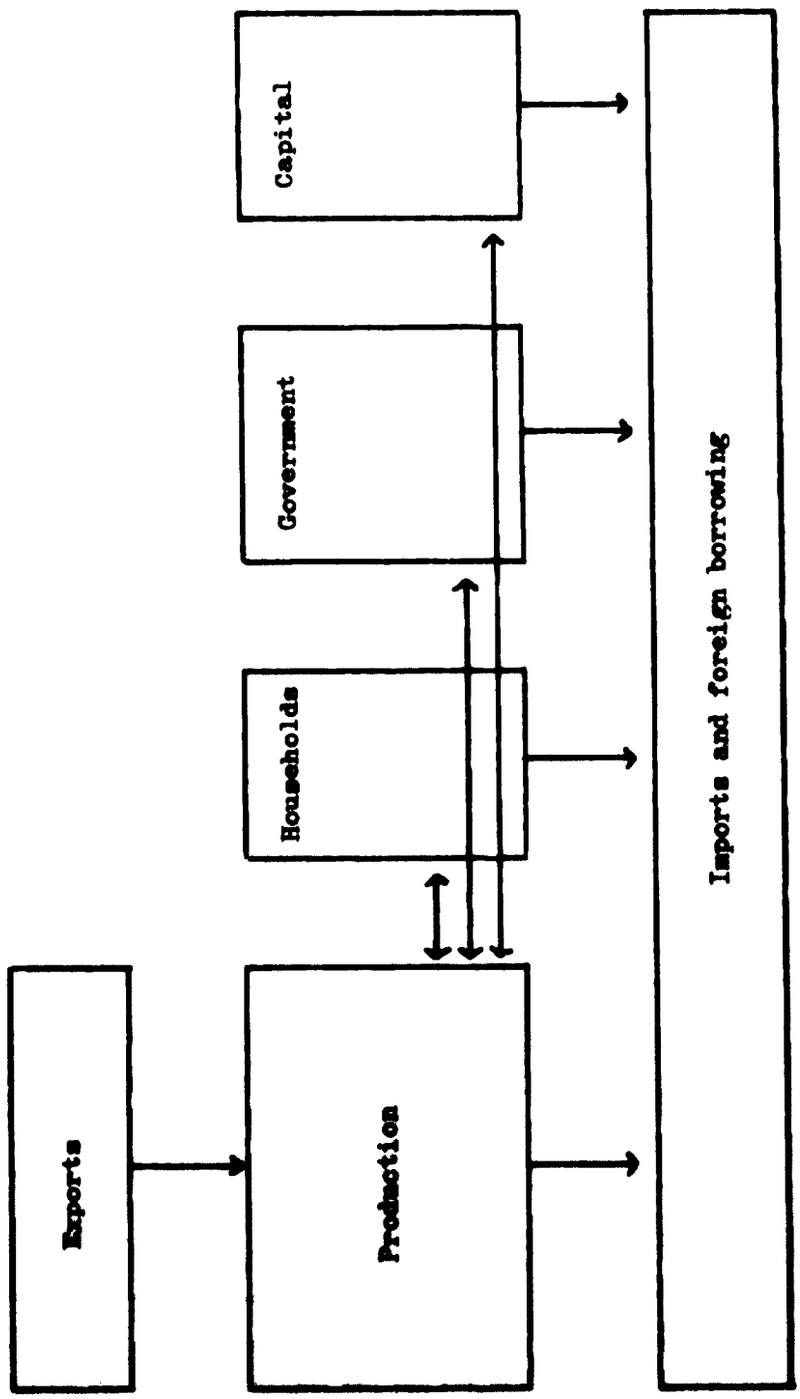


Figure 8. Outline of the closed national model

Nevertheless, the figures involved diminish rapidly. It is possible to derive a finite solution to this infinite process by putting the equations in the form of a matrix and inverting it. The matrix is discussed below, together with the equations used; in short, it means that given a set of export figures representing the external demand for the goods of each sector, we can calculate the consequences within the economy in terms of sectoral output, investment and income (and thus numbers employed in each sector).

The "Imports" box represents the other aspects of the national economy's connexion with the rest of the world. The given exports lead to production within the economy, and this in turn eventually causes an increase in the level of imports. We distinguish "intermediate" imports by sector of origin and destination, which means that we take account of the products imported by each of the sectors in order to carry out production. We also take account of final imports, i.e. imports that are consumed either by households or governments (whose different patterns of consumer good imports are kept separate in the model). Capital goods imported in response to investment are also considered.

In discussing the control of the inner layer, we have desoribed the ways in which the user can intervene, and the policy variables involved. To recapitulate, these are: savings rate; income tax rate; profit tax rate; and import-substitution variables (all the consumption coefficients).

The import classification given above (intermediate, final, capital) is one approach. Imports are often classified as competitive or non-competitive; competitive imports are those of a type produced in the country itself. In deciding policies of import-substitution, this distinction is important; for the investment associated with substitution of non-competitive goods is clearly of a different order. Indeed, a particular country may never be able to produce non-competitive goods owing to lack of resource endowments.

These points may seem obvious, but they have important implications for model construction, partioularly in light of the data necessary. Initially, and in order to simplify, we have assumed that only final consumer imports (i.e. imports direct to households) are competitive, and thus it is only the proportions between these and their domestic equivalents (in the household bill of goods) which may be changed as a policy variable. All other imports are assumed to be non-competitive, and the proportions in which they are imported may not be changed.

This is obviously one direction in which the model can be improved - that of investment in wholly new production oapacity, whioh amounts to the introduction of

a new production structure. As an important concern of planners and policy makers, it is an obvious priority area for incorporation.

An inspection of the equations that follow will suggest many other ways in which the model can be improved. For example, the complete linearity of the structural relationships, especially between capital and output and between household income and expenditures, is open to criticism.

We emphasize again, however, that this closed national model merely indicates the way in which the sectoral implications given by the inner layer of the over-all UNIDO system can be studied. The data requirements for more complicated models are correspondingly greater: in particular, consumption elasticities and the relationship between capital and output (including the estimates of capital stocks) raise many questions. This is one reason why the development and implementation of national models must be carried on in close collaboration with national planners.

The equations of the model

The matrix of the model is shown in Figure 9 . All the equations can be expressed as a single matrix equation:

$$Z = B^{-1} D$$

where B^{-1} is the inverse of the matrix shown, D is a column vector of the exogenous variables, and Z is a column vector of the endogenous variables. These variables are as follows:

(i) Exogenous variables

E = Total exports

e_i = Exports by sector i

K_o = Total fixed capital in the base year

D = Repayment of foreign debt

(ii) Endogenous variables

X_i = Gross output of sector i

DE = Export surplus less debt payments

F = Gross fixed capital formation

W = Personal income

T = Total tax revenue

R = Total gross profits

S = Total private savings

C = Total private consumption

G = Government expenditure

H = Foreign aid

L = Total employment

(iii) Structural coefficients

ratios to gross output of sector j:

a_{ij} = domestic intermediate inputs

w_j = personal income

m_{ij} = intermediate imports

t_j = indirect taxes

r_j = gross profits

k_j = capital-output ratio

l_j = labour-output ratio

shares of total government consumption:

g_i = domestic sector i

m_{gi} = imports of type i

shares of total gross fixed capital formation:

f_i = domestic sector i

m_{fi} = imports of type i

(iv) Policy variables

These are the coefficients of the matrix which may be changed by the user of the model.

s_o = Savings rate: a share of personal income

t_o = Direct tax rate on personal income

t_r = Tax rate on profits

c_i, m_{ci} = The proportions of total private consumption formed by good i; this is composed of domestic and competitive imports. The proportions between these can be changed.

The equations of the model are as follows:

Input-output relationships (row 1 of the matrix)

$$\sum_j a_{ij}X_j + c_iC + g_iG + f_iF + e_i = X_i$$

All production is consumed or invested. The coefficients relating to inputs sum to unity (column 1):

$$\sum_i a_{ij} + m_{ij} + w_j + t_j + r_j = 1$$

Personal income (row and column 4)

$$W = w_jX_j$$

Private consumption (row and column 8)

$$\sum_i c_i + \sum_i m_{ci} = 1$$

Government revenue and expenditure (row and column 6)

$$T = \sum_j t_jX_j + t_oW + t_rR$$

Government expenditure (row and column 9)

$$\sum_i g_i + \sum_i m_{gi} = 1$$

Gross profits (row 6)

$$\sum_j r_jX_j = R$$

Net profits (column 6 and column 10)

$$R(1 - t_r) = N$$

Gross fixed capital formation (row and column 3)

$$\sum_j k_jX_j - K_o = F$$

$$\sum_i f_i + \sum_i m_{fi} = 1$$

Total savings (row and column 7)

$$s_oW = S$$

Investment financing and foreign aid (row and column 11)

$$H = F - N - S + D$$

Foreign trade (row and column 2)

$$DE = E - \sum_i \sum_j m_{ij}X_j - \sum_i (m_{oi}C + m_{gi}G + m_{fi}F)$$

Total employment (row and column 12)

$$L = \sum_j l_jX_j$$

Figure 9. Model matrix and vectors

B:

	1	2	3	4	5	6	7	8	9	10	11	12	D
1	$(1-a_{ij})$		$-f_i$					$-c_i$	$-g_i$				e_i
2	$-a_{ij}$	+1	$-a_{fi}$					$-a_{ci}$	$-a_{gi}$				E
3	$-k_j$		+1										K_o
4	$-w_j$			+1									
5	$-t_j$			$-t_o$	+1	$-t_r$							
6	$-r_j$					+1							
7				$-s_o$			+1						
8			$(1-s_o-t_o)$					+1					
9					-1				+1				
10						$(1-t_r)$				+1			
11		-1					+1			+1	+1		D
12	$-l_j$												

Z: X_i DE F W T R S C G N H L

International consistency model

The international consistency model evaluates country plan alternatives from the point of view of international co-operation and trade relations.

It was obvious at the beginning of work on the UNIDO World Industry Co-operation Model that it would have to consist of several submodels designed to answer different sets of questions. One of these questions arises in connexion with the Lima target: will the development strategies of individual countries be compromised in fulfilling this global target? Finding a simple way to answer this question led to the idea of an international consistency model, and in turn to a simple linear programming formulation of the problem. The model described is based upon use of the well-known decomposition principle in multilevel planning.

Alternative country plans

We assume that each country involved in the UNIDO Model will work out its own detailed development strategies for the planning period. We assume also that these strategies may be characterized by several internally consistent macro-aggregates (GDP, industrial output, total imports, number employed, etc.) Additional plan alternatives can be elaborated using extreme assumptions concerning exogenously given variables, such as foreign trade market possibilities or foreign aid possibilities. The individual plan alternatives of a country therefore represent conflicting economic policy alternatives: autarchic development, export-oriented development, intensive development of modern industries, etc. The underlying technical, behavioral and institutional assumptions are hidden to a certain extent within these key macro-aggregates. We assume, finally, that plan alternatives will differ in number according to country.

In the following example, there are n countries ($i = 1, 2, \ldots n$) and each country has k plan alternatives ($k = 1, 2, \ldots, i_k$). The plan alternatives consist of R macroaggregates. Then the kth plan alternative of the country i can be described as vectors of R elements:

$$P_{ik} = \begin{matrix} p_{ik}^{(1)} \\ p_{ik}^{(2)} \\ \vdots \\ p_{ik}^{(R)} \end{matrix}$$

For the international consistency model, we specify the macroaggregates as follows:

1	=	GNP
2	=	Industrial production
3	=	Exports
4	=	Imports
5	=	Foreign trade balance
6	=	Total consumption
7	=	Domestic savings
8	=	Investment required
9	=	Balance of payments
10	=	Labour force required

The compromise of plan alternatives

In the international consistency model (see Figure 10) we want to ensure that each country will carry out one of its plans (pure strategy), or a weighted average of them (mixed development strategy), in such a way that the collection of country plans satisfies global constraints on international co-operation and international trade equilibrium. To achieve this, we employ the technique of linear programming, introducing into the constraints weighting constraints (in mathematical terms, convex combinations of plan alternatives). This approach, however, doesn't assume the necessity of a world-wide, global objective function, which should be considered merely as a part of the linear programming technique.

Series of calculations

Using the international consistency model, a series of calculations can be performed using different assumptions about total world exports and imports and about global limits or parameters. The computations give quantitative information regarding the following questions:

- Does there exist any compromise to individual country plans which will assure that a given percentage of world industrial production is produced by the developing countries and that world total exports are equal to world total imports (consistency check)?
- What is the maximum attainable industrial production of the developing world, assuming worldwide trade equilibrium in the above sense?
- What is the minimum deviation between total world exports and imports, using different assumptions about the production level of developing regions?

Figure 10. Structure of the international consistency model

	Country 1	Country 2	.....	Country n	World		RHS
Global structural constraints	$P_{11}w_{11}+\ldots+P_{1k_1}w_{1k_1}$	$+P_{21}w_{21}+\ldots+P_{2k_2}w_{2k_2}$	+.....	$+P_{n1}w_{n1}+\ldots+P_{nk_n}w_{nk_n}$	Aggregate variables	$\geq$ $=$ $\leq$	b
Weighting constraints	$w_{11}+\ldots+w_{1k_1}$	$w_{21}+\ldots+w_{2k_2}$	.....	$w_{n1}+\ldots+w_{nk_n}$		= = =	1 1 1
Objective functions							

The w_{ik} stands for the weights to the k-th alternative of country i

The following table comprises all these questions:

	World total G D P	Industrial production of developing countries	World total exports and imports	Global limits or shares
1.	Objective function (maximize)	Fixed percentage of world production	Equal	Fixed
2.	Lower limit	Objective function (maximize)	Equal	Modify regional GNP shares
3.	Lower limit	Objective function (maximize)	Equal	Modify lower limit of consumption
4.	Lower limit	Objective function (maximize)	Equal	Modify upper limit of foreign aid
5.	Lower limit	fixed	Objective function (minimize deviation)	Modify regional shares

Mathematical formulation of the model

The model has the following variables: 6 + number of alternatives.

w_{ik} weight of kth plan alternative of country i

WP world total production (GDP)

WIP world total industrial production

WET world total exports

WIT world total imports

Sd domestic saving of developing countries

F foreign aid

The model has the following parameters and exogenous data:

$p_{ik}^{(r)}$	rth macroaggregate of the kth plan alternative of county i
WPo	lower limit to world total GNP
C_o	lower limit of consumption
L_R	upper limit of regional labour force
α	share of industrial production of developing countries in the world industrial production
r_{R_i}	share of region R in world industrial production

The model's variables are related through the following equations or inequalities:

(1) GNP world identity

The world total GNP is the sum of the GNPs of the individual countries

$$\sum_{i=1}^{n} \sum_{k=1}^{i_k} p_{ik}^{(1)} w_{ik} - WP = 0$$

(2) GNP world lower limit

The world total production of the terminal year must be greater than that of the base year or a forecast for the reference year:

$$WP \geq WP_o$$

(3) World total industrial production

The total industrial production is the sum of industrial production of the individual countries

$$\sum_{i=k}^{n} \sum_{k=1}^{ik} {}^{(2)}p_{ik} w_{ik} - WIP = 0$$

(4) Industrial production of the developing countries[1/]

The industrial production of the developing countries must be equal to or greater than a given percentage of world industrial production

$$\sum_{i \in J} \sum_{k=1}^{ik} {}^{(2)}p_{ik} w_{ik} - \alpha\, WIP \geq 0$$

where J set of indexes of developing countries

(5) Regional shares of industrial production

Industrial production of a region must be greater than a given lower limit but may not exceed a given percentage of the world total industrial production

$$\sum_{k=1}^{ik} {}^{(2)}p_{ik} w_{ik} - r_{R_i} WIP \leq 0$$

(6) World export identity

$$\sum_{i=1}^{n} \sum_{k=1}^{i_k} {}^{(3)}p_{ik} w_{ik} - WET = 0$$

(7) World import identity

$$\sum_{i=1}^{n} \sum_{k=1}^{i_k} {}^{(4)}p_{ik} w_{ik} - WIT = 0$$

1/ The presence of this constraint depends on what objective function is chosen.

(8) World total exports are equal to world total imports[1/]

$$WET - WIT = 0$$

(9) Regional lower limits for consumption

Consumption in the terminal year must be greater than that of a previous year

$$\sum_{k=1}^{i_k} {}^{(6)}p_{ik}w_{ik} \geq C_o \quad \text{for several regions}$$

(10) Domestic savings identity of developing countries

$$\sum_{i \in J} \sum_{k=1}^{i_k} {}^{(7)}p_{ik}w_{ik} - S_d = 0$$

(11) Investments of developing countries

$$\sum_{i \in J} \sum_{k=1}^{i_k} {}^{(8)}p_{ik}w_{ik} - S_d - F \leq 0$$

(12) Foreign exchange of developed countries

$$\sum_{i \in D} \sum_{k=1}^{i_k} {}^{(5)}p_{ik}w_{ik} = F$$

(13) Regional labour force upper limit

$$\sum_{i=1}^{i_k} {}^{(10)}p_{ik}w_{ik} = L_R \quad \text{for several regions}$$

(14) Weighting constraints

$$\sum_{k=1}^{i_k} w_{ik} = 1 \quad \text{for all } i$$

1/ The presence of this constraint depends what objective function is chosen.

Number of constraints

10 structural constraints
+ 3 x number of regions
+ number of countries

Objective functions

(1) $WP \longrightarrow \max.$

(2) $\sum_{i} \sum_{k=1}^{i_k} {}^{(2)}p_{ik} w_{ik} \longrightarrow \max.$

(3) $|WET - WIT| \longrightarrow \min.$

The problem of maximizing or minimizing the absolute value of a linear function cannot be directly solved by the simplex algorithm. It is necessary to transform the problem into an equivalent form.

Consider the original problem:

$w_{ik}, \quad WET, \quad WIT \geq 0$

$$\sum_{i} \sum_{k} {}^{(3)}p_{ik} w_{ik} - WET = 0$$

$$\sum_{i} \sum_{k} {}^{(4)}p_{ik} w_{ik} - WIT = 0$$

$|WET - WIT| \longrightarrow \min.$

(Other constraints we disregard)

The transformation of the problem introduces new constraints and respecifies the objective function.

R E G I O N 1

	Constraints	Country 1 W_{11}	W_{12}	W_{13}	Country 2 W_{21}	W_{22}	W_{23}	W_{24}	Country 3 W_{31}	W_{32}	W_{33}
1.	GDP World identity	$p_{11}(1)$	$p_{12}(1)$	$p_{13}(1)$	$p_{21}(1)$	$p_{22}(1)$	$p_{23}(1)$	$p_{21}(1)$	$p_{31}(1)$	$p_{32}(1)$	$p_{33}(1)$
2.	GDP World lower limit										
3.	World industrial production	$p_{11}(2)$	$p_{12}(2)$	$p_{13}(2)$	$p_{21}(2)$	$p_{22}(2)$	$p_{23}(2)$	$p_{24}(2)$	$p_{31}(2)$	$p_{32}(2)$	$p_{33}(2)$
4.	Industrial production of developing countries	$p_{11}(2)$	$p_{12}(2)$	$p_{13}(2)$	$p_{21}(2)$	$p_{22}(2)$	$p_{23}(2)$	$p_{24}(2)$			
5.	Regional shares of industrial production Region 1	$p_{11}(2)$	$p_{12}(2)$	$p_{13}(2)$	$p_{21}(2)$	$p_{22}(2)$	$p_{23}(2)$	$p_{24}(2)$	$p_{31}(2)$	$p_{32}(2)$	$p_{33}(2)$
	Region 1										
6.	World exports identity	$p_{11}(3)$	$p_{12}(3)$	$p_{13}(3)$	$p_{21}(3)$	$p_{22}(3)$	$p_{23}(3)$	$p_{24}(3)$	$p_{31}(3)$	$p_{32}(3)$	$p_{33}(3)$
7.	World imports identity	$p_{11}(4)$	$p_{12}(4)$	$p_{13}(4)$	$p_{21}(4)$	$p_{22}(4)$	$p_{23}(4)$	$p_{24}(4)$	$p_{31}(4)$	$p_{32}(4)$	$p_{33}(4)$
8.	World trade equilibrium										
9.	Lower limits for consumption Region 1	$p_{11}(6)$	$p_{12}(6)$	$p_{13}(6)$	$p_{21}(6)$	$p_{22}(6)$	$p_{23}(6)$	$p_{24}(6)$	$p_{31}(6)$	$p_{32}(6)$	$p_{33}(6)$
	Region 1										
10.	Domestic savings of developing countries	$p_{11}(7)$	$p_{12}(7)$	$p_{13}(7)$	$p_{21}(7)$	$p_{22}(7)$	$p_{23}(7)$	$p_{24}(7)$			
11.	Investments of developing countries	$p_{11}(8)$	$p_{12}(8)$	$p_{13}(8)$	$p_{21}(8)$	$p_{22}(8)$	$p_{23}(8)$	$p_{24}(8)$			
12.	Foreign exchange of developed countries								$p_{31}(5)$	$p_{32}(5)$	$p_{33}(5)$
13.	Regional labour force - Region 1	$p_{11}(10)$	$p_{12}(10)$	$p_{13}(10)$	$p_{21}(10)$	$p_{22}(10)$	$p_{23}(10)$	$p_{24}(10)$	$p_{31}(10)$	$p_{32}(10)$	$p_{33}(10)$
14.	Weighting constraints Country 1	1	1	1							
	2				1	1	1	1			
	3								1	1	1
	Country n - 1										
	Country n										

Objective function

(**Developing countries** : **Country** 1
2
n - 1

Developed countries : **Country** 3
n)

R E G I O N 1

Country n-1			Country n											
$W_{n-1,1}$	$W_{n-1,2}$	$W_{n-1,3}$	W_{n1}	W_{n2}	W_{n3}	W_{n4}	WP	WIP	MRT	WIT	Sd	F		
$p_{n-1,1}(1)$	$p_{n-1,2}(1)$	$p_{n1,3}(1)$	$p_{n1}(1)$	$p_{n2}(1)$	$p_{n3}(1)$	$p_{n4}(1)$	-1						=	0
							1						$\geq$	WP_o
$p_{n-1,1}(2)$	$p_{n-1,2}(2)$	$p_{n-1,3}(2)$	$p_{n1}(2)$	$p_{n2}(2)$	$p_{n3}(2)$	$p_{n4}(2)$		-1					=	0
$p_{n-1,1}(2)$	$p_{n-1,2}(2)$	$p_{n-1,3}(2)$						-d					$\leq$	0
								$-d_{R_1}$					$\leq$	0
$p_{n-1,1}(2)$	$p_{n-1,2}(2)$	$p_{n-1,3}(2)$	$p_{n1}(2)$	$p_{n2}(2)$	$p_{n3}(2)$	$p_{n4}(2)$		$-d_{R_1}$					$\leq$	0
$p_{n-1,1}(3)$	$p_{n-1,2}(3)$	$p_{n-1,2}(3)$	$p_{n1}(3)$	$p_{n2}(3)$	$p_{n3}(3)$	$p_{n4}(3)$			-1				=	0
$p_{n-1,1}(4)$	$p_{n-1,2}(4)$	$p_{n-1,3}(4)$	$p_{n1}(4)$	$p_{n2}(4)$	$p_{n3}(4)$	$p_{n4}(4)$				-1			=	0
									1	-1			=	0
													$\leq$	$C^o_{R_1}$
$p_{n-1,1}(6)$	$p_{n-1,2}(6)$	$p_{n-1,3}(6)$	$p_{n1}(6)$	$p_{n2}(6)$	$p_{n3}(6)$	$p_{n4}(6)$					-1		$\leq$	$C^o_{R_1}$
$p_{n-1,1}(7)$	$p_{n-1,2}(7)$	$p_{n-1,3}(7)$											=	0
$p_{n-1,1}(8)$	$p_{n-1,2}(8)$	$p_{n-1,3}(8)$									-1	-1	$\leq$	0
			$p_{n1}(5)$	$p_{n2}(5)$	$p_{n3}(5)$	$p_{n4}(5)$						-1	=	0
													=	L_{R_1}
													=	1
													=	1
													=	1
														.
														.
1	1	1											=	1
			1	1	1	1							=	1

(1) 1 max.

(2) max.

The transformed problem will comprise two new constraints and two new variables

$$W_{ik} \quad WET, \quad WIT, \quad S_1 \quad S_2 \geq 0$$

$$\sum_i \sum_k {}^{(3)}p_{ik}w_{ik} - WET = 0$$

$$\sum_i \sum_k {}^{(4)}p_{ik}w_{ik} - WIT = 0$$

$$WET - WIT - S_1 \leq 0$$

$$WET - WIT + S_2 \geq 0$$

$$S_1 + S_2 \longrightarrow \min.$$

It is easy to prove that the transformed problem is equivalent to the original one.

The table on pages 58-59 shows the tableau for countries 1 to n, and regions 1 to L.

Trade determination

The direction of trade

Consider the case of n countries. Let $E = e_{ij}$, a matrix of export shares such that

$$\sum e_{ij} = 1 \quad \text{for all } i$$

Element e_{ij} is that fraction of the total exports of country i which delivered to country j. Then clearly $e_{ii} = 0$ for all i. We call E a trade pattern matrix.

Let $U = \{U_i\}$ = export values for each country

$V = \{V_j\}$ = import values for each country

The problem we set ourselves is to find a trade matrix, that is a matrix of the exports of each country to each of the others, which is consistent with given trade patterns. We call this given trade pattern a normative one, in that it represents a standard to be aimed for. Preservation of it as far as possible can be represented as follows :

$$f\ (E^*,\ E) = \text{minimum}$$

where E is the normative trade pattern, E^* the actual solution pattern and f is some function of the two matrices (e.g. the sum of the squares of the differences between the corresponding elements) which is to be minimised.

If U and V are also given, then it must be true that $(\hat{U}E^*)'i = V$ i.e. that the solution trade pattern E* is consistent with the given exports and imports.

We can transform this to a similar problem. Again, given E, U and V, let $S = \hat{U}E$. S can thus be regarded as a set of normative trade flows. Then it is required to find a solution S* such that

$$f\ (S^*,\ S) = \min$$

and $S^*i = U$

$S^{*\prime}i = V$

This is not the same as the previous problem, but it has the advantage of being a familiar question, not in international trade, but in input-output analysis. In estimating input-output data, given the new margins and a base year matrix, least squares estimation is one technique used to obtain a solution. It is perhaps less familiar than the RAS technique, but it is more suitable from the point of view of our trade determination procedures. For once we see the base matrix as a goal or standard, rather than only as a starting point for our calculations, then the minimisation procedure has a definite significance.

The minimand may at this point be defined more precisely

$$\sum_i \sum_j \left(\frac{S^*_{ij} - S_{ij}}{S_{ij}} \right)^2 = \text{minimum}$$

that is, the sum of squares of the relative deviations is to be a minimum subject to the constraints of the row and column totals.

A development of this standard formulation has been introduced by Lamel, Richter, Teufelsbauer and Zelle.[1/]

To a standard Lagrangian statement of the constrained minimisation they add constraints on subsets of the elements of the solution matrix; that is to say, when it is desired to maintain specific preconceived values for the totals of blocks of the matrix (of any shape and size) they can be incorporated as follows :

$$\sum_{(ij) \in U_k} S^*_{ij} = f_k \qquad k = 1, \ldots\ldots, m$$

where there are m linearly independent subset constraints. The different sets U_k overlap each other

The authors further express the solution in a partitioned matrix form which simplifies the computations in an interactive system where it is desired to repetitively modify the constraints of the last type.

1/ Lamel, J., Richter, J., Teufelsbauer, W., Zelle, K. "Comparative Analysis of Mathematical Methods for Updating Input-Output Tables" Paper presented to the Sixth International Conference on Input-Output Techniques, Vienna, 22-26 April 1974 .

The general Lagrangian is as follows:

$$\mathcal{L} = \tfrac{1}{2} \sum_{i}^{n} \sum_{j}^{n} \left(\frac{S^{*}_{ij} - S_{ij}}{S_{ij}} \right)^{2} - \sum_{i}^{n} p_i \left(\sum_{j} S^{*}_{ij} - U_i \right)$$

$$- \sum_{j}^{n-1} q_i \left(\sum_{i} S^{*}_{ij} - V_j \right) - \sum_{k}^{m} r_k \left(\sum_{i,j \in U_k} x^{*}_{ij} - f_k \right)$$

p, q, and r are the standard Lagrange multipliers. Our notation differs from that of Lamel et al. but the formulation is identical except in one respect: the original sum to be minimised is, as can be seen, of the sum of squares of the relative deviations: the term chosen by Lamel et al. is perhaps appropriate for specific input-output estimation, but does not seem necessary for our purposes.

Minimisation of the Lagrangian yields a set of simultaneous linear equations. This can be expressed in a partitioned matrix form which allows one to respecify the final (U_k type) constraints without having to solve the whole set of simultaneous equations once more. The authors envision its use in order to eliminate negative elements in the solution process. If these appear, it would be necessary simply to add the extra constraints that these be zero in the solution, and then to recompute. However, it should be pointed out that there is no guarantee that such an action would not then cause negative elements to appear elsewhere in the new solution.

Nevertheless, we have employed this facility because, for our purposes, it provides a way for the user to insert his own ideas on specific trading relationships within the broad framework of the normative trade pattern.

The operational data sources are thus as follows:

U and V : the exports and imports would normally come as output from the international consistency model. In the case where use of the model system begins only at the point of trade determination, then the user would supply them.

E : the normative trade pattern is supplied by the model system, and the user invited to modify or replace it.

U_k : the values of specific blocks (which can be as small as one element) which are to be adhered to are supplied by the user. In the case of any negative elements appearing in the solution, these are automatically constrained (by the computer program) to be zero and the solution recomputed.

Composition of trade

The result of the previous calculations is a matrix S^* of which the element s^*_{ij} is the total trade from country i to country j.

Consider a set of l commodities, each defined in such a way that the set contains all traded goods. Then we define a set of n x n matrices $C_k = c_{ijk}$ where K = 1,2, ... l, and n is the number of countries. An element C_{ijk} is the fraction of the total trade from country i to country j which is formed by commodity k.

If we assume these coefficients c_{ijk} for all i, j, and k to be given, then the product

$$s^*_{ij} \; c_{ijk}$$

gives the value of commodity k exported by country i to country j. The sum

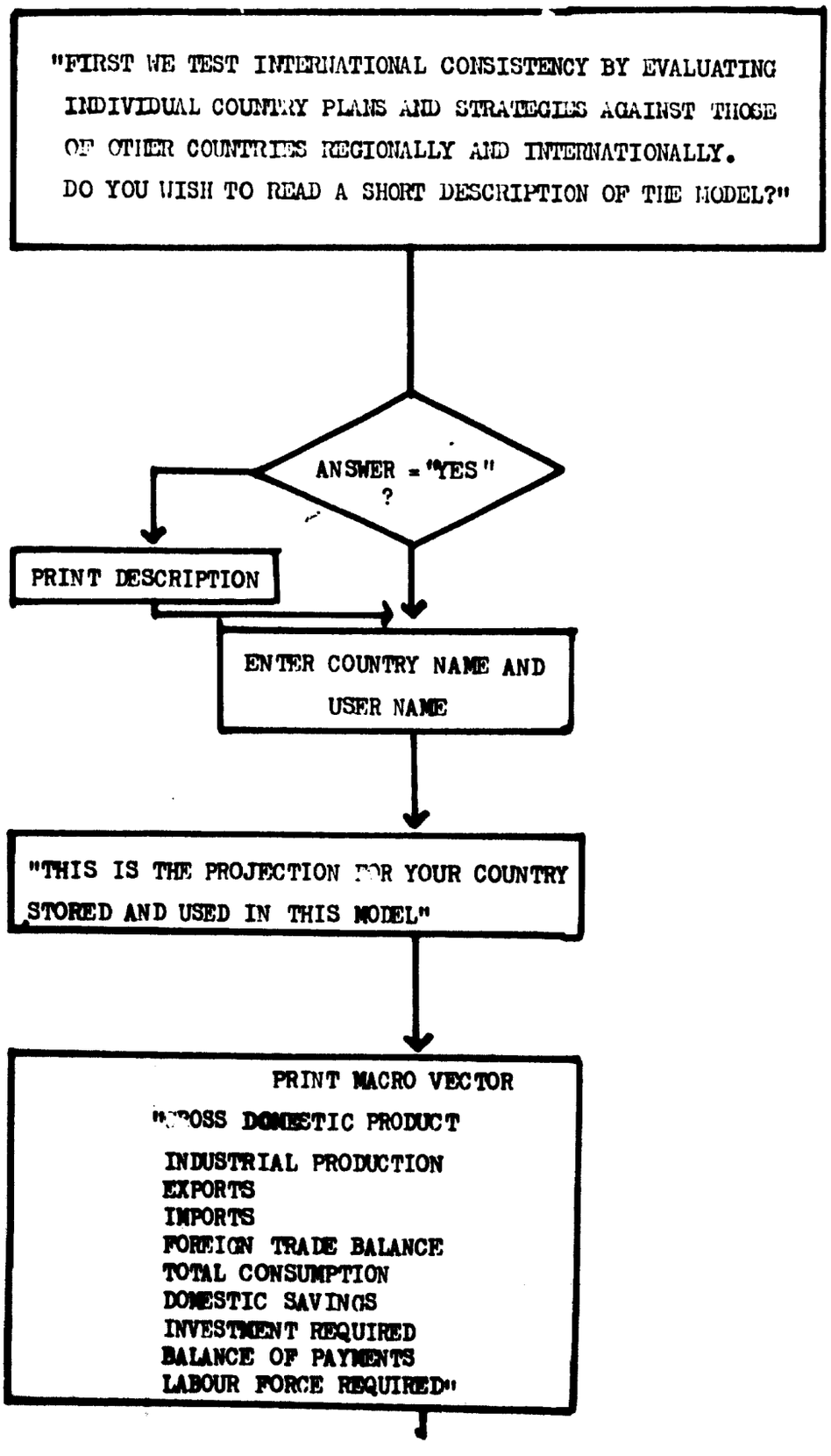
$$\sum_j s^*_{ij} \; c_{ijk}$$

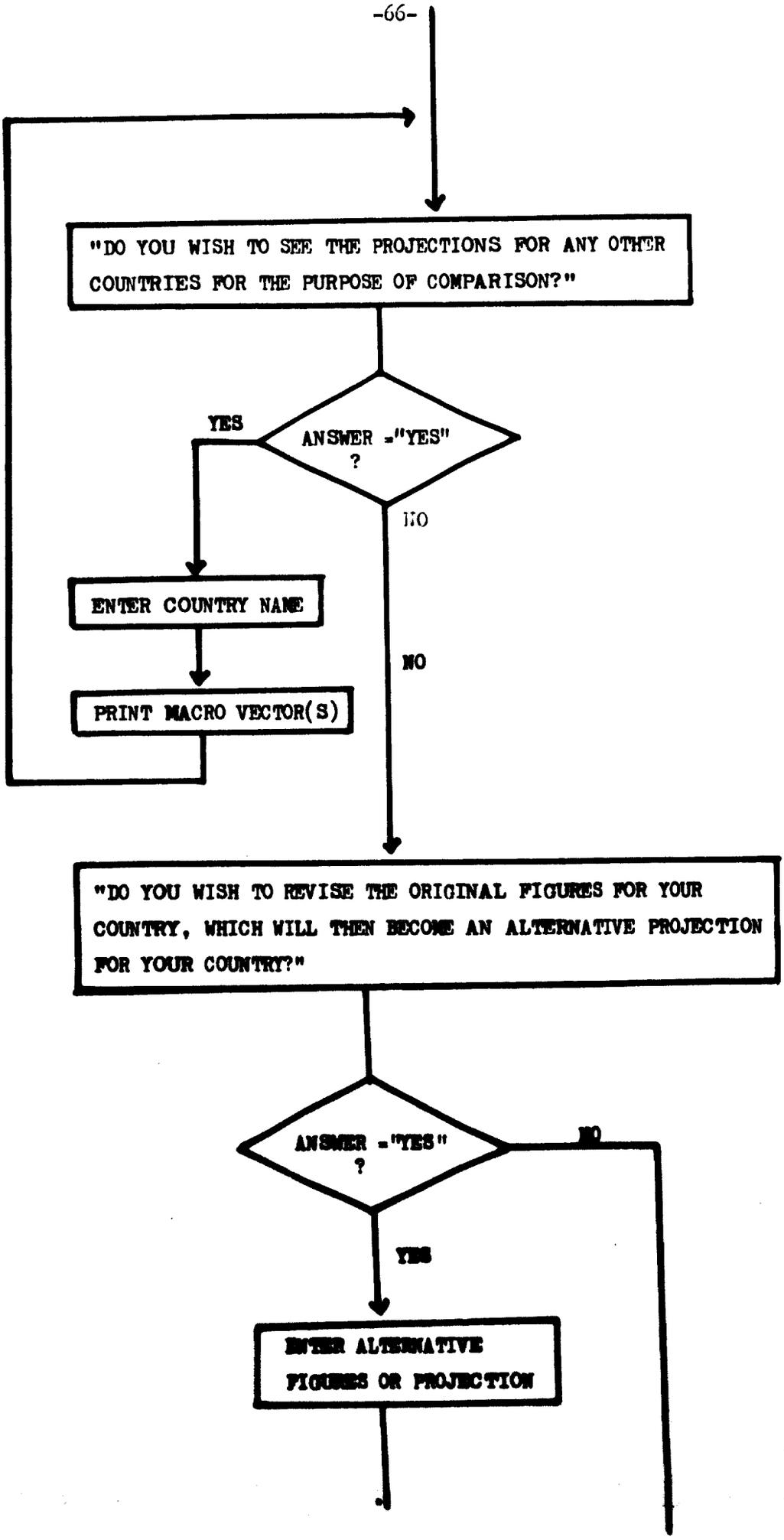
will thus be the total amount of commodity k exported by country i to all other countries.

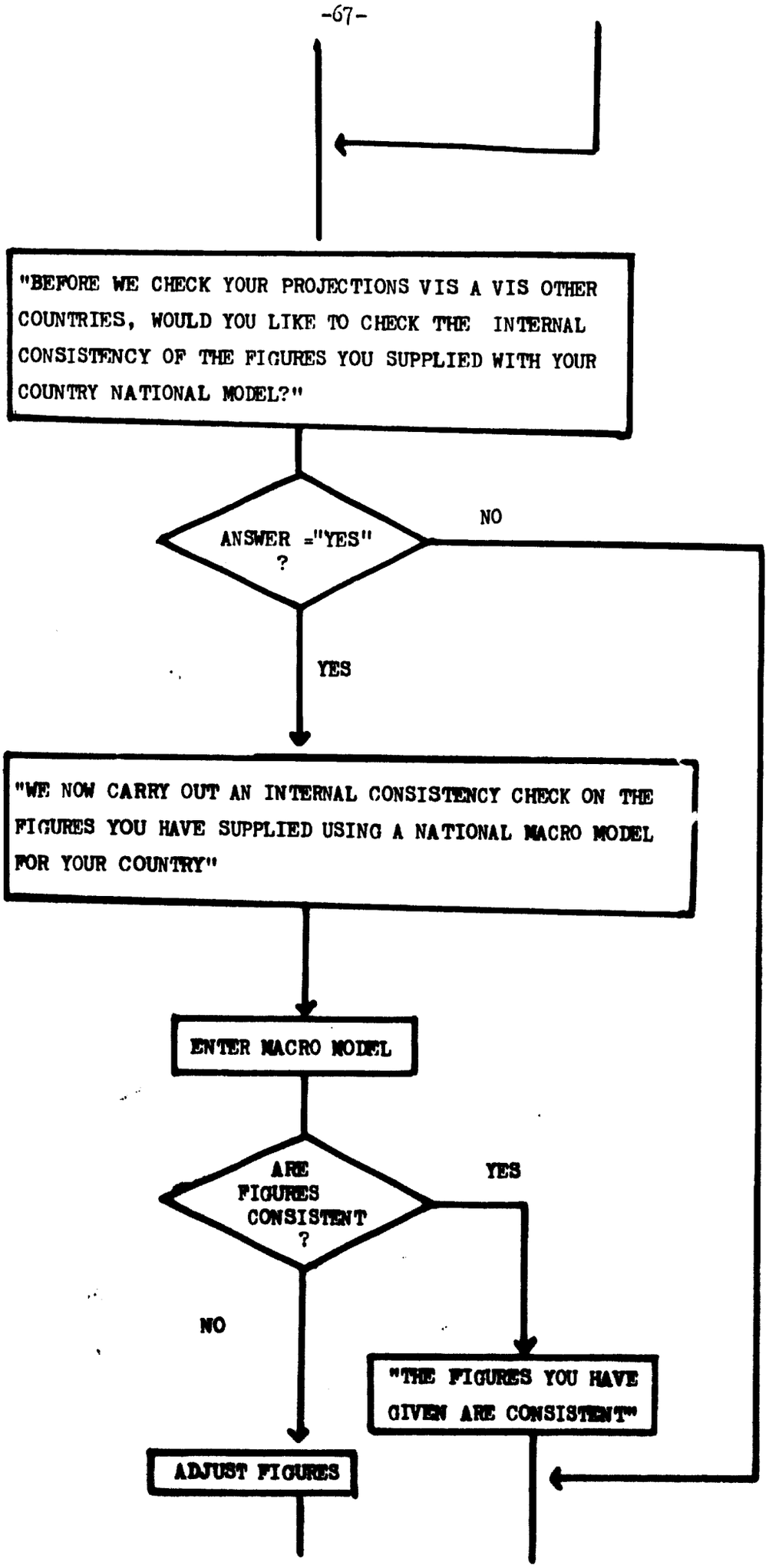
The derivation of the c_{ijk} coefficients must form part of another study in which their stability over time can be examined and any trends with respect to volume identified.

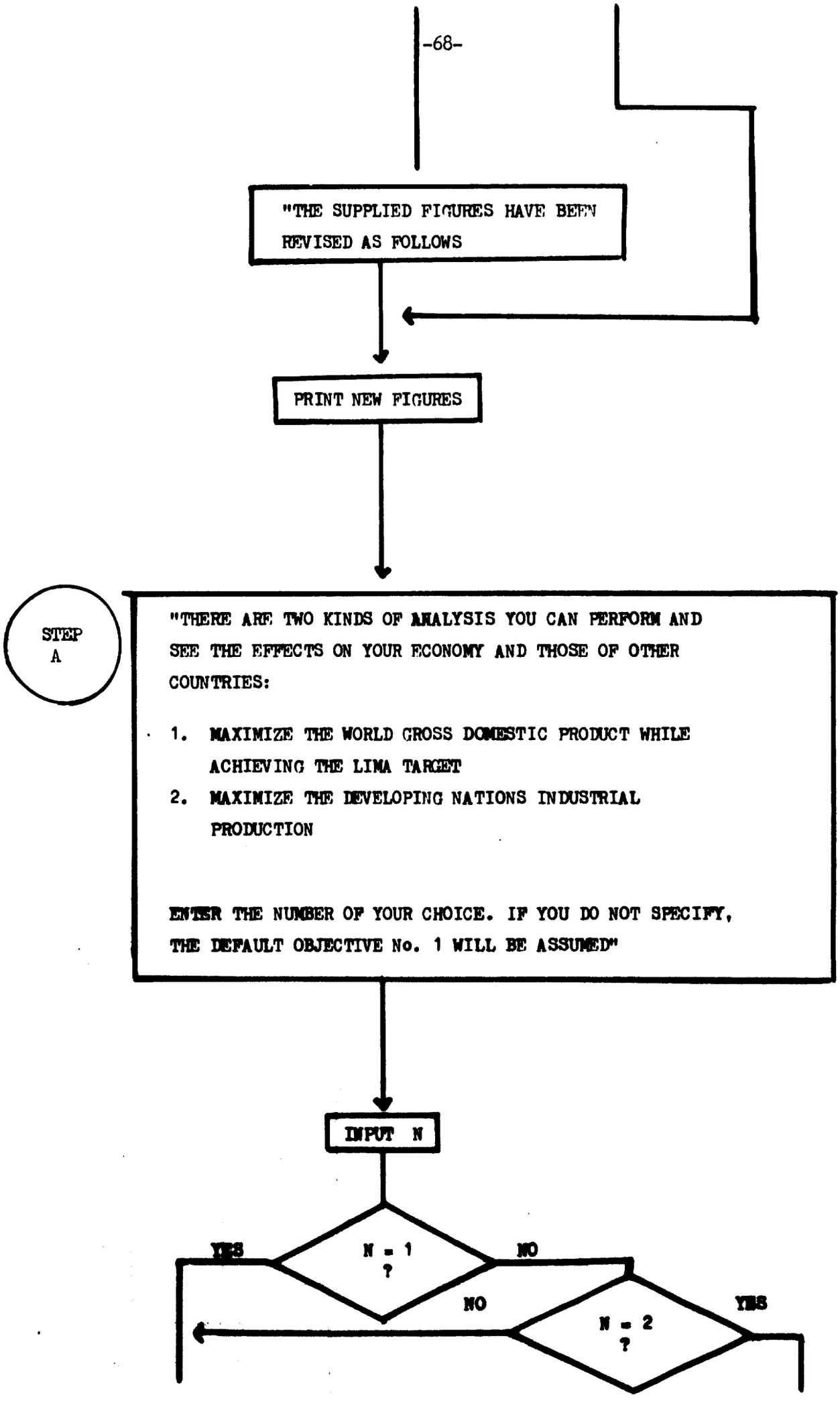
Chapter VII

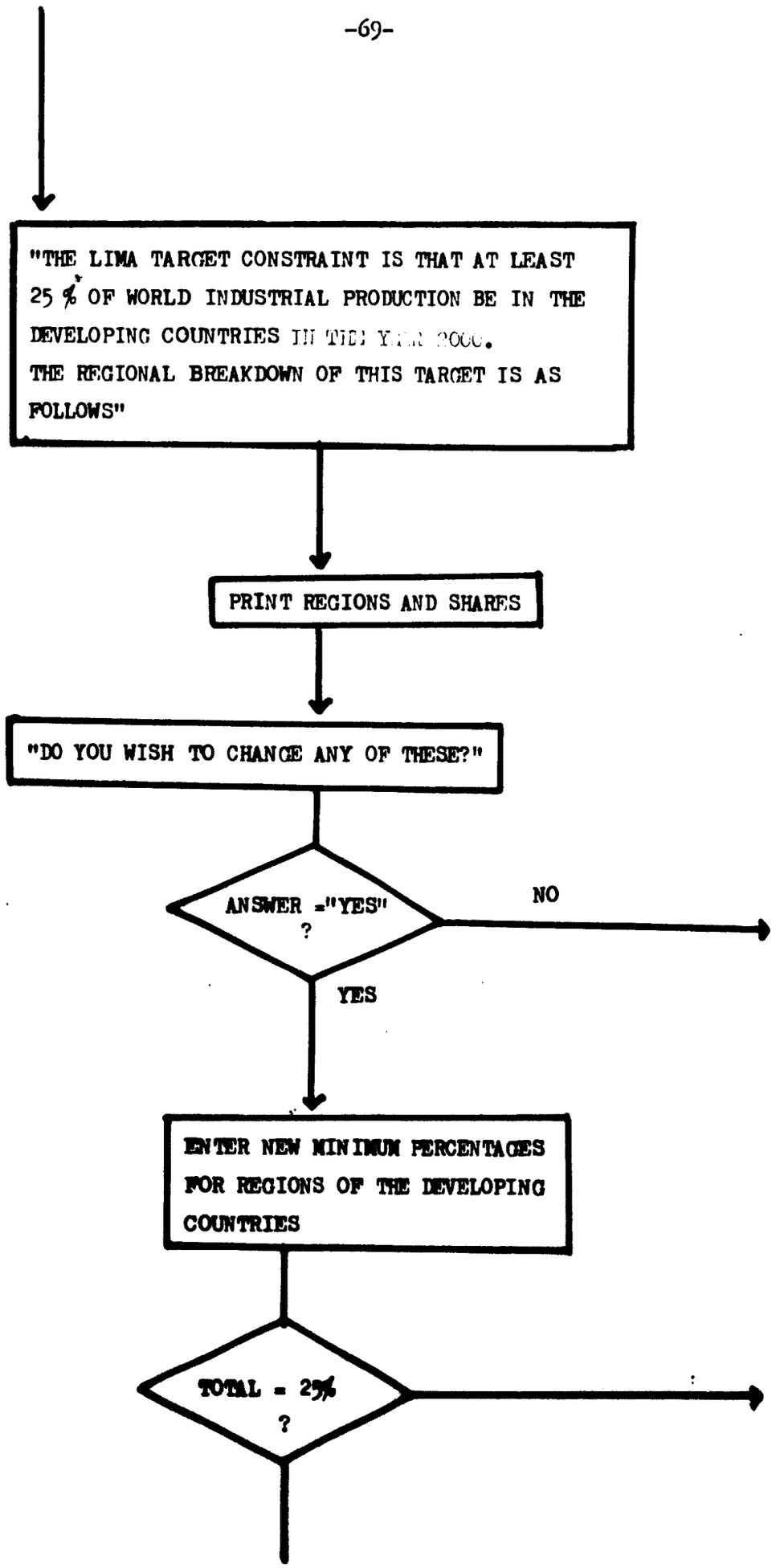
DEMONSTRATION MODEL

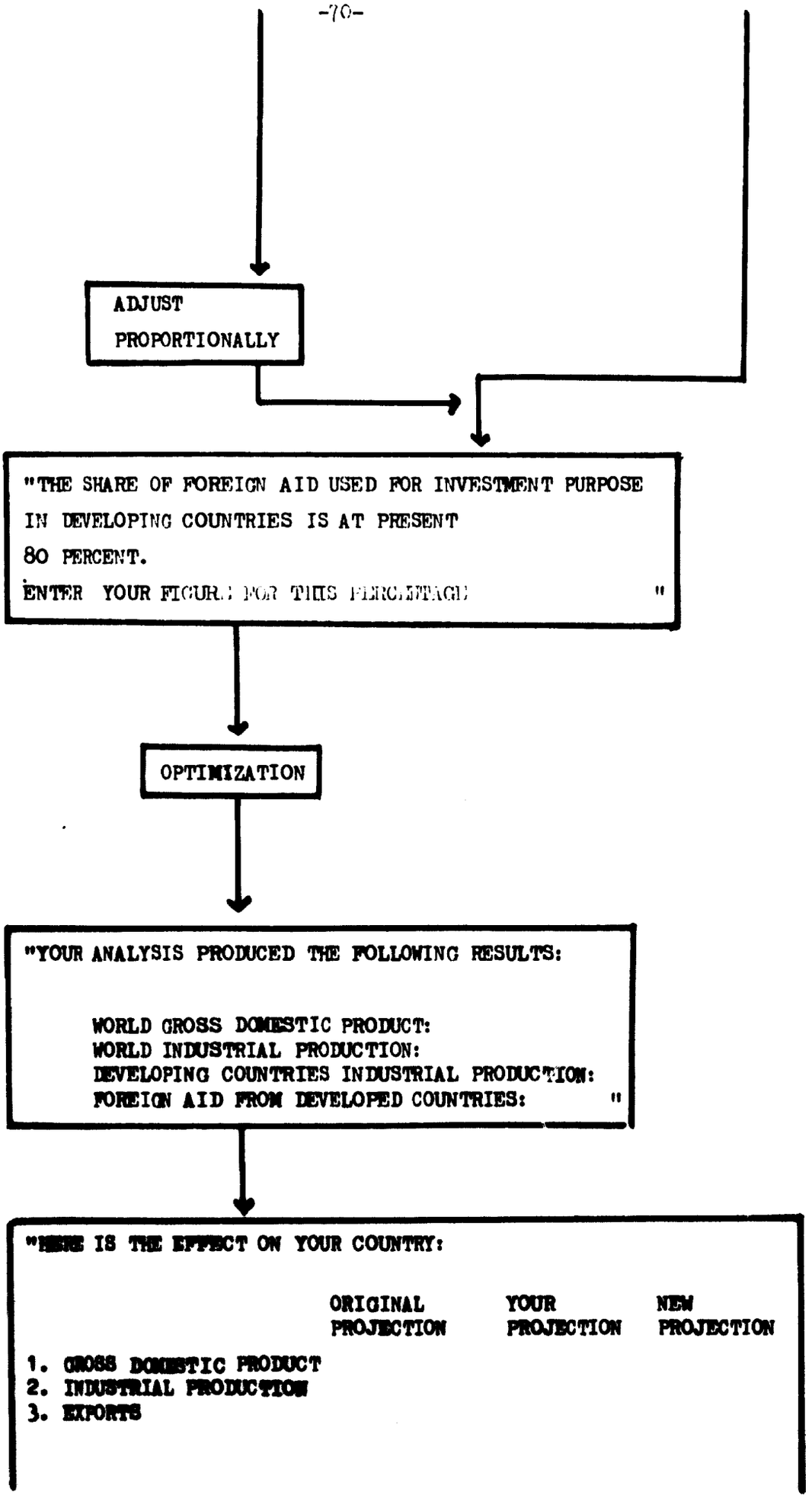


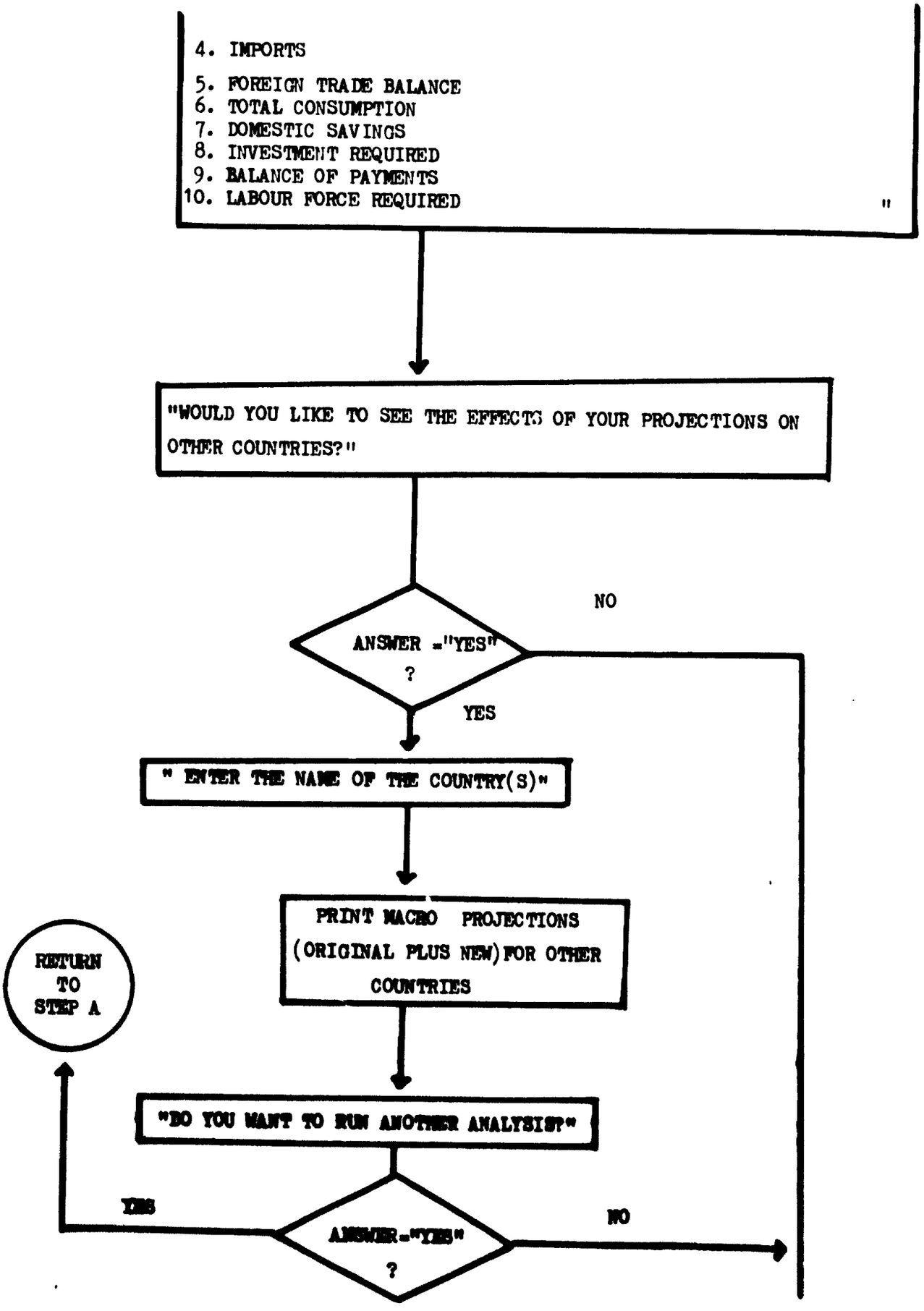

"DO YOU WISH TO SEE THE PROJECTIONS FOR ANY OTHER COUNTRIES FOR THE PURPOSE OF COMPARISON?"
ANSWER ="YES" ?
YES
NO
ENTER COUNTRY NAME
PRINT MACRO VECTOR(S)
NO
"DO YOU WISH TO REVISE THE ORIGINAL FIGURES FOR YOUR COUNTRY, WHICH WILL THEN BECOME AN ALTERNATIVE PROJECTION FOR YOUR COUNTRY?"
ANSWER ="YES" ?
NO
YES
ENTER ALTERNATIVE FIGURES OR PROJECTION

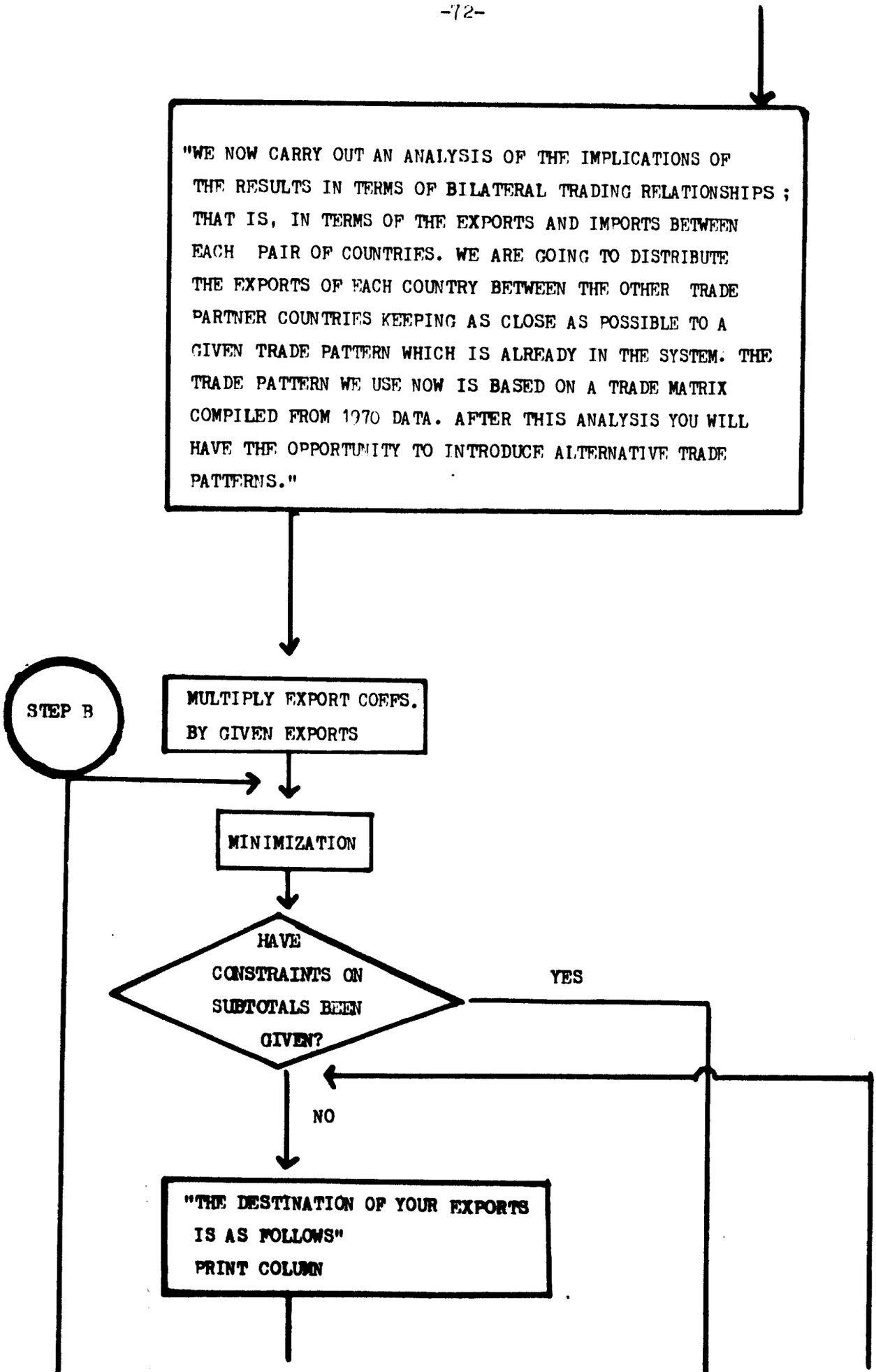

"BEFORE WE CHECK YOUR PROJECTIONS VIS A VIS OTHER COUNTRIES, WOULD YOU LIKE TO CHECK THE INTERNAL CONSISTENCY OF THE FIGURES YOU SUPPLIED WITH YOUR COUNTRY NATIONAL MODEL?"
ANSWER ="YES" ?
NO
YES
"WE NOW CARRY OUT AN INTERNAL CONSISTENCY CHECK ON THE FIGURES YOU HAVE SUPPLIED USING A NATIONAL MACRO MODEL FOR YOUR COUNTRY"
ENTER MACRO MODEL
ARE FIGURES CONSISTENT ?
YES
NO
"THE FIGURES YOU HAVE GIVEN ARE CONSISTENT"
ADJUST FIGURES

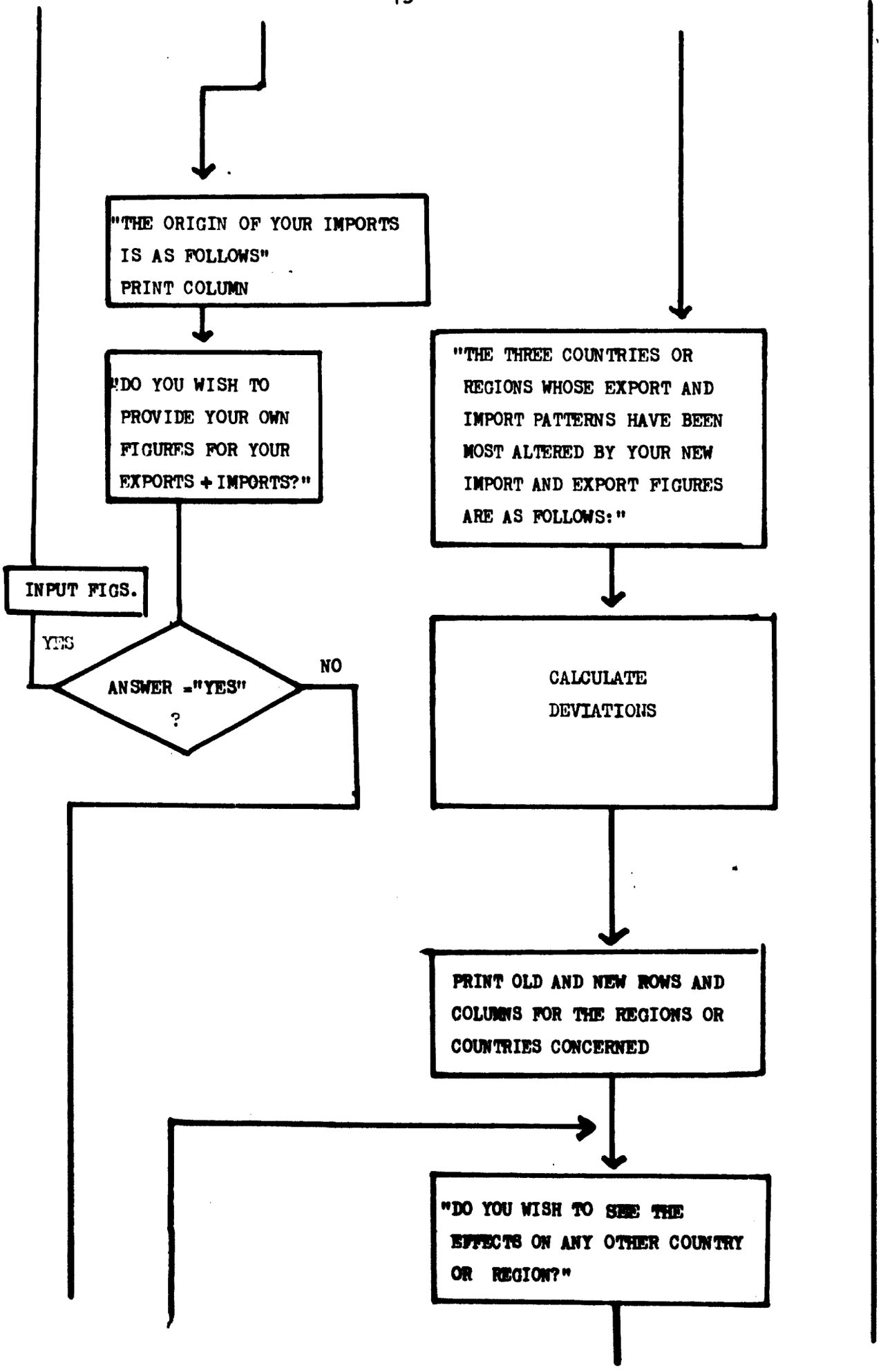

"THE SUPPLIED FIGURES HAVE BEEN REVISED AS FOLLOWS
PRINT NEW FIGURES
STEP A
"THERE ARE TWO KINDS OF ANALYSIS YOU CAN PERFORM AND SEE THE EFFECTS ON YOUR ECONOMY AND THOSE OF OTHER COUNTRIES:
1. MAXIMIZE THE WORLD GROSS DOMESTIC PRODUCT WHILE ACHIEVING THE LIMA TARGET
2. MAXIMIZE THE DEVELOPING NATIONS INDUSTRIAL PRODUCTION
ENTER THE NUMBER OF YOUR CHOICE. IF YOU DO NOT SPECIFY, THE DEFAULT OBJECTIVE No. 1 WILL BE ASSUMED"
INPUT N
N = 1 ?
YES
NO
N = 2 ?
NO
YES

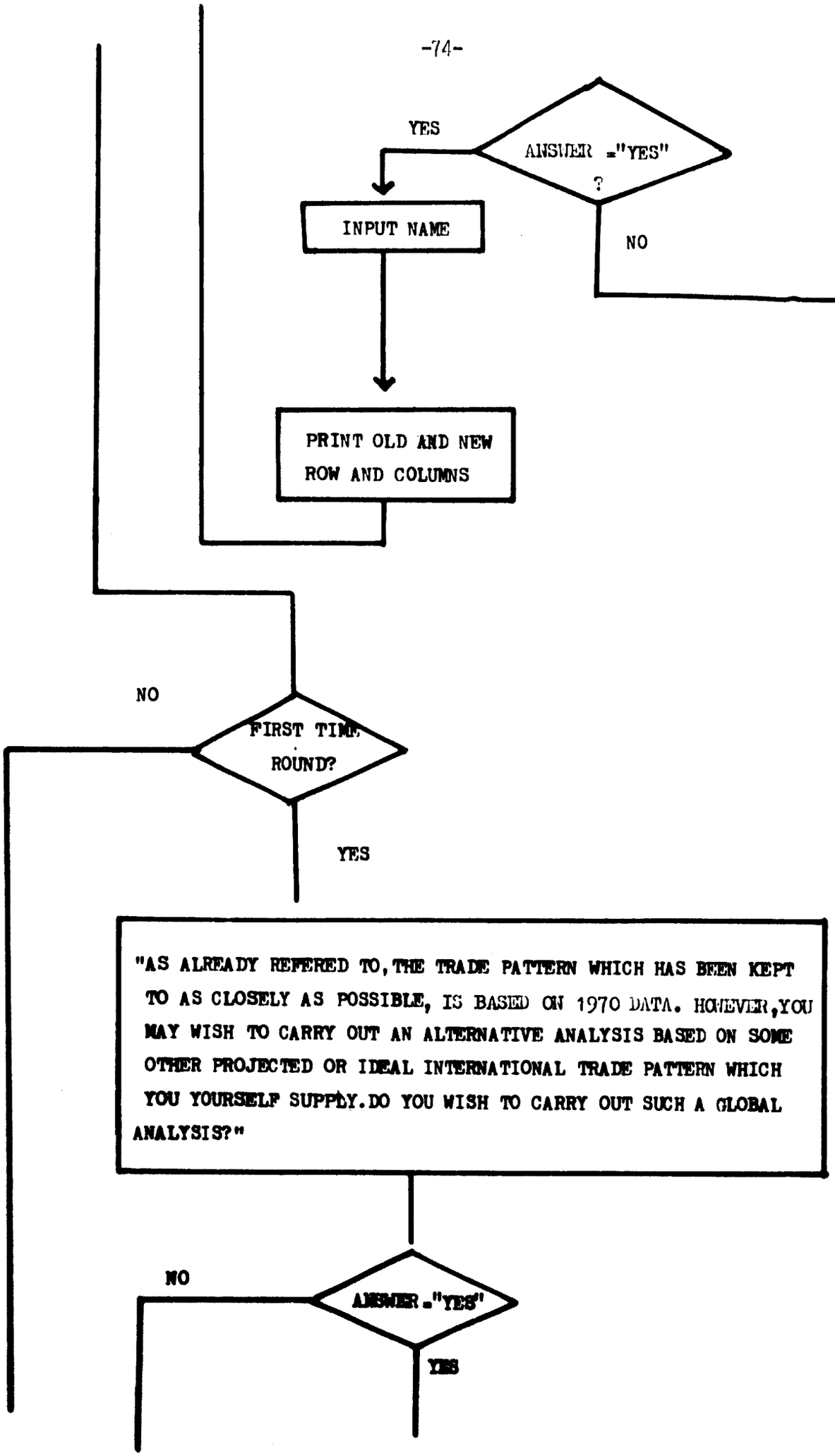

"THE LIMA TARGET CONSTRAINT IS THAT AT LEAST 25 % OF WORLD INDUSTRIAL PRODUCTION BE IN THE DEVELOPING COUNTRIES IN THE YEAR 2000. THE REGIONAL BREAKDOWN OF THIS TARGET IS AS FOLLOWS"
PRINT REGIONS AND SHARES
"DO YOU WISH TO CHANGE ANY OF THESE?"
ANSWER ="YES" ?
NO
YES
ENTER NEW MINIMUM PERCENTAGES FOR REGIONS OF THE DEVELOPING COUNTRIES
TOTAL = 25% ?

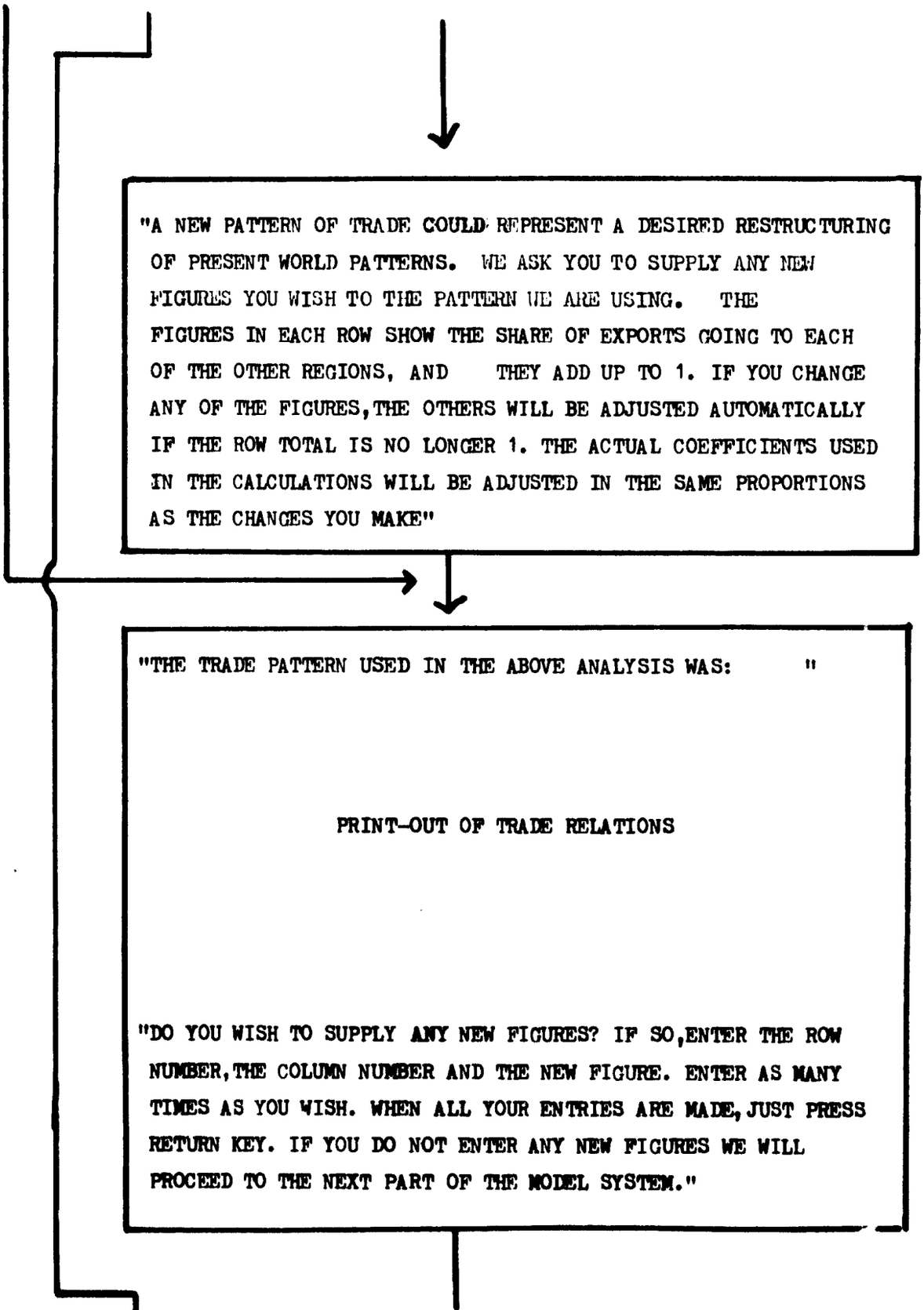

ADJUST
PROPORTIONALLY
"THE SHARE OF FOREIGN AID USED FOR INVESTMENT PURPOSE
IN DEVELOPING COUNTRIES IS AT PRESENT
80 PERCENT.
ENTER YOUR FIGURE FOR THIS PERCENTAGE "
OPTIMIZATION
"YOUR ANALYSIS PRODUCED THE FOLLOWING RESULTS:
WORLD GROSS DOMESTIC PRODUCT:
WORLD INDUSTRIAL PRODUCTION:
DEVELOPING COUNTRIES INDUSTRIAL PRODUCTION:
FOREIGN AID FROM DEVELOPED COUNTRIES: "
"HERE IS THE EFFECT ON YOUR COUNTRY:
ORIGINAL PROJECTION
YOUR PROJECTION
NEW PROJECTION
1. GROSS DOMESTIC PRODUCT
2. INDUSTRIAL PRODUCTION
3. EXPORTS

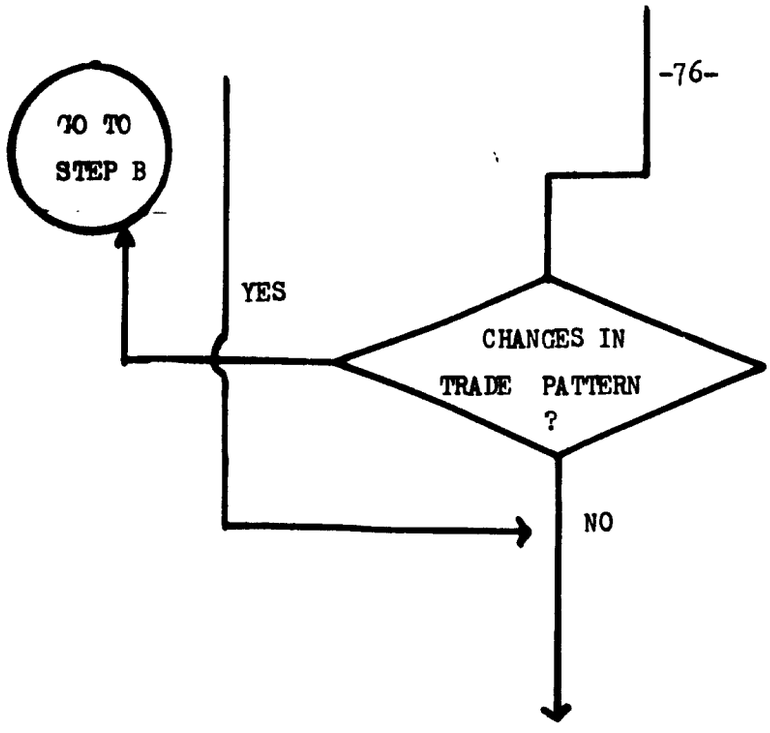

4. IMPORTS
5. FOREIGN TRADE BALANCE
6. TOTAL CONSUMPTION
7. DOMESTIC SAVINGS
8. INVESTMENT REQUIRED
9. BALANCE OF PAYMENTS
10. LABOUR FORCE REQUIRED "
"WOULD YOU LIKE TO SEE THE EFFECTS OF YOUR PROJECTIONS ON OTHER COUNTRIES?"
ANSWER = "YES" ?
NO
YES
" ENTER THE NAME OF THE COUNTRY(S)"
PRINT MACRO PROJECTIONS (ORIGINAL PLUS NEW) FOR OTHER COUNTRIES
"DO YOU WANT TO RUN ANOTHER ANALYSIS?"
ANSWER = "YES" ?
YES
NO
RETURN TO STEP A


"WE NOW CARRY OUT AN ANALYSIS OF THE IMPLICATIONS OF THE RESULTS IN TERMS OF BILATERAL TRADING RELATIONSHIPS ; THAT IS, IN TERMS OF THE EXPORTS AND IMPORTS BETWEEN EACH PAIR OF COUNTRIES. WE ARE GOING TO DISTRIBUTE THE EXPORTS OF EACH COUNTRY BETWEEN THE OTHER TRADE PARTNER COUNTRIES KEEPING AS CLOSE AS POSSIBLE TO A GIVEN TRADE PATTERN WHICH IS ALREADY IN THE SYSTEM. THE TRADE PATTERN WE USE NOW IS BASED ON A TRADE MATRIX COMPILED FROM 1970 DATA. AFTER THIS ANALYSIS YOU WILL HAVE THE OPPORTUNITY TO INTRODUCE ALTERNATIVE TRADE PATTERNS."
STEP B
MULTIPLY EXPORT COEFS. BY GIVEN EXPORTS
MINIMIZATION
HAVE CONSTRAINTS ON SUBTOTALS BEEN GIVEN?
YES
NO
"THE DESTINATION OF YOUR EXPORTS IS AS FOLLOWS"
PRINT COLUMN


"THE ORIGIN OF YOUR IMPORTS IS AS FOLLOWS"
PRINT COLUMN
"DO YOU WISH TO PROVIDE YOUR OWN FIGURES FOR YOUR EXPORTS + IMPORTS?"
INPUT FIGS.
YES
ANSWER ="YES" ?
NO
"THE THREE COUNTRIES OR REGIONS WHOSE EXPORT AND IMPORT PATTERNS HAVE BEEN MOST ALTERED BY YOUR NEW IMPORT AND EXPORT FIGURES ARE AS FOLLOWS:"
CALCULATE DEVIATIONS
PRINT OLD AND NEW ROWS AND COLUMNS FOR THE REGIONS OR COUNTRIES CONCERNED
"DO YOU WISH TO SEE THE EFFECTS ON ANY OTHER COUNTRY OR REGION?"


YES
ANSWER ="YES"
?
NO
INPUT NAME
PRINT OLD AND NEW
ROW AND COLUMNS
NO
FIRST TIME
ROUND?
YES
"AS ALREADY REFERED TO, THE TRADE PATTERN WHICH HAS BEEN KEPT TO AS CLOSELY AS POSSIBLE, IS BASED ON 1970 DATA. HOWEVER, YOU MAY WISH TO CARRY OUT AN ALTERNATIVE ANALYSIS BASED ON SOME OTHER PROJECTED OR IDEAL INTERNATIONAL TRADE PATTERN WHICH YOU YOURSELF SUPPLY. DO YOU WISH TO CARRY OUT SUCH A GLOBAL ANALYSIS?"
NO
ANSWER ."YES"
YES


"A NEW PATTERN OF TRADE COULD REPRESENT A DESIRED RESTRUCTURING OF PRESENT WORLD PATTERNS. WE ASK YOU TO SUPPLY ANY NEW FIGURES YOU WISH TO THE PATTERN WE ARE USING. THE FIGURES IN EACH ROW SHOW THE SHARE OF EXPORTS GOING TO EACH OF THE OTHER REGIONS, AND THEY ADD UP TO 1. IF YOU CHANGE ANY OF THE FIGURES, THE OTHERS WILL BE ADJUSTED AUTOMATICALLY IF THE ROW TOTAL IS NO LONGER 1. THE ACTUAL COEFFICIENTS USED IN THE CALCULATIONS WILL BE ADJUSTED IN THE SAME PROPORTIONS AS THE CHANGES YOU MAKE"
"THE TRADE PATTERN USED IN THE ABOVE ANALYSIS WAS: "
PRINT-OUT OF TRADE RELATIONS
"DO YOU WISH TO SUPPLY ANY NEW FIGURES? IF SO, ENTER THE ROW NUMBER, THE COLUMN NUMBER AND THE NEW FIGURE. ENTER AS MANY TIMES AS YOU WISH. WHEN ALL YOUR ENTRIES ARE MADE, JUST PRESS RETURN KEY. IF YOU DO NOT ENTER ANY NEW FIGURES WE WILL PROCEED TO THE NEXT PART OF THE MODEL SYSTEM."



USING LATEST TRADE MATRIX, CALCULATE WITH COEFFICIENTS, THE SECTORAL AND COMMODITY BREAKDOWN OF EXPORTS

"COMPOSITION OF TRADE -- USING COMPOSITION COEFFICIENTS WHICH ARE SPECIFIC TO EACH BILATERAL TRADE RELATIONSHIP, WE CAN NOW ANALYSE WHAT COMMODITIES MAKE UP EACH OF THE EXPORT AND IMPORT FIGURES RELATING TO YOUR COUNTRY. THIS MAKES IT POSSIBLE TO GIVE A BREAKDOWN OF THE TOTAL EXPORTS OF YOUR COUNTRY IN TERMS OF THE STANDARD INDUSTRIAL TRADE CLASSIFICATION CODES. YOUR EXPORTS BY COMMODITY SECTION ARE AS FOLLOWS:

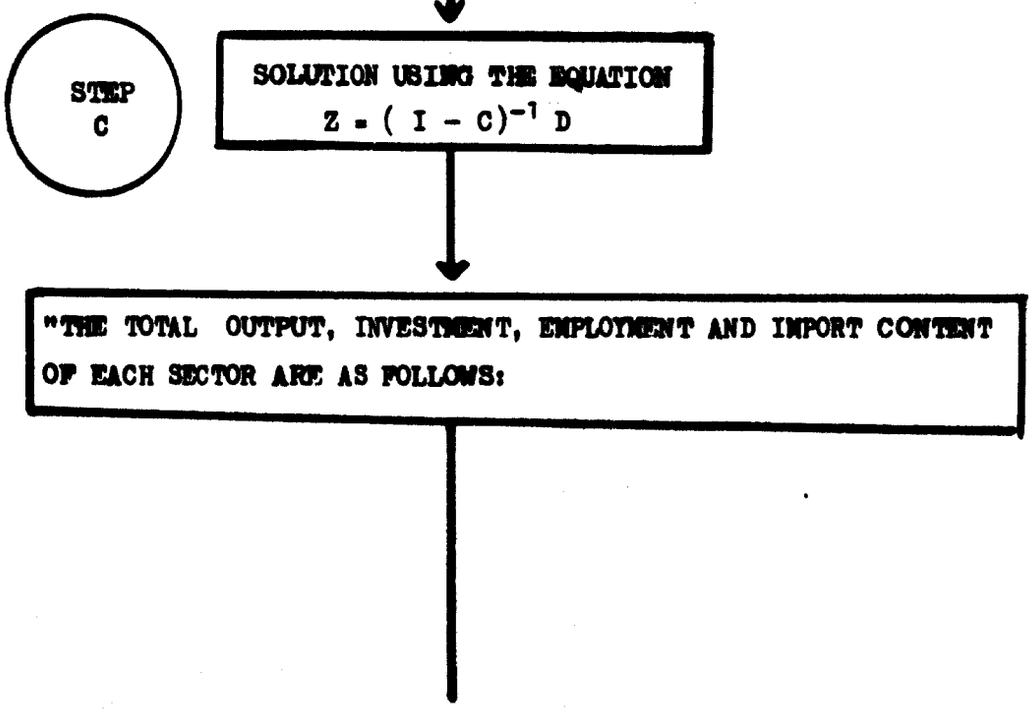
SITC CODE		VALUE($)
0	FOOD AND LIVE ANIMALS	
1	BEVERAGES AND TOBACCO	
2	CRUDE MATERIALS INEDIBLE EXC. FUEL	
3	MINERAL FUELS, LUBRICANTS	
4	ANIMAL/VEG./OIL/FATS	
5	CHEMICALS	
6	MANUFACTURED GOODS	
7	MACHINERY AND TRANSPORT EQUIPMENT	
8	MISCELLANEOUS MANUFACTURED OUTPUTS	
9	COMMODITIES NOT ELSEWHERE CLASSIFIED	

"AS A RESULT OF THE PREVIOUS ANALYSIS, WE HAVE THE SECTORAL BREAKDOWN OF YOUR EXPORTS. WE WILL NOW CARRY OUT AN ANALYSIS OF THE IMPLICATIONS FOR YOUR COUNTRY AT A SECTORAL LEVEL. WE DO THIS USING A CLOSED INPUT-OUTPUT MODEL OF YOUR COUNTRY, WHICH TAKES ACCOUNT OF THE INTER-CONNECTIONS BETWEEN THE DIFFERENT ECONOMIC SECTORS.

THE MODEL ALLOWS FOR CHANGES IN POLICIES TO BE TAKEN INTO ACCOUNT. AT THE MOMENT, THE POLICY VARIABLES ARE OF FOUR KINDS:

1. INCOME TAX
2. PROFIT TAX
3. SAVINGS RATE
4. IMPORT SUBSTITUTION

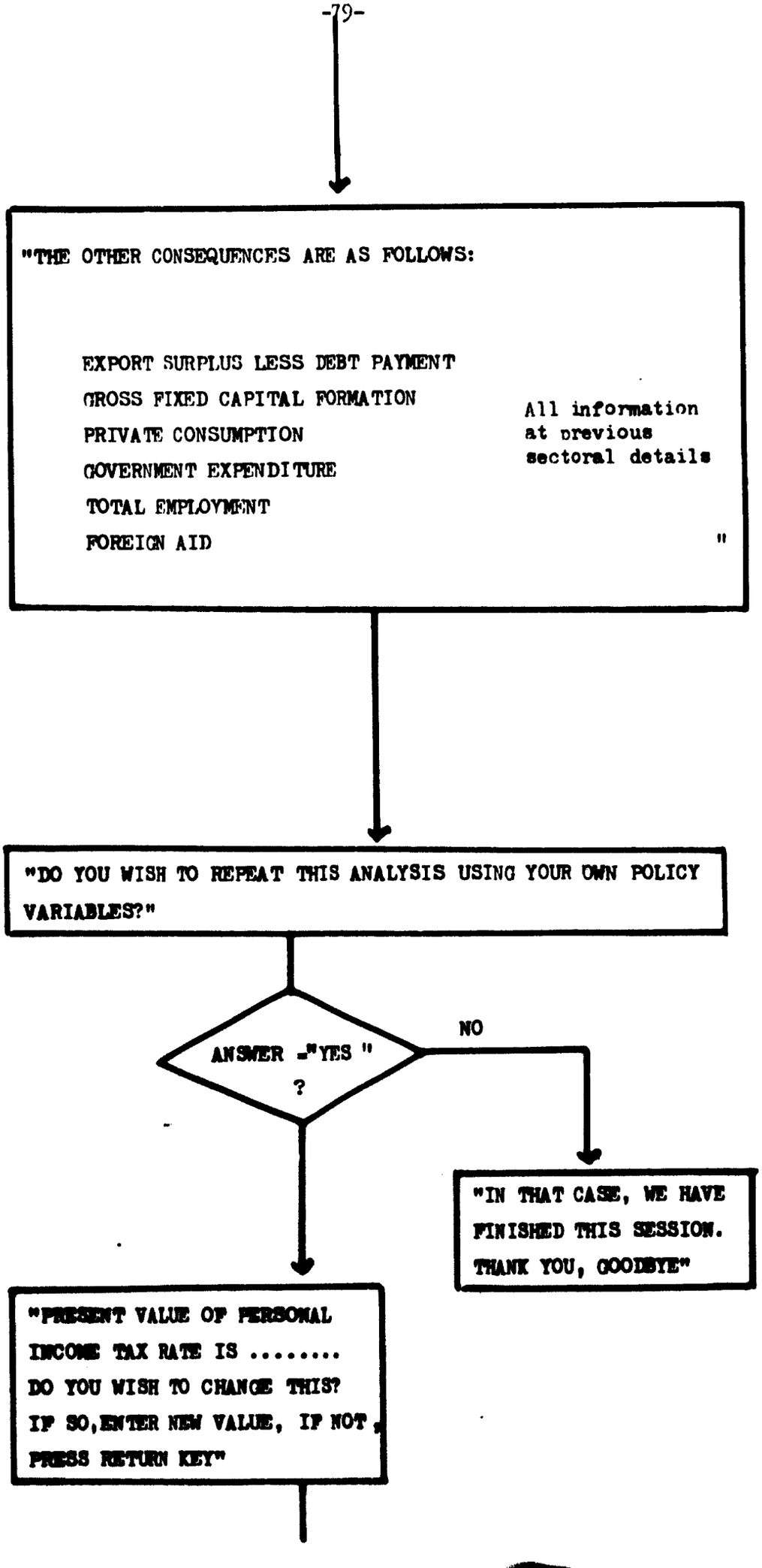
FIRST WE WILL RUN THE MODEL WITH CURRENT VALUES FOR THESE VARIABLES."

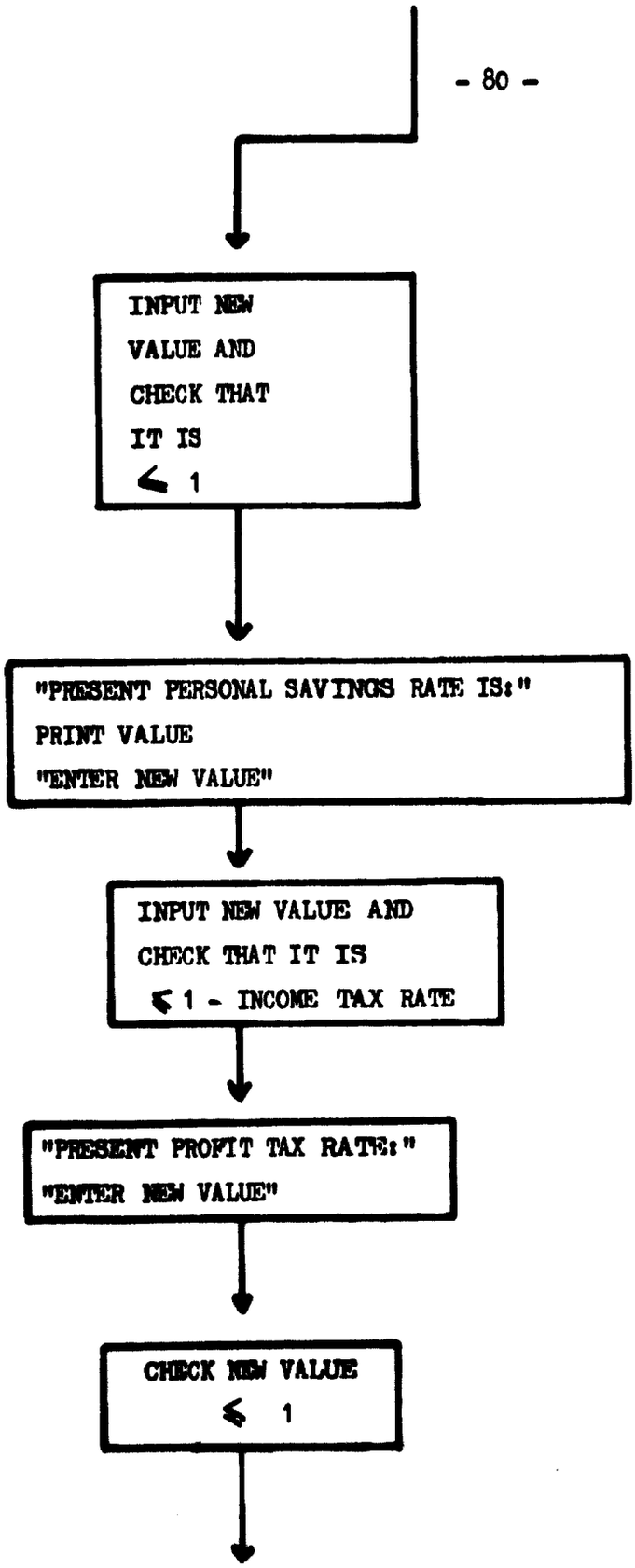


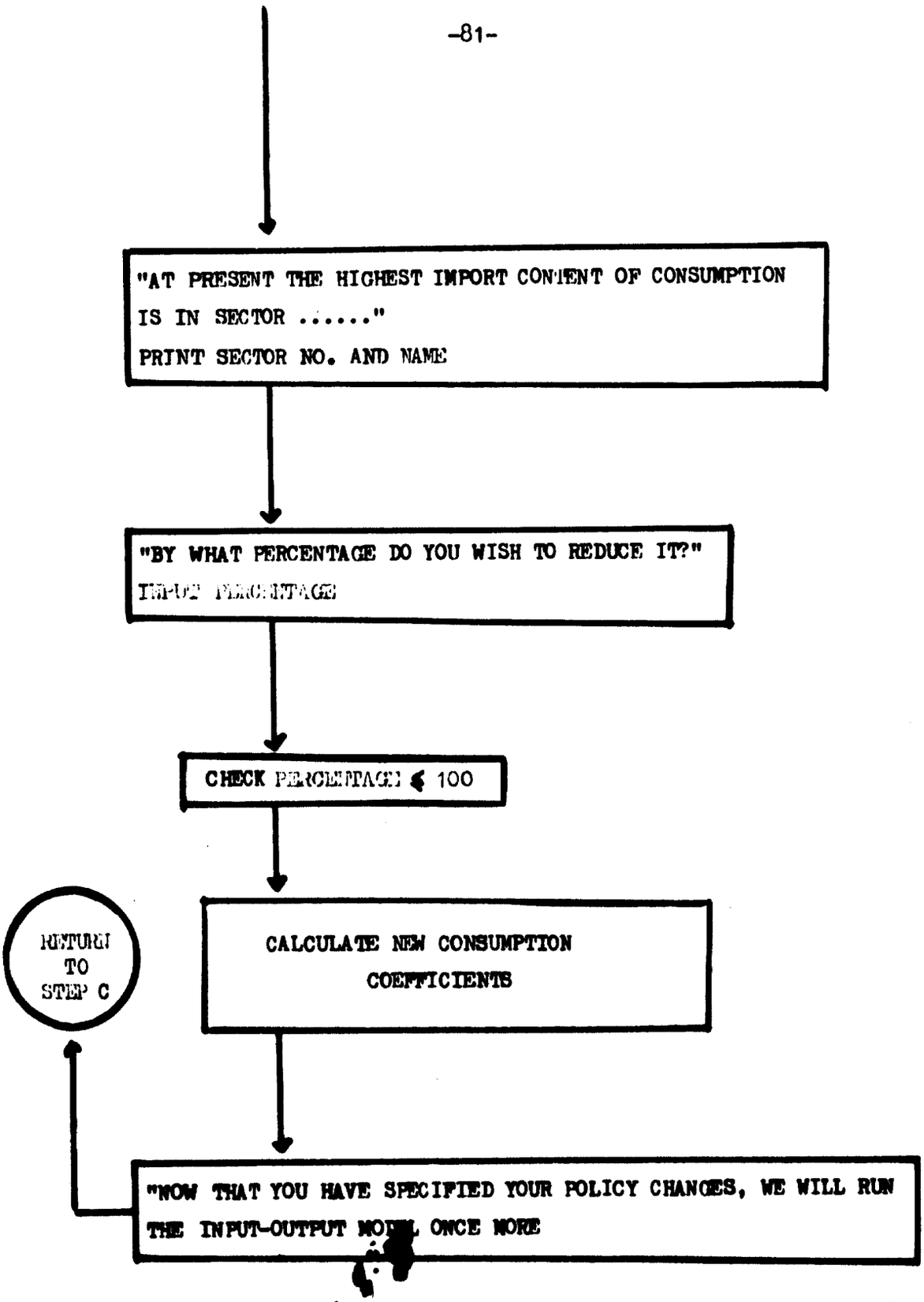
"

	OUTPUT($)	INVEST($) -UNIT	EMPLOY -MENT	IMPORT CONTENT
AGRICULTURE FISHING FORESTRY				
MINING QUARRYING				
BAKERY CHOCOLATE SWEETS				
BEVERAGES TOBACCO				
TEXTILE RAW MATERIAL ROPE TWINE				
FINISHED TEXTILES				
GARMENTS KNITWEAR MADE-UP TEXTILES				
FOOTWEAR LEATHER FUR PRODUCTS				
SAWMILL PRODUCTS				
WOOD PRODUCTS PRINTING PUBLISHING				
RUBBER PRODUCTS				
PAINT DETERGENT SOAP				
PETROLEUM PRODUCTS OTHER CHEMICALS				
MISC.NON-METALIC MINERAL PRODUCTS				
METAL PRODUCTS MACHINERY				
BUILDING AND REPAIR OF TRANSPORT EQUIP.				
ELECTRICITY AND WATER SUPPLY				
BUILDING AND CONSTRUCTION				
TRADE AND DISTRIBUTION				
TRANSPORT AND COMMUNICATION				
RESTAURANT AND HOTEL SERVICES				
OWNERSHIP OF DWELLINGS				
FINANCIAL SERVICES				
MISC. SERVICES (EXC.GOVERNMENT SERV.)				
GOVERNMENT SERVICES				
OWNERSHIP OF BUSINESS PREMISES				
UNSPECIFIED				

"


"THE OTHER CONSEQUENCES ARE AS FOLLOWS:
EXPORT SURPLUS LESS DEBT PAYMENT
GROSS FIXED CAPITAL FORMATION
PRIVATE CONSUMPTION
GOVERNMENT EXPENDITURE
TOTAL EMPLOYMENT
FOREIGN AID
All information at previous sectoral details
"
"DO YOU WISH TO REPEAT THIS ANALYSIS USING YOUR OWN POLICY VARIABLES?"
ANSWER ="YES" ?
NO
"IN THAT CASE, WE HAVE FINISHED THIS SESSION. THANK YOU, GOODBYE"
"PRESENT VALUE OF PERSONAL INCOME TAX RATE IS .....
DO YOU WISH TO CHANGE THIS?
IF SO, ENTER NEW VALUE, IF NOT, PRESS RETURN KEY"


INPUT NEW
VALUE AND
CHECK THAT
IT IS
< 1
"PRESENT PERSONAL SAVINGS RATE IS:"
PRINT VALUE
"ENTER NEW VALUE"
INPUT NEW VALUE AND
CHECK THAT IT IS
≤ 1 - INCOME TAX RATE
"PRESENT PROFIT TAX RATE:"
"ENTER NEW VALUE"
CHECK NEW VALUE
≤ 1


"AT PRESENT THE HIGHEST IMPORT CONTENT OF CONSUMPTION IS IN SECTOR ....."
PRINT SECTOR NO. AND NAME
"BY WHAT PERCENTAGE DO YOU WISH TO REDUCE IT?"
INPUT PERCENTAGE
CHECK PERCENTAGE ≤ 100
CALCULATE NEW CONSUMPTION COEFFICIENTS
"NOW THAT YOU HAVE SPECIFIED YOUR POLICY CHANGES, WE WILL RUN THE INPUT-OUTPUT MODEL ONCE MORE
RETURN TO STEP C

Chapter VIII

QUANTITATIVE ANALYSIS OF THE LIMA TARGET

In March 1975, the Second General Conference of UNIDO adopted the Lima Declaration and Plan of Action on Industrial Development and Co-operation, paragraph 28 of which reads in part, "... in view of the low percentage share of the developing countries in total world industrial production... their share should be increased to ... at least 25 per cent of total world industrial production by the year 2000, while making every endeavour to ensure that the industrial growth so achieved is distributed among the developing countries as evenly as possible."

Although succinct and clear in its meaning at the political level, the above quotation would appear to contain ambiguities with respect to the terms required for meaningful/quantitative analysis. A paper prepared by UNIDO for the Third Conference of African Ministers of Industry, in Nairobi, December 1975[1], and a report by the UNCTAD Secretariat submitted to UNCTAD IV, Nairobi, May 1976[2] have clarified many of these ambiguous terms and concepts. For example, "industry" is now taken to exclude mining, electricity, gas and water and to consist solely of manufacturing activities (roughly corresponding to the group of activities covered by major division 3 of the ISIC). The term "industrial production" is defined as net output (value added, or the manufacturing sector's contribution to GDP). As no statistics are available for the socialist countries of Asia, the definition of "developed countries" includes "developed market economies" and "centrally planned (Europe) economies", while the definition of "developing countires" includes only "developing market economies" listed in the United Nations Yearbook of National Accounts Statistics.

Notwithstanding these clarifications, the Lima target still means many things to many people, especially in the absence of guidance in interpreting the over-all target in terms of the individual sharing of responsibility, and in terms of the specific activities that will be required year after year to enable planners, in both developed and developing countries, to reach the target. As it stands now, the cheapest solution

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1/ "The implication of raising Africa's share in world industrial production to 2 per cent by the year 2000", UNIDO/ICIS.10.

2/ "The dimensions of the required restructuring of world manufacturing output and trade in order to reach the Lima target", UNCTAD, TD/185/Supp.1.

may well turn out to be the concentration of global efforts on the development of one or a very few countries, and the postponement of such effort until the last possible moment, the year 2000.1/

Such an extreme solution would not, of course, be acceptable, even if it were proven to be economically feasible. The intention here then, is to analyse some of the basic "scenarios" and development "variants" suggested for the achievement of the Lima target in the hope of contributing to a continuous process of refining the concepts involved in the definition of the target, which would have value for individual economic planners. It should be realised, however, that the Lima target is largely a political target, requiring political consensus among countries once the economic analyses have provided the necessary basis for dialogue.

One conceptual problem encountered in interpreting the Lima Declaration is its insistence on framing the aspiration of the developing countries in terms of a global manufacturing production "share" in the year 2000. First of all, if we exclude the possibility of attaining the target through a global redeployment of existing production capacities, and include only improvements resulting from new investments, we should have some running notion as to the probable, absolute level of total global manufacturing production in year 2000. Twenty-five per cent of nothing would still be nothing, and a target which cannot be defined in terms of absolute levels of effort required until the final moment, and only after the performances of other participants are known, would be very difficult to achieve.

This is precisely the reason why the UNIDO and UNCTAD papers set out first to project the absolute level of manufacturing production (GDP value added) for the developed countries in the year 2000 and to work backwards to calculate the yearly effort required for the developing countries to achieve the target. For instance, the UNCTAD paper projects the total value of manufacturing output for the developed countries in the year 2000 to be $4,233 billion (in 1972 constant dollars). The total value of manufacturing output required for the developing countries to meet the Lima target would be one third of this amount, or $1,411 billion. Given the manufacturing output figure of $108 billion for the developing countries in 1972, the required annual average growth rate in manufacturing for these countries would amount to 9.6 per cent.

1/ Such extreme solutions, unavoidable in the absence of further definitions and constraints, are called "bang bang solutions" in the jargon of control theory. This problem will be discussed again later, in dealing with the problems of setting an optimal time path to achieve the Lima target.

One danger of accepting this figure as an annual target is immediately obvious: it depends entirely on the accuracy of the manufacturing output projection for the developed countries in the year 2000. The UNIDO paper therefore uses a different approach. It simply adopts several growth variants for the developed countries, consisting of low to high annual average growth rates in the manufacturing sector, and computes the corresponding annual growth rates in the developing countries to meet the Lima target.[1/] This approach, however, fails to define the annual target unequivocally: There will be as many target figures as there are growth variants.

The UNIDO paper does suggest one possible solution, however. An analysis of the numerical solutions shown discloses that, although the annual average growth rate for the developing countries to achieve the Lima target depends upon and varies with the growth prospectives in the developed countries (growth variants), the differences between the growth rates for the developed and the developing countries invariably remain within a narrow range of 6.5 to 6.7 per cent. Taking advantage of this fact, the annual target might be defined in a more definitive form: namely the target (for any intermediate year) for the developing countries as a whole should exceed the rate achieved by the developed countries by, say, a constant 6.7 per cent.

1/ The variants are as follows:

		Output Manufacturing 1975	2000	Average annual growth rate
		$	$	(per cent)
Variant I :	Developed	1,240	6,272	6.7
	Developing	93	2,148	13.4
Variant II :	Developed	1,240	5,320	6.0
	Developing	93	1,837	12.6
Variant III :	Developed	1,240	4,198	5.0
	Developing	93	1,440	11.6
Variant IV :	Developed	1,240	3,304	4.0
	Developing	93	1,224	10.5

The following table summarises the results of separate computer runs using our general-purpose "Lima Scenario" programme.

Run No.	Annual average growth rate, developed countries (per cent)	Growth pattern, developed countries (per cent)	Statistical delay adjustment	Capital assistance (per cent)	Annual grow... rate required, developing countries (per cent)	Growth rate gap (per cent)
1	4.26	4.26 Constant	Concurrent		9.65	5.39
2	4.26	Random fluctuation (0 - 10)	Concurrent		9.65	5.39
3	4.26	0 first ten years	Concurrent		9.65	5.39
4	2.07	Random fluctuation	One year lag		7.35	5.22
5	4.26	Random fluctuation	One year lag		9.65	5.42
6	6.14	Random fluctuation	One year lag		11.6	5.59
7	2.07	Random fluctuatior	One year lag	1	0.73	-1.40
8	4.26	Random fluctuation	One year lag	1	2.64	-1.39
9	6.14	Random fluctuation	One year lag	1	4.65	-1.38

The first three runs simply confirm the concept of average annual rates. Given the projected annual average growth rate in the developed countries (4.26 per cent in our example), the average growth rate required for the developing countries to achieve the Lima target would remain 9.65 per cent, regardless of what the actual year-to-year fluctuation in the developed countries might turn out to be during the course of the next 25 years.

In setting the annual target, the developing countries still have the option of adopting the average 9.65 per cent figure, to be achieved more or less consistently, year after year, or the option of determining each year's target separately and only in relation to the observed current status of economic affairs in the developed countries. The annual target rate for the developing countries for any specific year would be equal, therefore, to the actual growth rate in the developed countries, plus 5.39 per cent. The results of both of these approaches will be the same, provided the option taken is binding throughout till year 2000.

If we agree to accept the option of varying annual targets, it will be expedient to adopt a "one-year-lag" system whereby the current annual target rate for the developing countries equals the published growth rate of the preceding year for the developed countries, plus a predetermined figure symbolizing the Lima target. This is because there is usually a one-year delay in publishing statistics on industrial performance. The rest of our examples, therefore, use this one-year adjustment system.

Examples 4, 5 and 6 treat three hypothetical growth variants, and assume respectively 2.07, 4.26 and 6.14 annual average growth rates for the developed countries. The corresponding rates required for the developing countries to achieve the Lima target are 7.35, 9.65 and 11.63 per cent. The difference between the growth rates of the developed and the developing countries, therefore, ranges from 5.22 to 5.59 per cent. In this case, without first being able to agree on one specific growth variant, the use of any annual average growth rate for the developing countries as a target figure would be meaningless. One could, however, have an unambiguously defined target if one were to set the current year target with only post facto information on the industrial performance in the developed countries, and a set of precomputed figures (5.22, 5.42 and 5.59 per cent) to be added on.[1/]

The above discussion brings out one additional unfavourable aspect of using the annual average figure as a target. Is it reasonable, for example, to aim at a 9.6 per cent (UNCTAD) growth rate year after year while the growth rate in the developed countries continues to fluctuate anywhere from a negative to a 10 per cent figure? The Lima target requires a higher growth rate for the developing countries, preferably consistently higher, than that for the developed countries. However, reality dictates that, when defining the Lima target, allowance be made for inevitable fluctuations in growth rates in the developed countries, and their impact upon the growth rates of the developing countries.

1/ To prove the validity of this method mathematically would, we suspect, require subjective interpretation of probability theory or statistical decision theory. No attempts are made here because the logic of this approach is no more tenuous than the one involved in the use of average annual rate as a target figure.

Examples 7, 8 and 9 use the same growth variants that are used in examples 4, 5 and 6, with an additional condition that the total annual capital transfer (official and private) from the developed to the developing countries would amount to 1 per cent of the GDP of the developed countries. Such a capital transfer reduces the required annual average growth rates drastically for the developing countries. It reduces, for example, the required annual average growth rate from 7.35 to 0.73 per cent for the developing countries when the rate of growth for the developed countries is expected to remain on the average 2.07 per cent per annum. Our example, using the growth variant for the developed countries of 6.14 per cent annual average rate, yields the required growth rate of 4.65 per cent for the developing countries. This means that the annual target rates for the developing countries are in fact lower than the growth rates for the developed countries by 1.38 - 1.40 per cent.[1/]

We now turn to an analysis of the economic significance of the figures and calculations shown in our examples: namely, what are the prospects of the developing countries out-performing the developed (in the range of 5 - 5.5. per cent) each year for the next quarter century.

Figures 11 and 12[2/] plot the performance of both the developed[3/] and the developing countries in terms of annual GDP and manufacturing output growth rates over the past 15 years. For some reason, 1966-67 provided a point at which the economic performance of the developing countries became consistently better, in terms of annual rates, than that observed in the developed countries.[4/]

1/ The implication of this result is quite surprising in itself and requires further examination. Our particular example above assumes that, of the total 1 per cent GDP capital transfer, 28 per cent will be invested in the manufacturing sector of the developing countries. Furthermore, the 1 per cent figure represents gross figure, and in addition to the current rate of capital transfer. All these points are, however, incidental to the one we are making here.

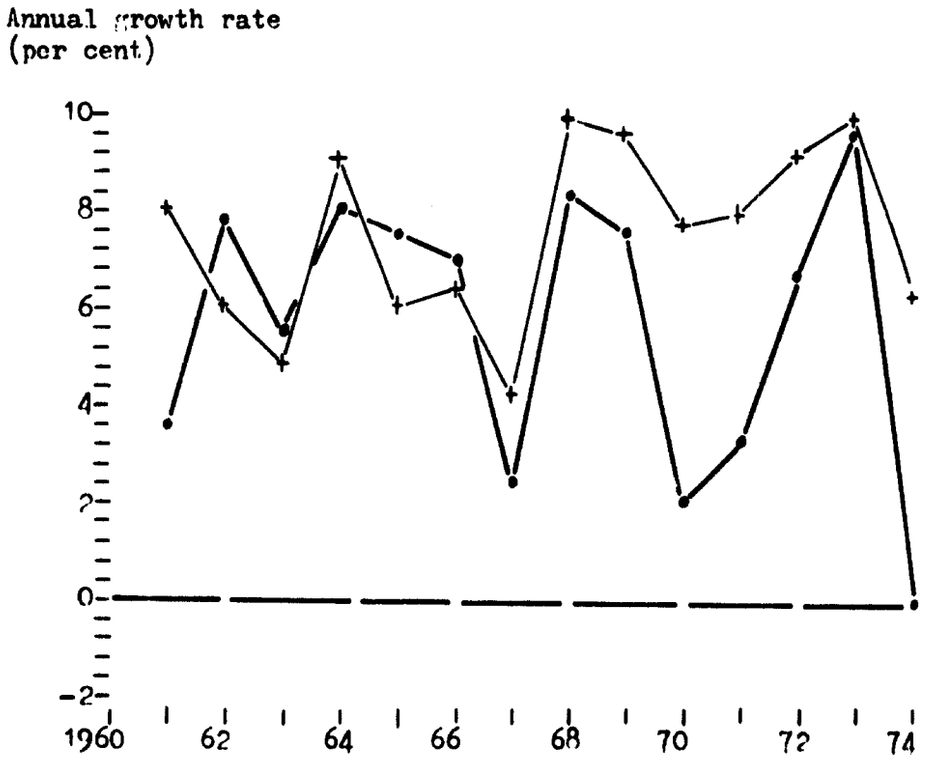
2/ Figures 11 and 12 are based on data from the UN Yearbook of National Account Statistics, Vol. III, table 4A (1975).

3/ Owing to the statistical difficulty of interpreting GDP and manufacturing output figures for the centrally planned economies, the rates for the developed countries are based on those for the developed market economies alone.

4/ We have yet to find the real reasons for this turn around. The only significant fact we have come across is that in 1967 the rate of capital transfer from the developed to the developing countries increased by 40 per cent.

Figure 11. GDP

Figure 12. Manufacturing



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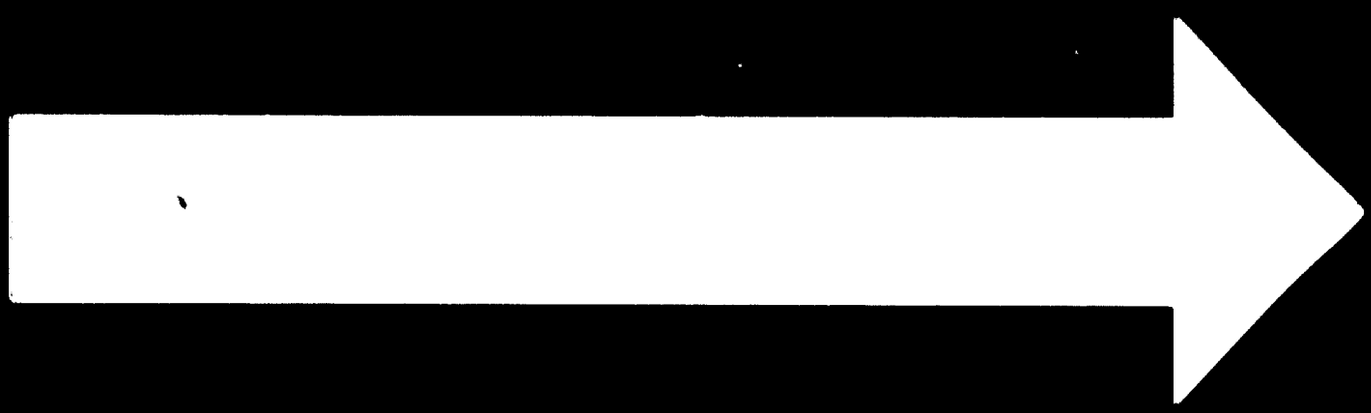

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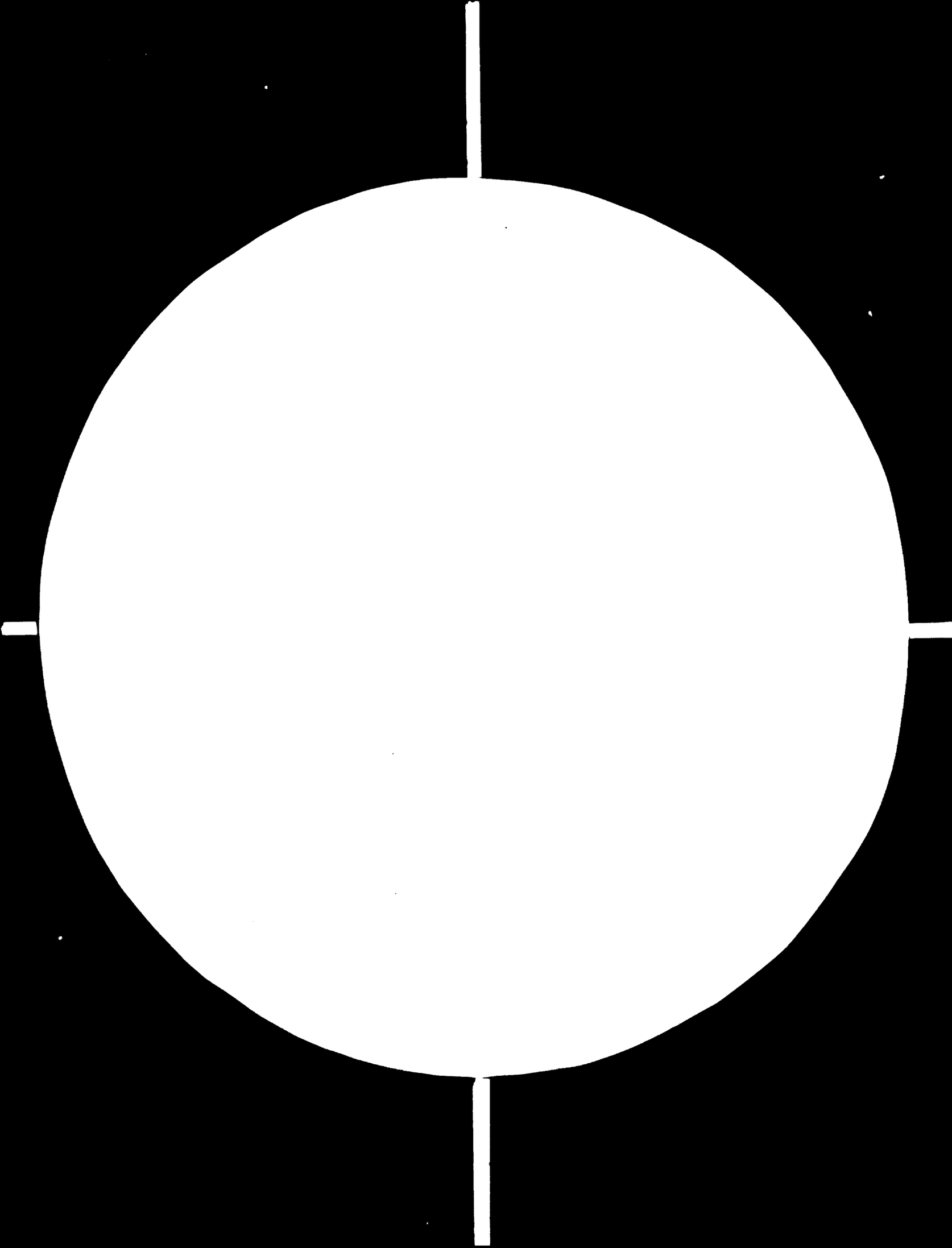


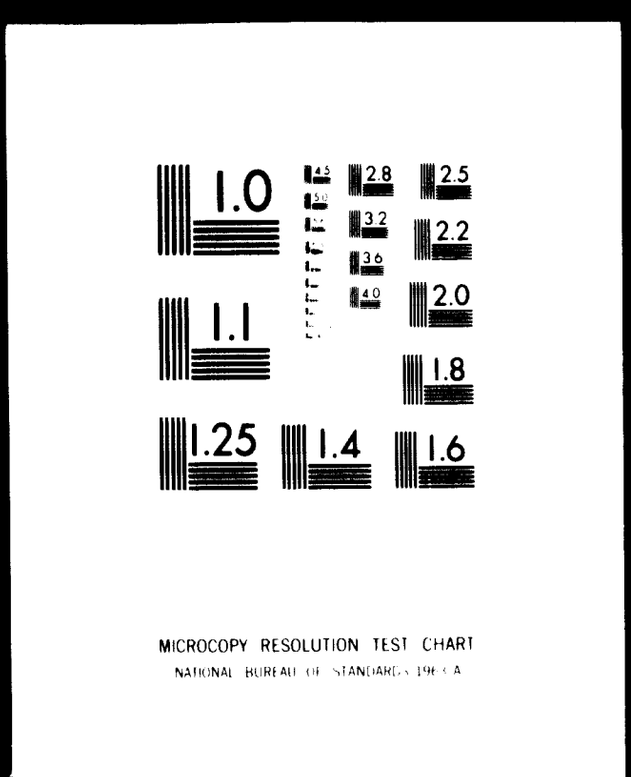
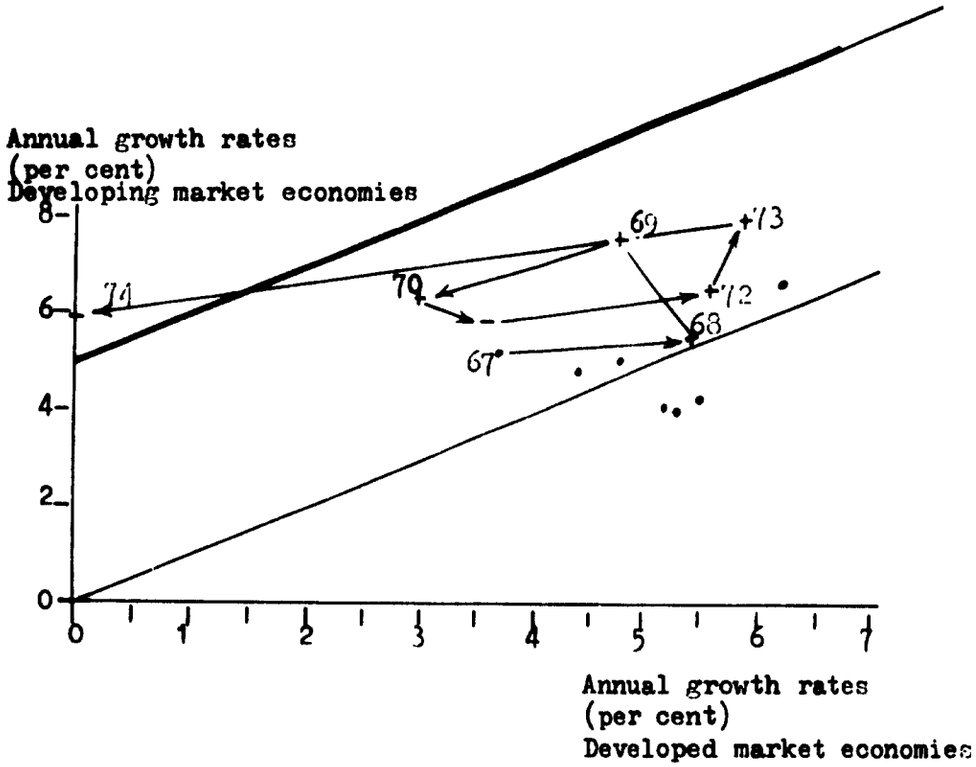


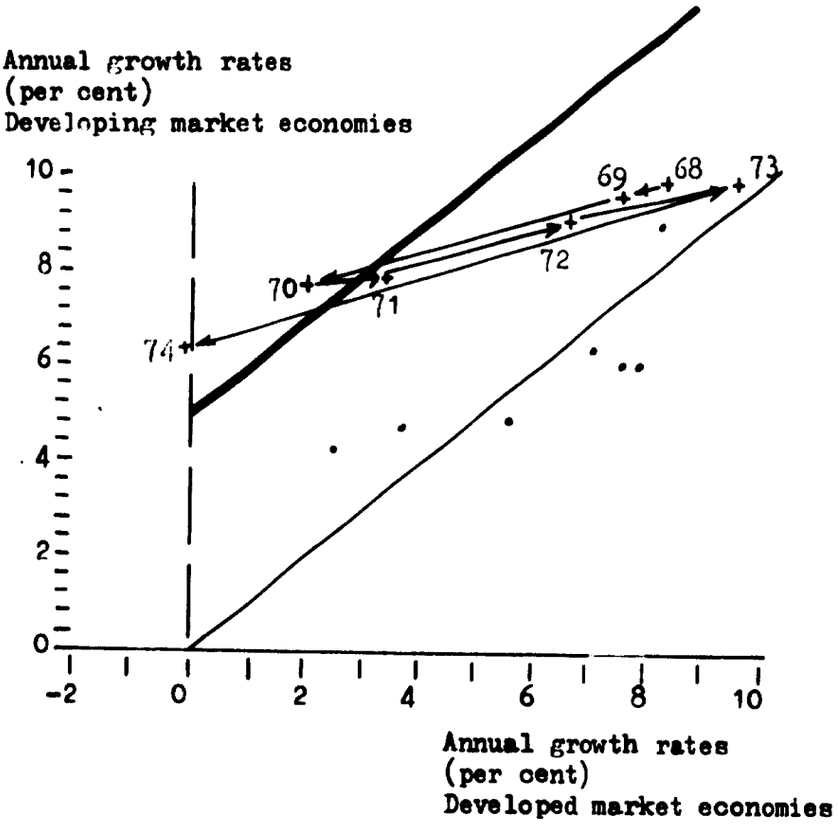
Figure 13. GDP



... Rates for period 1960 to 1967

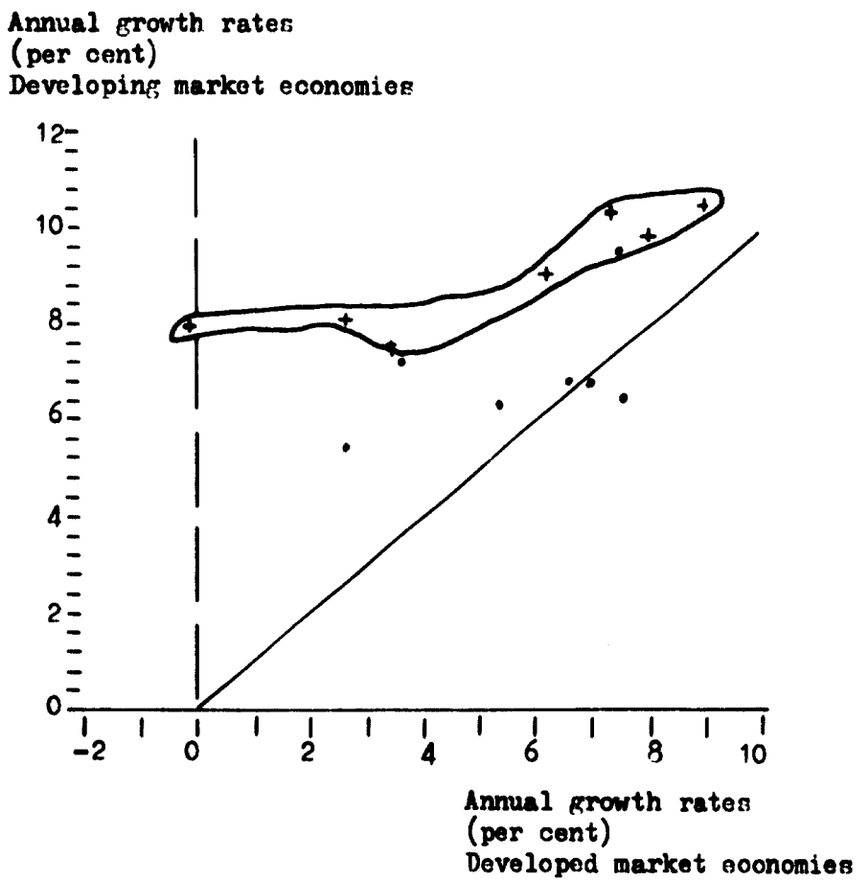
+++ Rates for period 1967 to 1974

Figure 14. Manufacturing growth rates required for the Lima target



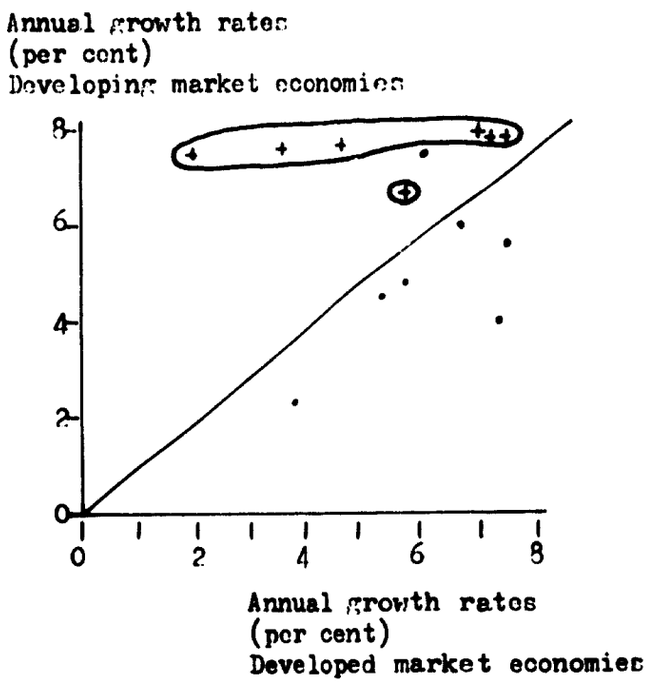
... Rates for period 1960 to 1967
+++ Rates for period 1967 to 1974

Figure 15. Industrial activities



... Rates for period 1960 to 1967
+++ Rates for period 1967 to 1974

Figure 16. Transport and Communication



... Rates for period 1960 to 1967
+++ Rates for period 1967 to 1974

In Figures 13 and 14, the same information is organized in a different format. In both, the vertical axis shows the growth rates for the developing, and the horizontal axis for the developed, countries. The slanted line drawn upwards from the origin (0) represents all the points where the rates of growth for the developed and developing countries are identical. A parallel line located above this equal rate line maintains a distance of 5 - 5.5 per cent, symbolizing the Lima target, in our example. All the points shown in the diagrams are co-ordinates representing actual performance rates for the developed and developing countries over the past 15 years.

One can notice from these diagrams that the developing countries have been performing generally well, and consistently better, since 1967. However, they have seldom out-performed the developed countries to the extent needed to achieve the Lima target.

Limiting our analysis for the moment to the new economic relationship established since 1967, we link our yearly observations with arrow lines to give a time sequence of events. One can immediately notice the contrast between the two diagrams: while the GDP relationship shows a complicated "cobweb", the manufacturing output relationship shows a striking uniformity. First of all, the manufacturing output relationship does not vacillate; in terms of timing and direction, manufacturing activities in the developing countries are irrevocably and closely tied to those in the developed countries. Second, the slopes of all the arrow lines are practically the same and show the same inclinations on the part of the developing countries to resist and insure against severe fluctuations in the manufacturing activities in the developed countries. Similar relationships can be observed for transportation and other industrial sectors as well.

If we can attach any significance to this newly observed relationship, two broad policy implications emerge. First a negative one: as one can read out from Figure 15, the Lima target could be met if one could induce the developed countries to adopt a deliberate policy of reducing their growth rates to a range of 0 - 3 per cent per annum. As we see it, this solution, if adopted as a conscious global policy, would be contrary to the true spirit of Lima. Furthermore, this solution would create an immense balance-of-payments problem for the developing countries, as discussed below in more detail.

The second, and more positive, policy implication is, of course, a further improvement in the relatively favourable position attained since 1967, by introducing whatever structural changes are necessary within and without the developing countries. This means, technically, "shifting" the whole band containing arrow lines in our

diagram upwards so that the new intercept between the band itself and the Lima target line allows a 4 - 5 per cent average annual growth rate for the developed countries.

A third possible approach might be to find "an optimum time path" for the developing countries to follow in order to reach the Lima target.[1/] The optimal control model used for the time being is very crude and contains only two hypothetical countries (a developed and a developing) and two sectors (manufacturing and non-manufacturing). Control is essentially over the yearly investment allocations needed for these two sectors to the year 1999, the control period, in orde to achieve the maximum stream of consumption and yet to increase the manufacturing share for the developing countries to 25 per cent in the terminal year, 2000.

In order to simplify the calculations, the relationship between the developed and the developing countries is defined in terms of exogenously determined[2/] annual capital transfer.

In order to avoid extreme solutions, the minimum yearly level of consumption is specified as the rate of current consumption level plus the rate of population increase. Investments are always in net figures and cannot assume negative values at any time, thus preventing negative saving (capital decumulation) as a quick way

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1/ Discussing global policy when in fact a body for formulating and implementing global policy is non-existent, would not be useful. To the extent that the structural changes required to achieve the Lima target have to be the results of deliberate planning and conscious policy making on the part of 150-odd individual countries, the Lima target should be apportioned at the individual country level. We have discussed the problem of ambiguity associated with the use of an "average" annual growth rate as a yearly target for a whole group of developing countries. Splitting the Lima target evenly among 120-odd developing countries would not be acceptable. On the other hand, asking every developing country to perform 5 - 5.5 per cent better than the developed countries every year would not be practicable. There is no unique criterion to be used, and no unilateral apportionment can be made. The 25 per cent figure for the share of total world industrial production reserved for the developing countries was arrived at from consideration of previously adopted regional goals. These were indicative targets for co-operative planning in each region. The proposed UNIDO World Industry Co-operation Model therefore also provides this joint planning feature.

2/ We also have a more integrated version in which investment can be switched from one country to another over time. As a two-country-two-sector model is, however, too simplistic for any practical purpose, we are in the process of developing a more comprehensive dynamic planning model. Meanwhile, the analytical and numerical solution processes of our optimal control model are available on request.

of reaching the Lima target. Physical capital is not "malleable"; once invested in one sector, it cannot be shifted to another to produce a different product.

An outcome of our calculation is summarized in Figures 17 and 18. As may be recalled, the objective of our exercise was to reach the Lima target without sacrificing the current level of per capita consumption. The results are still surprising: the developing countries will be better off by withholding net investment (out of domestic savings) in the manufacturing sector until the year 1993 and concentrate, instead, all investment activities in the non-manufacturing sector. The manufacturing output of the developing countries will increase at less than 5 per cent per year, and until 1993 this will be financed by capital transfer from the developed countries. This means, in fact, that the manufacturing output share for the developing vis-a-vis the developed countries will definitely deteriorate. Improvements in the share of manufacturing output will come about only after intensive investment activities in the manufacturing sector during the final seven years. The manufacturing output of the developing countries will increase 12 per cent in 1994, 20 per cent in 1995, 28 per cent in 1996, 34 per cent in 1997, 33 per cent in 1998, 36 per cent in 1999 and 32 per cent in 2000, in a final rush to meet the Lima target.

Our result aptly captures the spirit of the so-called "turnpike" solution. A turnpike or motorway is a fast road which it may be advantageous to use in a journey even if it does not represent a straight line between starting point and destination. One therefore diverts to the turnpike and uses it until one is near the destination. Figure 18 shows the programmed annual expansion rates for developing countries' manufacturing output given by this roundabout route, which contrasts with the straight line and the "zig-zag" line mentioned previously.

Again, we would like to remind readers that our calculations so far are intended solely for the purpose of illustrating the conceptual problems related to the definition of the Lima target. The optimum time path, for instance, contains many arbitrary assumptions. We have also stipulated that the policy makers for the developing countries would rather not reduce current consumption by even a small amount, although such an action might considerably reduce the strain of achieving the Lima target later on.

Again, the optimum time path we have shown for all the developing countries does not represent the optimum path for each developing country: if we were to combine the optimum paths for all the developing countries, the combined path would in no way resemble the one we have shown. This being the case, the proposed UNIDO World

Figure 17. An optimum time path to reach the Lima target: developing countries

(Iteration No. 441, UNIDO Optimal Control)

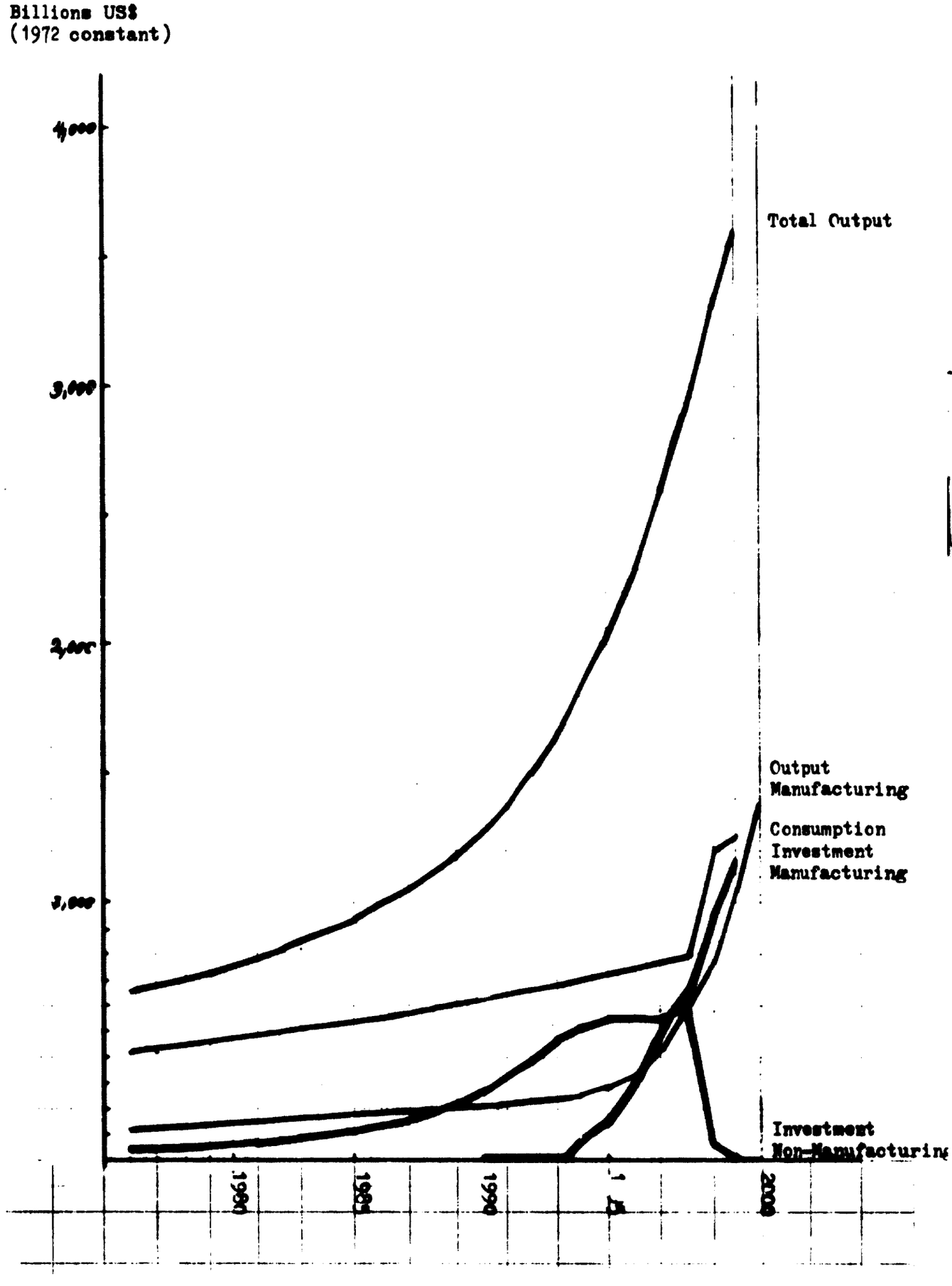
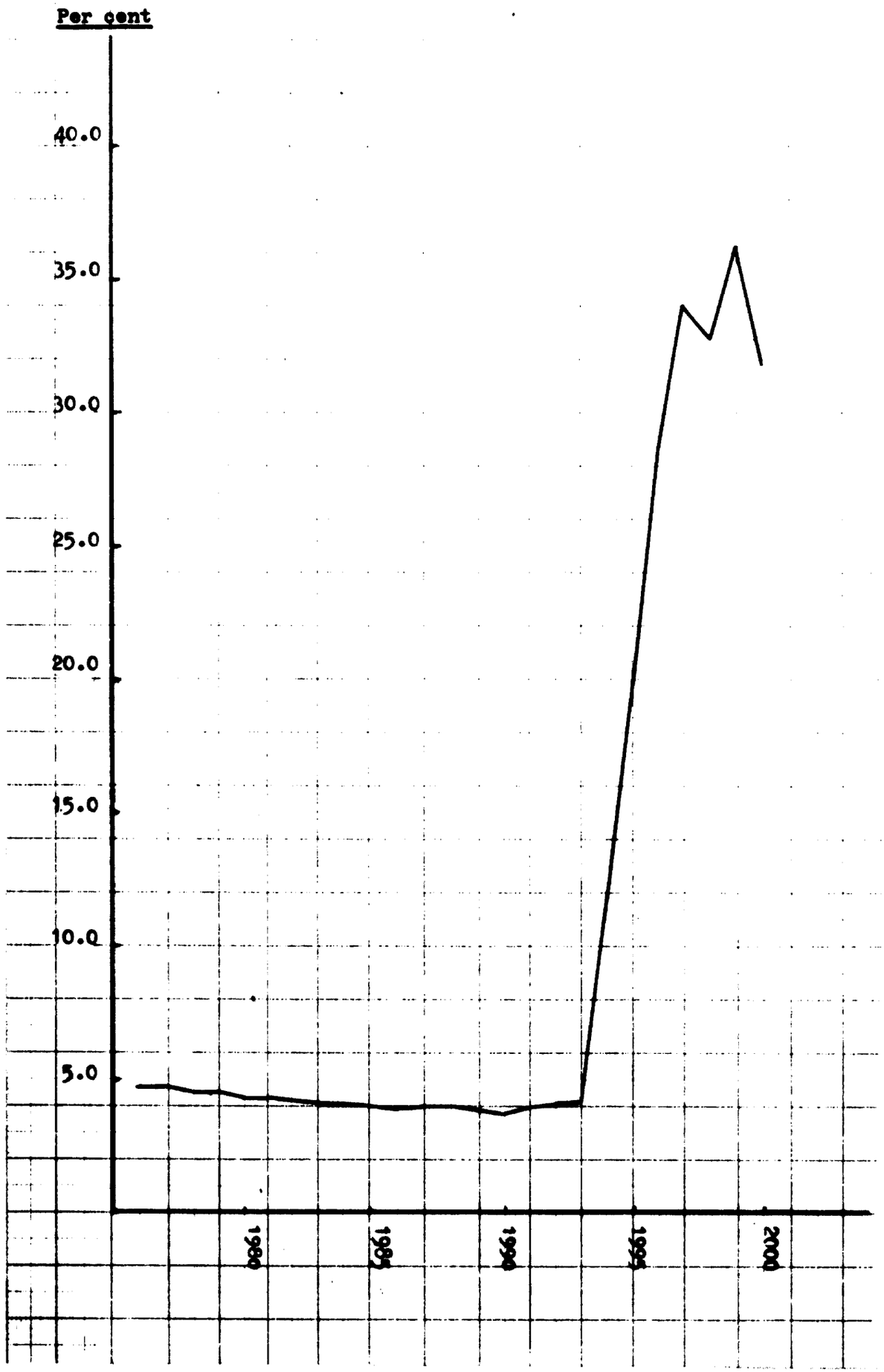


Figure 18. Annual growth rate - manufacturing, developing countries
(Iteration No. 441, UNIDO Optimal Control)



Industry Co-operation Model will contain separate national optimization models (subject to the control of national planners) which will be interlinked through the external manifestations of the national, long-term policies of each country in order to produce a synthesized global strategy in pursuance of the common global target, namely the Lima target.

We have mentioned that one of the policy decisions to be made will be the decision to sacrifice the current level of consumption. In the final analysis, the Lima target is but one means towards improving the material welfare of the people of the developing countries. This being the case, one might conceivably take the view that the share in manufacturing output stipulated in the Lima Declaration is nothing but a proxy target which is unequivocally translatable into a GNP target. Before rejecting outright such a liberal interpretation, let us consider some of the preliminary findings concerning the real cost of attaining the Lima target - the sacrifice involved in terms of "basic human needs".

One way of measuring this cost would be to construct an optimum time path programmed to fulfil the basic human needs. Economists at the Fundación Bariloche have recently completed a massive study solely concerned with creating an idealized world whereby global resources would be mobilized to give every baby born in future the same opportunity to live for 75.6 years.[1/] In essence, the Bariloche Model can be summarized as follows:

1. Its objective is to improve the life expectancy at birth of every member of society;

2. This objective is given a quantitative expression in terms of the minimum level of "basic human needs" - e.g. per capita consumption goods, educational requirements and food, in addition to housing requirements per family - needed to sustain a given level of life expectancy;

3. The model then minimizes the time-span required to reach an ideal stage, through an optimum allocation of resources in each region;

4. The model's main constraints:
   (a) Reallocation of resources (labour, capital, arable land, etc.) from one use to another is permitted at the rate of no more than 1 per cent a year of the existing allocation between the sectors; and
   (b) At no time is the absolute level of present consumption per capita allowed to decrease;

5. The computational procedure used is quite similar to that used for the UNIDO optimal control programme (a year-to-year optimization with a penalty function attached for missing the target).

1/ Based on one of the original scenarios run at an IIASA conference in 1974.

What follows is a very brief summary of the results obtained by running the entire Bariloche Model at UNIDO in December 1976.

This model was not designed with the Lima target in mind, and does not treat manufacturing output as a separate variable. We, therefore, used its GNP figures, which we converted into manufacturing output figures through the use of projected, fixed "share of manufactures" in each region in the year 2000.

Owing to limitation of time, we were only able to run the model four times. The first time, we ran it without the Lima target; that is, to see the probable manufacturing share for the developing countries in the year 2000 if the world envisioned by the Bariloche group were to proceed along its own course. Surprisingly, the result included a 22.91 per cent manufacturing output share for the developing countries by the year 2000. Our second run overshot the mark (Lima = 27 per cent) and a subsequent effort to bring it down resulted in another under-achievement (Lima = 24 per cent). Our final run used the "Lima = 24 per cent" version with the added feature of an increased capital transfer from the developed to the developing countries.[1/] The results of the four runs are summarized in Tables 1 to 4 and Figures 19-[illegible].

1/ Capital transfer is assumed to reach the official target of 1 per cent of GNP of the developed countries by the year 1980.

Table 1. Africa, year 2000

	Bariloche standard	Lima, 24 per cent	Lima, 24 per cent and aid	Lima, 27.7 per cent
Population (millions)	705.6	705.9	703.9	674.0
Population growth rate (percentage)	2.35	2.32	2.32	1.67
Life expectancy (years)	58.6	58.5	58.2	61.9
Natality rate (per 1,000)	32.5	31.7	32.4	23.9
Average family size (persons)	4.5	4.47	4.4	3.5
GNP/capita (dollars)	330.0	365.0	319.0	480.0
Calories	(1987)	(1987)	(1986)	(1988)
Educated (8-17) population (percentage)	55.7	54.8	52.3	59.9
Houses/families (percentage)	61.2	66.4	65.6	99.9

Note: Parentheses mean the year minimum level achieved.

Table 2. Asia, year 2000

	Bariloche standard	Lima, 24 per cent	Lima, 24 per cent and aid	Lima, 27.7 per cent
Population (millions)	492.9	491.7	493.0	491.9
Population growth rate (percentage)	1.27	1.25	1.26	1.24
Life expectancy (years)	70.2	70.3	70.2	70.3
Natality rate (per 1,000)	18.3	18.0	18.0	18.0
Average family size (persons)	3.5	3.5	3.5	3.5
GNP/capita (dollars)	940.0	1,085.0	1,130.0	1,310.0
Calories/capita	(1986)	(1987)	(1986)	(1988)
Education (8-17) population	(1991)	(1991)	(1992)	(1991)
Houses/family	(1992)	(1992)	(1992)	(1992)

Note: Parentheses mean the year minimum level achieved.

Table 3. Latin America, year 2000

	Bariloche standard	Lima, 24 per cent	Lima, 24 per cent and aid	Lima, 27.7 per cent
Population (millions)	4,022	4,026	3,918	3,992
Population growth rate (percentage)	2.04	2.05	1.87	1.88
Life expectancy (years)	65.81	65.79	66.00	67.80
Natality rate (per 1,000)	26.40	26.53	24.70	24.14
Average family size (persons)	4.60	4.60	4.23	4.60
GNP/capita (dollars)	287.60	287.00	306.30	350.90
Calories/capita (units)	(1995)	(1995)	(1990)	(1996)
Educated (8-17) population (percentage)	78.50	78.40	77.50	89.50
Houses/families (percentage)	70.30	69.80	78.80	69.80

Note: Parentheses mean the year minimum level achieved.

Table 4. Industrialized world, year 2000

	Bariloche standard	Lima, 24 per cent	Lima, 24 per cent and aid	Lima, 27.7 per cent
Population (millions)	1,165	1,165	1,165	1,165
Population growth rate (percentage)	0.25	0.25	0.25	0.25
Life expectancy (years)	71.40	71.40	71.40	71.40
Natality rate (per 1,000)	14.10	14.10	14.10	14.10
Average family size (persons)	3	3	3	3
GNP/capita (dollars)	3,968.00	3,968.00	3,918.00	3,968.00
Calories/capita	(1980)	(1980)	(1980)	(1980)
Education (8-17) population	(1972)	(1972)	(1972)	(1972)
Houses/family	(1976)	(1976)	(1976)	(1976)

Note: Parentheses mean the year minimum level achieved

Figure 19. Basic human needs - selected indicators

Latin America

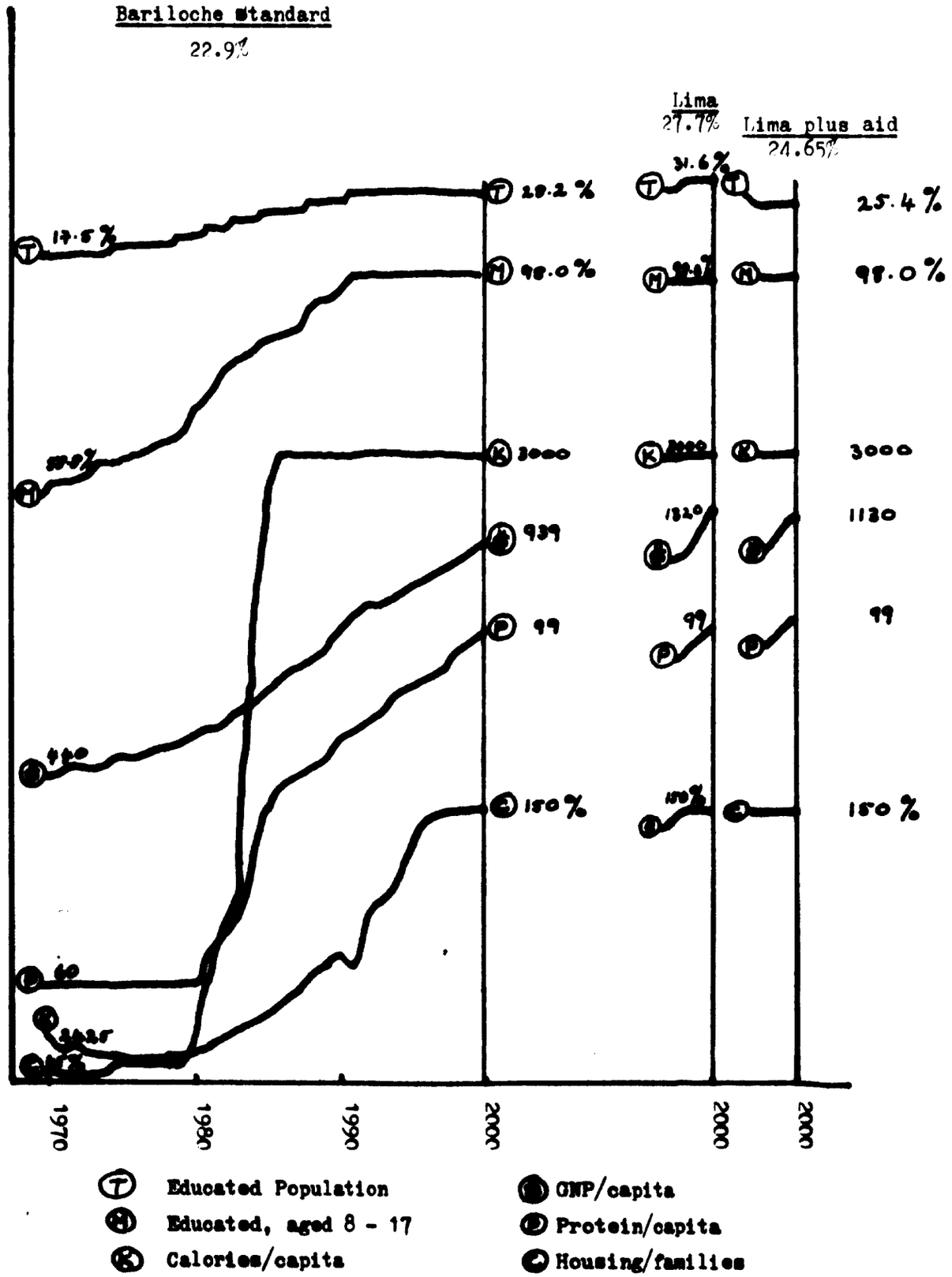


Figure 20. Basic human needs - selected indicators

Africa

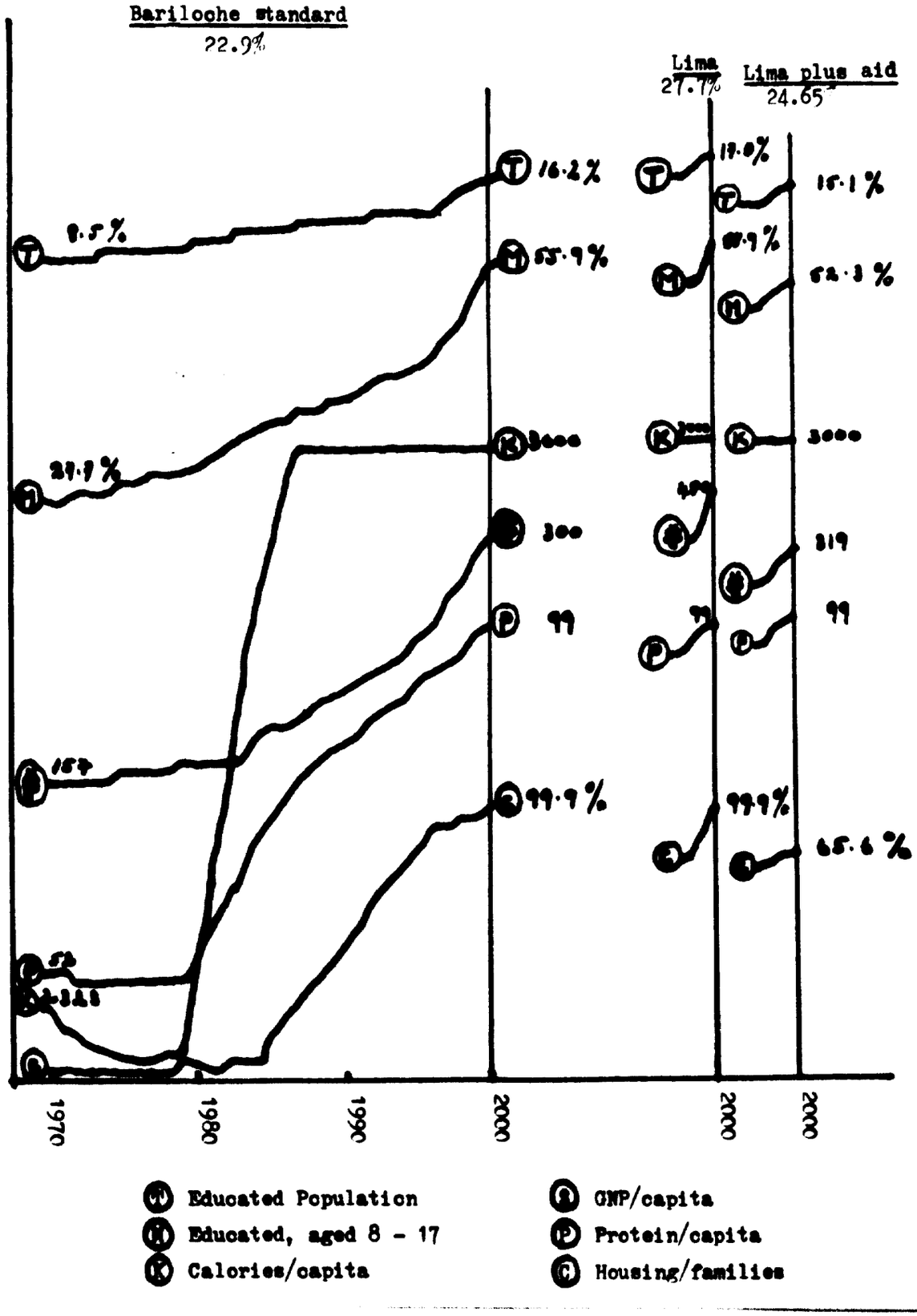


Figure 21. Basic human needs - selected indicators
Asia.

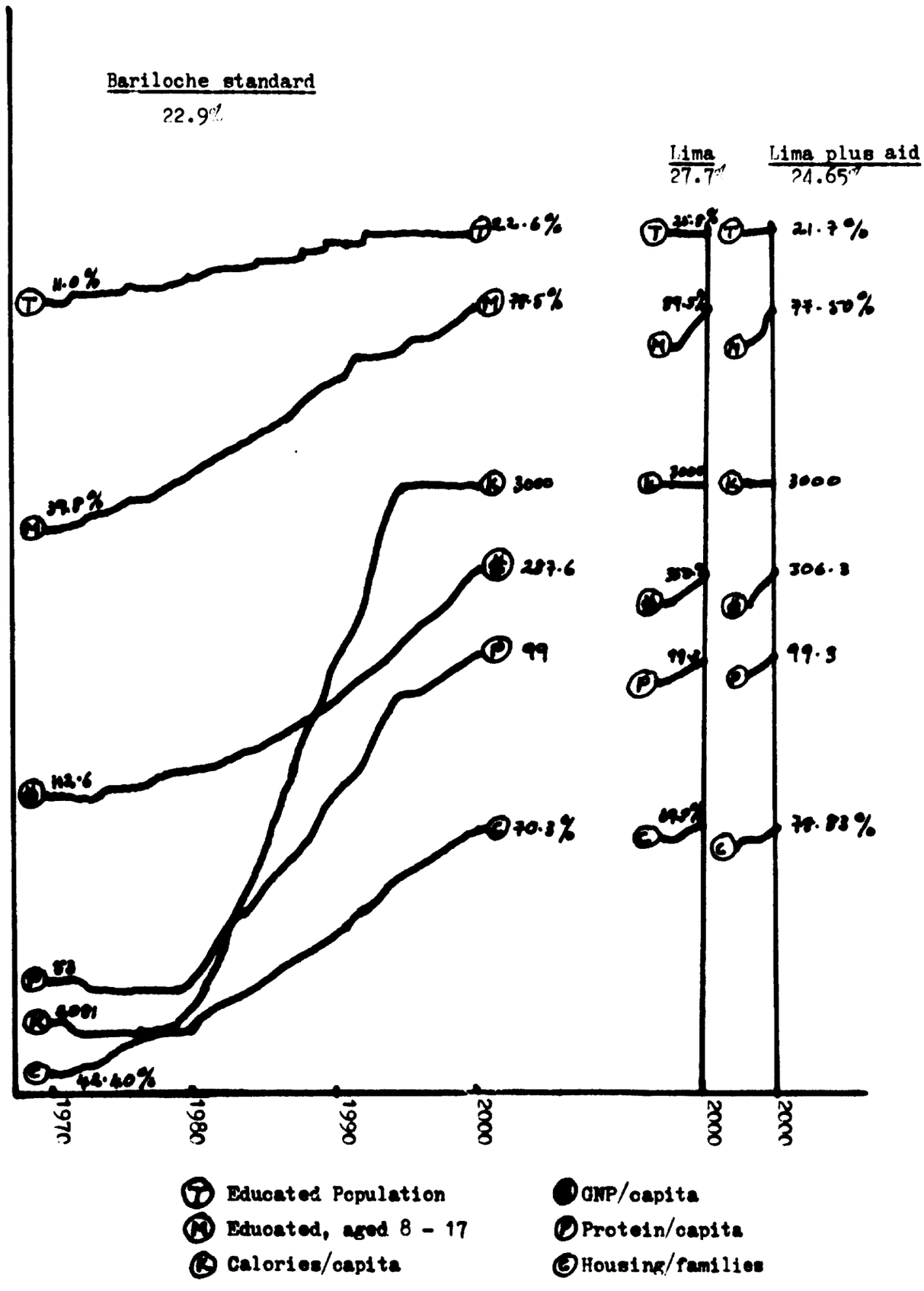
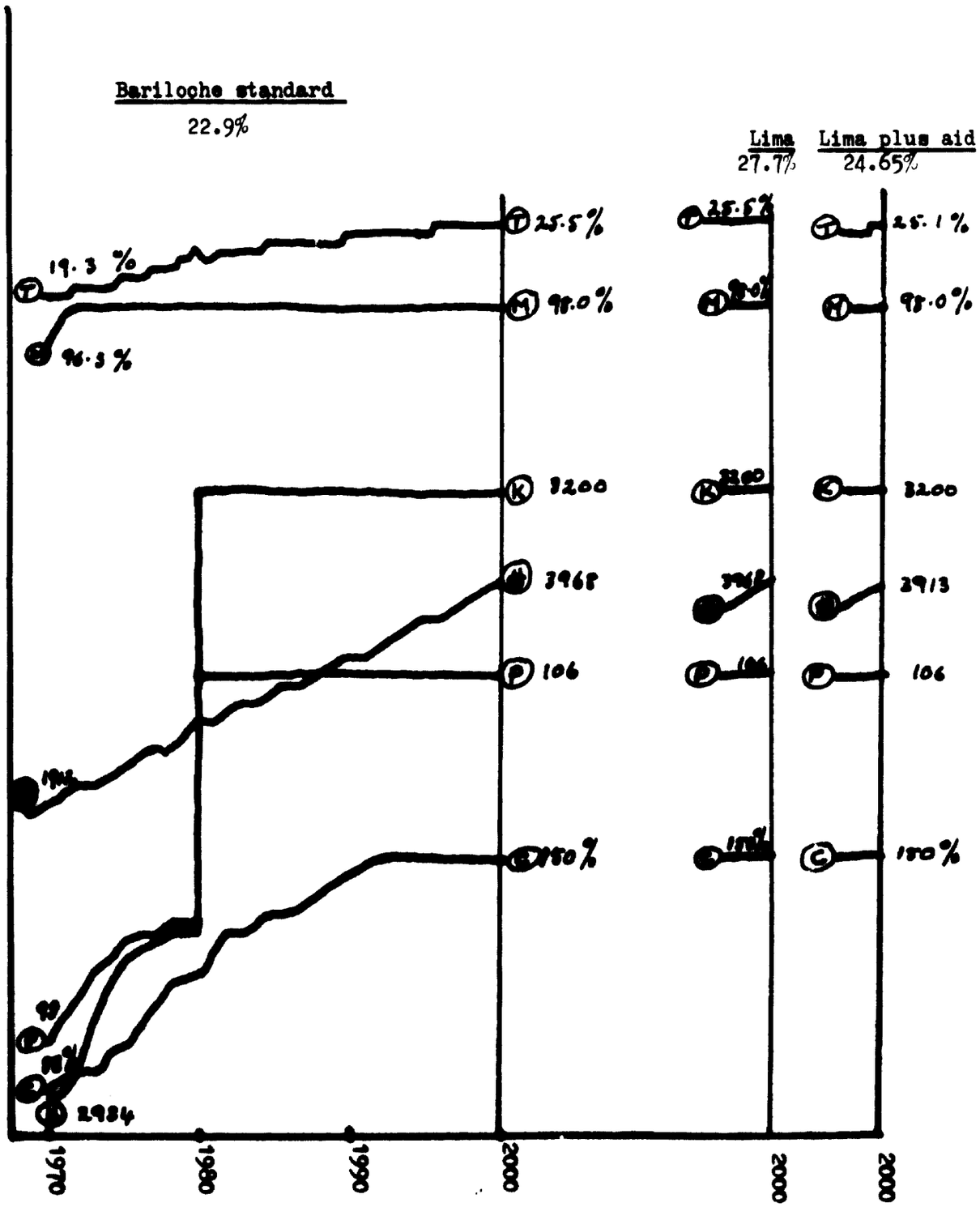


Figure 22. Basic human needs - selected indicators

Developed Countries



On the basis of our preliminary computer runs, a tentative conclusion can be drawn which is not altogether surprising: the Lima target should make a positive contribution to the fulfilment of basic human requirements. A rapid industrialization effort to achieve the target will have the effects of reducing birth rates in Asia and Africa to a noticeable degree and of raising the demand for educated labour forces. Housing will be much easier to provide with increased manufacturing output in Africa, while increased investment in the manufacturing sector will have positive effects on housing in Asia and Latin America, as well as in the developed countries. Life expectancy will also improve. The GNP per capita figures are definitely higher in all regions except, of course, for the developed region when it has to subsidize industrialization in the rest of the world. One negative aspect of the Lima target according to the Bariloche model is that it will set back food production goals by approximately one year in all the developing regions.

Recently, a group of economists led by Professor Leontief submitted a report entitled Future of the World Economy to the United Nations. The report is a massive undertaking describing and projecting the world economy for the first time in great detail. The amount of detail stems largely from the fact that the analyses were carried out using an input-output approach. This approach is necessarily detailed because it describes the process as well as the final results of any expansionary activity in the economy. For example, the initial effect of a new investment in the manufacturing sector is to increase output by the industry supplying the input requirements of this new investment. The changes in output for this input producer are again diffused to other industries, creating indirect output expansions. An increase in output, at the same time, represents an additional increment of income received by households. This increment in turn results in additional increases in effective demand for a series of products creating induced expansion of outputs.

Given the logic of this approach, it can be seen that a planned expansion in one sector of the economy might not turn out to be feasible unless the same degree of planning is put into the rest of the economy, which provides the inputs to this sector. The relevance of this point becomes obvious when one considers the restructuring of the economy at the global level, which requires co-operation and co-ordination between nations as consumers as well as suppliers of each others' output.

The Leontief report covers 15 economic regions, each broken down to 48 industrial sectors. Since these regions do not represent policy-making entities, the model is a projection rather than a policy simulation one, as

is the proposed UNIDO model. However, one can still interpret regional aggregate figures as the results of some definite and conscious policy decisions of the individual countries within that region. In this sense, the model uses three alternative scenarios which embody different regional development strategies. As the work was started five years ago, the Lima target is not reflected in these scenarios. We propose, nevertheless, to seek access to the Leontief model and to run it according to the Lima scenario in the coming year.

In the meantime, the developers of the UNIDO model have finished their own regionalized input-output analysis, which is small but which integrates the Lima target as an explicit constraint in regional development strategies. Because of its small size, we have been able to run 18 (macro simulation) plus 4 (input-output) scenarios or sensitivity analyses. That is to say, we recognize two aggregate variables which are subject to over-all policy changes, namely the incremental capital-output ratios (as reflections of rationalization in industry and educational and technological policy: 3 variants) and the elasticity of manufacturing output with respect to GNP (as reflection of investment reallocation policy: 2 variants). In addition, we have used three growth variants for the developed countries (5.1; 4; and 3 per cent). The combination gives 18 scenarios for our "macro simulation"[1/]. Each of these macro simulations has different implications in terms of structural changes (input-output table). Instead of producing 18 different structural tables, we present 4 input-output tables for each region, and only for the reference years 1980, 1990 and 2000.

If there are 18 plus 4 different projections, which one to take? We reproduce the results of one version at the end of this Chapter. The real purpose of our study, however, is not to produce a unique set of projections, but to simulate the effects of different policies, in both the developed and the developing countries, in reaching the Lima target. Such an analysis would require a careful comparison of the results of all (18 plus 4) versions, and we leave this to the reader. Some general conclusions of the study may be summarized, however:

1/ The elasticity of manufacturing output with respect to GNP compares changes in manufacturing output against changes in GNP in percentage terms. The reader should note that we use this parameter as a policy variable and, therefore, it does not resemble the value actually observed. The Regional and Country Studies Section of UNIDO has done a statistical analysis which gives the following regression formula:

$$\ln MVA = -4.13970 + 1.34156 \ln \frac{GDP}{pop} + 1.10263 \ln pop$$

(a) Generally speaking, reaching the Lima target implies that average GDP growth rates in the developing countries must exceed those of the developed countries by 3 to 5 per cent (depending on regions) points in real terms. The trend rates of growth of GDP 1972-2000 at constant terms must lie within the range of 7.2 to 8.0 per cent for Africa, 6.6 to 8.4 per cent for Asia, 6.1 to 7.8 per cent for Latin America, and 7.8 to 9.5 per cent for the Middle East.

(b) Average growth rates in manufacturing in the developing countries must exceed those of the developed countries by 5 to 7 per cent. The rate required for Africa is 7.8 to 10.0 per cent (or 4.9 per cent higher than that for the developed countries). The rates required for Asia, Latin America and Middle East are, respectively, 8.3 to 10.5 per cent (5.4 per cent); 7.7 to 9.9 per cent (4.7 per cent); and 9.8 to 12.0 per cent (6.8 per cent).

(c) All the variants show that agriculture has to grow slightly more rapidly than GDP in Africa, Asia and the Middle East. This is because, firstly, agriculture is an important sector for job creation, industrialization creating comparatively less employment because of the high labour productivity; second, the agricultural sector frees foreign exchange resources for the imports needed for industrialization; third, it constitutes an important domestic market for the manufactured products; and fourthly, only a sufficient agricultural surplus allows migration from the agricultural to the industrial sector.

(d) As expected, investment requirements are high. The necessary average growth rates of investment are: 6.7 to 11.5 per cent in Africa; 7.7 to 8.0 per cent in Asia; 7.7 to 8.0 per cent in Latin America; and 7.7 to 13.2 per cent in the Middle East. These figures represent 22 to 24 per cent of the GDP of Asia, Africa and Latin America and 27 per cent in the case of the Middle East.

(e) Future world trade will naturally be characterized by increased trade in manufacturing. The relative importance of the total exports from the developed countries will diminish, reflecting, in a general way, the equalization effect of the Lima target. Nevertheless, over 90 per cent of total exports from the developed countries will consist of manufactured goods by the year 2000.

(f) The developing world, with the exception of the Middle Eastern countries, will continue to experience balance-of-payments problems. The trade deficit will amount to $20-33 billion a year by the year 2000. This compares favourably, however, if converted into GDP share against the current situation.

(g) It goes without saying that if the productivity of capital can be improved (decrease in capital-output ratios) in the developing countries, the task of achieving the Lima target will be much easier, especially in terms of balance-of-trade and consumption levels.

We reproduce in the pages that follow a set of computer printouts for several regions, in terms of major economic sectors. The information is organized in three tables for each region, and for the world, and the assumptions are printed at the foot of each table. In each case, the third table contains the projected input-output structure of the particular region. Taking the first column (agriculture) of the African 1980 input-output table, and reading upwards it can be seer that the total agricultural output of $49.9 billion is produced by using up $39.9 billion worth of capital and labour (GNP contribution), inputs provided by other sectors ($43.0 billion), and manufacturing ($5.3 billion), mining (zero) and agriculture ($1.5 billion). Reading across from the right-hand side, the first row (agriculture) shows how this total of $49.9 billion is distributed. Leaving imports aside for a moment, $6.3 billion worth of agricultural products are exported, and $40.6 billion worth consumed domestically. In addition, the agricultural products are used as inputs to other sectors. The manufacturing sector uses $6.29 billion worth, and the agricultural sector uses $1.5 billion worth of its own output as inputs.

All these regional input-output tables are consolidated into a "world input-output" table which serves as a consistency check as well as giving a global picture. We have not so far, however, been able to link these regional tables with an inter-regional trade-table (nor did the Leontief United Nations model); instead, we describe world trade as a whole in Table 5.

The total world trade volume will reach $1,794 billion in the year 2000, of which $984 billion (58 per cent) will represent the export of manufactured goods from developed to developing countries. The developed countries, in turn, will import $613 billion worth of manufactured goods from the developing countries, resulting in a $370-billion trade surplus for the developed countries. This surplus from the manufacturing trade is large enough to finance trade deficits in other commodities and leaves the developed countries as net creditors of $20[illegible] llion. Only the Middle Eastern countries fare better than the rest of the developing countries, with a positive trade balance of $14 billion. Incidentally, the export revenue of minerals and oil is expected to cover only 60 per cent of the total import bill for manufactured goods for the Middle East region. The trade deficits

for Africa, Asia and Latin America are respectively $43, $156 and $18 billion. Obviously, the achievement of the Lima target by the developing countries does not solve their balance-of-payments problems. Although a further analysis will be required to assess the implications of the Lima target on this balance-of-payments problem, it is safe to say that without a continuous creation of international credit, the Lima target will be difficult to achieve.

One interesting finding of this study is, as mentioned before, that the balance-of-payments problem for the developing countries will be much worse if the Lima target is achieved at the cost of slowing down economic activities in the developed countries. Our calculation, using growth variant No. 3 for the developed countries (annual average growth rate = 3 per cent), shows trade deficits of $56 billion, $164 billion, $34 billion and $63 billion for Afrioa, Asia, Latin America and the Middle East respectively. The reason is that under such circumstances the developed countries reduce imports in greater proportion than exports, which in turn reflects rigidity in the consumption function.

Table 5. International trade, year 2000

(Billions of 1972 constant United States dollars)

	Agriculture	Mining	Manufacturing	Others	Total
Africa					
EX	24,662	10,045	34,754	7,737	77,200
IM	12,692	4,193	94,255	9,058	120,200
C	+11,970	+5,851	-59,500	-1,321	-43,000
Asia					
EX	20,814	1,674	92,649	7,061	122,200
IM	43,810	18,484	192,741	23,264	278,300
	-22,995	-16,809	-100,092	-16,202	-156,100
Latin America					
E	61,896	13,073	78,032	20,697	173,700
I	16,761	20,287	135,952	19,499	192,500
	+45,135	-7,214	-57,9.9	+1,198	-18,800
Middle East					
EX	41,848	115,658	59,208	83,184	299,900
IM	26,083	12,717	212,194	34,803	285,800
	+15,764	+102,940	-152,986	+48,380	+14,099
Industrialized					
EX	69,177	7,347	984,255	60,719	1,121,500
IM	119,052	92,115	613,756	92,774	917,700
	-49,874	-84,768	+370,498	-32,055	+203,800
World total					
EX	218,400	147,800	1,248,900	179,400	1,794,500
IM	218,400	147,800	1,248,900	179,400	1,794,500
	0	0	0	0	0

AFRICA

	TOTAL	AGRICULTURE	MINING	MANUFACTURING	OTHER
OUTPUT IN BILL. 1972 U.S. $					
1972	65.3	20.8	5.0	7.6	31.8
1980	113.8	39.9	8.7	15.0	50.0
1990	232.8	81.8	17.9	35.4	97.7
2000	473.7	166.4	36.4	83.0	187.8
YEARLY RATE OF GROWTH OF OUTPUT					
1972-1980	0.06945	0.08130	0.06965	0.08449	0.05681
1980-1990	0.07159	0.07166	0.07159	0.08586	0.06684
1990-2000	0.07101	0.07104	0.07101	0.08521	0.06530
OUTPUT SHARE (IN PERCENTAGES)					
1972	100.0	31.9	7.7	11.7	48.7
1980	100.0	35.1	7.7	13.1	44.0
1990	100.0	35.1	7.7	15.2	41.9
2000	100.0	35.1	7.7	17.5	39.6
OUTPUT PER CAPITA IN THOUS.1972 U.S. $					
1972	0.19205	0.06132	0.01476	0.02244	0.09352
1980	0.26655	0.09357	0.02052	0.03512	0.11732
1990	0.40573	0.14252	0.03124	0.06167	0.17029
2000	0.62012	0.21791	0.04774	0.10863	0.24583
YEARLY RATE OF GROWTH OF OUTPUT PER CAPITA					
1972-1980	0.04097	0.05282	0.04117	0.05601	0.02833
1980-1990	0.04201	0.04207	0.04201	0.05628	0.03725
1990-2000	0.04242	0.04245	0.04242	0.05661	0.03671

ASSUMPTIONS

AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES	0.0400		
ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80,1980-90,1990-2000	1.3	1.3	1.3
ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80,1980-90,1990-2000	3.0	3.0	3.0

AFRICA

	GOVERNMENT CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS
FINAL DEMAND IN BILL. 1972 U.S. $				
1972	10.1	44.4	11.2	14.2	14.8
1980	17.7	87.9	22.9	17.1	31.9
1990	36.3	171.6	48.2	37.4	60.8
2000	73.9	345.3	97.4	77.2	120.2
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA				
1972-1980	0.06941	0.08529	0.08867	0.02342	0.09594
1980-1990	0.07159	0.06683	0.07453	0.07812	0.06428
1990-2000	0.07101	0.06990	0.07023	0.07247	0.06815
FINAL DEMAND SHARE (IN PERCENTAGES)				
1972	15.6	68.1	17.2	21.7	22.7
1980	15.6	77.3	20.1	15.0	28.0
1990	15.6	73.7	20.7	16.0	26.1
2000	15.6	72.8	20.5	16.3	25.3
FINAL DEMAND PER CAPITA IN THOUS.1972 U.S. $				
1972	0.02997	0.13079	0.03314	0.04179	0.04364
1980	0.04158	0.20606	0.05365	0.04013	0.07488
1990	0.06329	0.29906	0.08410	0.06521	0.10594
2000	0.09674	0.45206	0.12753	0.10114	0.15735
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA				
1972-1980	0.04093	0.05681	0.06019	-0.00505	0.06746
1980-1990	0.04201	0.03724	0.04494	0.04854	0.03469
1990-2000	0.04242	0.04131	0.04163	0.04388	0.03956

ASSUMPTIONS

AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES 0.0400

ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80,1980-90,1990-2000 1.3 1.3 1.3

ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80,1980-90,1990-2000 3.0 3.0 3.0

	AGRICULTURE	MININGEQU.	MANUFACTUR.	OTHER SECT.	CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS	TOTAL OUTPUT
AFRICA - INPUT-OUTPUT TABLES 1980									
AGRICULTURE	1.5303	0.0000	6.2927	0.0000	40.6520	0.0000	6.3000	4.9000	49.8750
MININGEQU.	0.0000	1.5524	8.2476	0.0000	0.0000	0.0000	6.2000	1.5000	14.5000
MANUFACTUR.	5.3572	1.9051	6.0528	11.3264	23.7920	8.9666	3.1000	23.0000	37.5000
OTHER SECT.	3.0875	2.3425	1.9069	13.3004	41.0560	13.9334	1.5000	2.5000	74.6269
VALUE ADDED	39.9000	8.7000	15.0000	50.0000					
TOTAL OUTPUT	49.8750	14.5000	37.5000	74.6269	105.5000	22.9000	17.1000	31.9000	176.5019
AFRICA - INPUT-OUTPUT TABLES 1990									
AGRICULTURE	4.3867	0.0000	14.6907	0.0000	83.6890	0.0000	14.2000	7.9000	109.0667
MININGEQU.	0.0000	5.5305	20.7028	0.0000	0.0000	0.0000	7.8000	2.2000	29.8333
MANUFACTUR.	14.8223	3.8903	13.6472	23.8847	47.3046	19.5509	11.5000	46.1000	88.5000
OTHER SECT.	8.0575	4.5125	4.0593	26.4456	77.0063	28.6491	3.9000	4.6000	148.0303
VALUE ADDED	81.8000	17.9000	35.4000	97.7000					
TOTAL OUTPUT	109.0667	29.8333	88.5000	148.0303	208.0000	48.2000	37.4000	60.8000	375.4303
AFRICA - INPUT-OUTPUT TABLES 2000									
AGRICULTURE	12.1333	0.0000	35.9887	0.0000	177.5922	0.0000	24.7000	12.7000	237.7143
MININGEQU.	0.0000	7.2688	47.3979	0.0000	0.0000	0.0000	10.0000	4.2000	60.6667
MANUFACTUR.	30.3359	8.1860	32.0597	49.8970	96.2437	41.2777	34.8000	94.3000	207.5000
OTHER SECT.	19.8451	8.8119	8.8537	51.2261	145.3240	56.1223	7.7000	9.0000	288.9231
VALUE ADDED	166.4000	36.4000	83.0000	187.8000					
TOTAL OUTPUT	237.7143	60.6667	207.5000	288.9231	419.2000	97.4000	77.2000	120.2000	794.8040

ASIA

	TOTAL	AGRICULTURE	MINING	MANUFACTURING	OTHER
OUTPUT IN BILL. 1972 U.S. $					
1972	162.9	58.9	4.4	23.6	75.9
1980	294.3	129.3	7.9	48.4	108.6
1990	624.6	275.2	16.8	119.0	213.5
2000	1319.1	581.9	35.6	291.0	410.5
YEARLY RATE OF GROWTH OF OUTPUT					
1972-1980	0.07395	0.09818	0.07391	0.08967	0.04484
1980-1990	0.07523	0.07551	0.07523	0.08996	0.06755
1990-2000	0.07475	0.07488	0.07475	0.08941	0.06535
OUTPUT SHARE (IN PERCENTAGES)					
1972	100.0	36.2	2.7	14.5	46.6
1980	100.0	43.9	2.7	16.4	36.9
1990	100.0	44.0	2.7	19.0	34.1
2000	100.0	44.1	2.7	22.0	31.1
OUTPUT PER CAPITA IN THOUS.1972 U.S. $					
1972	0.14662	0.05307	0.00396	0.02126	0.06832
1980	0.21408	0.09406	0.00578	0.03520	0.07903
1990	0.35152	0.15488	0.00949	0.06696	0.12017
2000	0.59717	0.26346	0.01612	0.13173	0.18585
YEARLY RATE OF GROWTH OF OUTPUT PER CAPITA					
1972-1980	0.04730	0.07153	0.04726	0.06302	0.01819
1980-1990	0.04959	0.04986	0.04959	0.06431	0.04191
1990-2000	0.05299	0.05312	0.05299	0.06765	0.04359

ASSUMPTIONS

AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES 0.0400

ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80,1980-90,1990-2000	1.3	1.3	1.3
ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80,1980-90,1990-2000	3.0	3.0	3.0

ASIA

	GOVERNMENT	CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS
FINAL DEMAND IN BILL. 1972 U.S. $					
1972	17.8	118.2	30.1	25.8	29.2
1980	32.3	244.8	62.9	28.4	74.2
1990	66.7	499.8	135.8	60.6	140.3
2000	145.1	1045.0	285.0	122.2	278.3
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA					
1972-1980	0.07437	0.09095	0.09207	0.01175	0.11649
1980-1990	0.07523	0.07136	0.07689	0.07576	0.06366
1990-2000	0.07475	0.07375	0.07413	0.07018	0.06849
FINAL DEMAND SHARE (IN PERCENTAGES)					
1972	11.0	72.6	18.5	15.8	17.9
1980	11.0	83.1	21.3	9.6	25.2
1990	11.0	80.0	21.7	9.7	22.4
2000	11.0	79.2	21.6	9.2	21.0
FINAL DEMAND PER CAPITA IN THOUS.1972 U.S. $					
1972	0.01607	0.10645	0.02712	0.02327	0.02630
1980	0.02354	0.17806	0.04578	0.02066	0.05398
1990	0.03866	0.28127	0.07643	0.03410	0.07895
2000	0.06568	0.47309	0.12904	0.05534	0.12599
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA					
1972-1980	0.04772	0.06430	0.06542	-0.01489	0.08984
1980-1990	0.04959	0.04571	0.05124	0.05011	0.03802
1990-2000	0.05299	0.05199	0.05237	0.04842	0.04673

ASSUMPTIONS	AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES	0.0400		
	ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80,1980-90,1990-2000	1.3	1.3	1.3
	ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80,1960-90,1990-2000	3.0	3.0	3.0

	AGRICULTURE	MININGEQU.	MANUFACTUR.	OTHER SECT.	CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS	TOTAL OUTPUT
ASIA - INPUT-OUTPUT TABLES 1980									
AGRICULTURE	31.9228	0.0000	16.3897	2.9637	139.4810	1.0571	9.4000	16.5000	184.7143
MININGEQU.	0.0000	0.6478	13.7272	0.0000	0.0000	0.0000	1.8000	6.3000	9.8750
MANUFACTUR.	16.0316	0.4321	20.4105	14.8234	62.4944	28.7662	14.8000	45.2000	112.5581
OTHER SECT.	7.4599	0.8950	13.6308	18.4130	75.1246	33.0767	2.4000	6.2000	144.8000
VALUE ADDED	129.3000	7.9000	48.4000	108.6000					
TOTAL OUTPUT	184.7143	9.8750	112.5581	144.8000	277.1000	62.9000	28.4000	74.2000	451.9474
ASIA - INPUT-OUTPUT TABLES 1990									
AGRICULTURE	85.8218	0.0000	47.3083	7.7667	291.4241	2.3638	15.3000	26.6000	423.3846
MININGEQU.	0.0000	1.1120	27.7880	0.0000	0.0000	0.0000	1.7000	9.6000	21.0000
MANUFACTUR.	43.9782	1.0805	60.0948	39.5773	133.1748	65.6383	39.1000	92.4000	290.2439
OTHER SECT.	18.3847	2.0074	36.0529	44.1560	143.8011	67.7979	4.5000	11.7000	305.0000
VALUE ADDED	275.2000	16.8000	119.0000	213.5000					
TOTAL OUTPUT	423.3846	21.0000	290.2439	305.0000	568.4000	135.8000	60.6000	140.3000	1039.6285
ASIA - INPUT-OUTPUT TABLES 2000									
AGRICULTURE	224.6873	0.0000	125.2748	19.2872	618.4931	5.0910	20.8000	43.8000	969.8333
MININGEQU.	0.0000	2.0715	59.2285	0.0000	0.0000	0.0000	1.7000	18.5000	44.5000
MANUFACTUR.	119.2943	2.5892	164.7882	101.6914	292.7679	146.4691	92.6000	192.7000	727.5000
OTHER SECT.	43.9517	4.2393	87.2086	100.0599	278.8391	133.4399	7.1000	23.3000	631.5385
VALUE ADDED	581.9000	35.6000	291.0000	410.5000					
TOTAL OUTPUT	969.8333	44.5000	727.5000	631.5385	1190.1000	285.0000	122.2000	278.3000	2373.3718

LATIN AMERICA

	TOTAL	AGRICULTURE	MINING	MANUFACTURING	OTHER
OUTPUT IN BILL. 1972 U.S. $					
1972	217.0	28.7	10.0	52.0	126.3
1980	375.8	48.1	17.2	101.5	208.9
1990	753.3	96.4	34.6	234.0	388.2
2000	1511.1	193.4	69.5	540.0	708.2
YEARLY RATE OF GROWTH OF OUTPUT					
1972-1980	0.06867	0.06467	0.06845	0.08360	0.06293
1980-1990	0.06952	0.06948	0.06952	0.08352	0.06195
1990-2000	0.06961	0.06959	0.06961	0.08362	0.06010
OUTPUT SHARE (IN PERCENTAGES)					
1972	100.0	13.2	4.6	24.0	58.2
1980	100.0	12.8	4.6	27.0	55.5
1990	100.0	12.8	4.6	31.0	51.5
2000	100.0	12.8	4.6	35.7	46.8
OUTPUT PER CAPITA IN THOUS.1972 U.S. $					
1972	0.74570	0.09862	0.03436	0.17869	0.43402
1980	1.02704	0.13155	0.04724	0.27732	0.57092
1990	1.56299	0.20013	0.07189	0.48547	0.80548
2000	2.37981	0.30467	0.10947	0.85039	1.11528
YEARLY RATE OF GROWTH OF OUTPUT PER CAPITA					
1972-1980	0.04001	0.03601	0.03978	0.05493	0.03427
1980-1990	0.04199	0.04195	0.04199	0.05599	0.03441
1990-2000	0.04204	0.04202	0.04204	0.05605	0.03254

ASSUMPTIONS

AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES 0.0400

ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80,1980-90,1990-2000	1.3	1.3	1.3
ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80,1980-90,1990-2000	3.0	3.0	3.0

LATIN AMERICA

	GOVERNMENT CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS
FINAL DEMAND IN BILL. 1972 U.S. $				
1972	22.7	147.9	49.9	28.4	32.1
1980	39.4	274.5	74.8	39.8	52.7
1990	79.1	534.9	151.7	85.3	97.7
2000	158.6	1066.4	304.8	173.7	192.5
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA				
1972-1980	0.06914	0.07725	0.05050	0.04183	0.06200
1980-1990	0.06952	0.06671	0.07070	0.07618	0.06171
1990-2000	0.06961	0.06899	0.06973	0.07113	0.06774
FINAL DEMAND SHARE (IN PERCENTAGES)				
1972	10.5	68.1	23.0	13.1	14.8
1980	10.5	73.0	19.9	10.5	14.0
1990	10.5	71.0	20.1	11.3	12.9
2000	10.5	70.5	20.1	11.4	12.7
FINAL DEMAND PER CAPITA IN THOUS.1972 U.S. $				
1972	0.07800	0.50845	0.17171	0.09792	0.11039
1980	0.10783	0.75003	0.20450	0.10880	0.14414
1990	0.16411	1.10984	0.31491	0.17699	0.20288
2000	0.24988	1.67941	0.48007	0.27364	0.30319
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA				
1972-1980	0.04048	0.04859	0.02184	0.01317	0.03334
1980-1990	0.04199	0.03918	0.04317	0.04865	0.03418
1990-2000	0.04204	0.04142	0.04216	0.04356	0.04017

ASSUMPTIONS

AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES 0.0400

ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80,1980-90,1990-2000	1.3	1.3	1.3
ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80,1980-90,1990-2000	3.0	3.0	3.0

	AGRICULTURE	MINING&QU.	MANUFACTUR.	OTHER SECT.	CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS	TOTAL OUTPUT
LATIN AMERICA - INPUT-OUTPUT TABLES 1960									
AGRICULTURE	1.6803	0.0139	31.2696	0.0000	24.1555	0.1890	18.0000	6.6000	68.7143
MINING&QU.	0.0000	3.6303	18.2451	4.7912	0.0000	0.0000	9.3000	7.3000	28.6667
MANUFACTUR.	13.9325	3.1345	59.6587	29.2181	123.4067	32.0960	8.0000	33.4000	236.0465
OTHER SECT.	5.0015	4.6820	25.3731	35.6240	166.2377	42.5150	4.5000	5.4000	278.5333
VALUE ADDED	48.1000	17.2000	101.5000	208.9000					
TOTAL OUTPUT	68.7143	28.6667	236.0465	278.5333	313.8000	74.8000	39.8000	52.7000	611.9608
LATIN AMERICA - INPUT-OUTPUT TABLES 1990									
AGRICULTURE	3.8118	0.0389	73.2779	0.0000	44.0283	0.3509	37.2000	10.4000	148.3077
MINING&QU.	0.0000	6.7319	40.9346	10.2002	0.0000	0.0000	10.5000	10.7000	57.6667
MANUFACTUR.	36.5163	7.0247	161.7394	75.1889	260.2668	69.6956	26.8000	66.5000	570.7317
OTHER SECT.	11.5796	9.2712	60.7799	80.9823	309.7049	81.5535	10.8000	10.1000	554.5714
VALUE ADDED	96.4000	34.6000	234.0000	388.2000					
TOTAL OUTPUT	148.3077	57.6667	570.7317	554.5714	614.0000	151.6000	85.3000	97.7000	1331.2775
LATIN AMERICA - INPUT-OUTPUT TABLES 2000									
AGRICULTURE	9.3406	0.0853	177.2683	0.0000	89.8215	0.7177	61.9000	16.8000	322.3333
MINING&QU.	0.0000	12.7487	88.7599	21.5247	0.0000	0.0000	13.1000	20.3000	115.8333
MANUFACTUR.	93.5283	15.5105	408.9597	184.9107	555.0587	149.9321	78.0000	135.9000	1350.0000
OTHER SECT.	26.0644	17.9889	135.0120	174.9030	580.2199	154.1503	20.7000	19.5000	1089.5385
VALUE ADDED	193.4000	69.5000	540.0000	708.2000					
TOTAL OUTPUT	322.3333	115.8333	1350.0000	1089.5385	1225.1000	304.8000	173.7000	192.5000	2877.7051

MIDDLE EAST

	TOTAL	AGRICULTURE	MINING	MANUFACTURING	OTHER
OUTPUT IN BILL. 1972 U.S. $					
1972	73.4	7.5	27.3	7.0	31.5
1980	145.9	19.0	54.3	16.0	56.6
1990	345.3	45.2	128.4	44.4	127.1
2000	821.5	108.0	305.6	124.0	283.9
YEARLY RATE OF GROWTH OF OUTPUT					
1972-1980	0.08595	0.11548	0.08597	0.10333	0.07318
1980-1990	0.08609	0.08664	0.08609	0.10206	0.08088
1990-2000	0.08667	0.08690	0.08667	0.10270	0.08031
OUTPUT SHARE (IN PERCENTAGES)					
1972	100.0	10.3	37.2	9.5	43.0
1980	100.0	13.0	37.2	10.9	38.7
1990	100.0	13.1	37.2	12.8	36.8
2000	100.0	13.1	37.2	15.0	34.5
OUTPUT PER CAPITA IN THOUS.1972 U.S. $					
1972	0.84367	0.08689	0.31379	0.08045	0.36252
1980	1.31525	0.17156	0.48927	0.14414	0.51026
1990	2.28695	0.29997	0.85074	0.29403	0.84219
2000	4.04712	0.53210	1.50552	0.61083	1.39865
YEARLY RATE OF GROWTH OF OUTPUT PER CAPITA					
1972-1980	0.05550	0.08503	0.05552	0.07288	0.04272
1980-1990	0.05531	0.05587	0.05531	0.07129	0.05010
1990-2000	0.05707	0.05731	0.05707	0.07311	0.05072

ASSUMPTIONS

AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES 0.0400

ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80,1980-90,1990-2000	1.3	1.3	1.3
ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80,1980-90,1990-2000	3.0	3.0	3.0

MIDDLE EAST

	GOVERNMENT CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS
FINAL DEMAND IN BILL. 1972 U.S. $				
1972	13.0	32.5	14.7	30.5	17.4
1980	25.9	91.5	36.0	49.1	56.7
1990	61.4	196.1	85.4	124.1	121.9
2000	146.2	456.5	204.6	299.9	285.8
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA				
1972-1980	0.08600	0.12939	0.11196	0.05926	0.14717
1980-1990	0.08609	0.07614	0.08624	0.09275	0.07642
1990-2000	0.08667	0.08448	0.08731	0.08819	0.08520
FINAL DEMAND SHARE (IN PERCENTAGES)				
1972	17.8	44.3	20.1	41.6	23.8
1980	17.8	62.7	24.7	33.6	38.8
1990	17.8	56.7	24.7	35.9	35.3
2000	17.8	55.5	24.9	36.5	34.7
FINAL DEMAND PER CAPITA IN THOUS.1972 U.S. $				
1972	0.15011	0.37390	0.16931	0.35137	0.20103
1980	0.23411	0.82514	0.32498	0.44247	0.51146
1990	0.40707	1.29888	0.56596	0.82240	0.80738
2000	0.72038	2.24892	1.00799	1.47778	1.40796
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA				
1972-1980	0.05555	0.09894	0.08150	0.02881	0.11672
1980-1990	0.05531	0.04537	0.05547	0.06198	0.04565
1990-2000	0.05707	0.05489	0.05771	0.05860	0.05560

ASSUMPTIONS

AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES 0.0400

ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80,1980-90,1990-2000	1.3	1.3	1.3
ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80,1980-90,1990-2000	3.0	3.0	3.0

	AGRICULTURE	MINING&QU.	MANUFACTUR.	OTHER SECT.	CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS	TOTAL OUTPUT
MIDDLE EAST - INPUT-OUTPUT TABLES 1980									
AGRICULTURE	3.1571	0.0000	1.9595	0.0000	24.3469	0.1793	5.1000	7.6000	27.1429
MINING&QU.	0.0000	9.4069	12.3617	2.0654	0.0000	13.4410	34.0000	3.4000	67.8750
MANUFACTUR.	3.2317	2.3690	5.2376	7.3015	46.2871	8.7824	2.5000	38.5000	37.2093
OTHER SECT.	1.7540	1.7991	1.6505	9.4998	46.8660	13.5972	7.5000	7.2000	75.4667
VALUE ADDED	19.0000	54.3000	16.0000	56.6000					
TOTAL OUTPUT	27.1429	67.8750	37.2093	75.4667	117.5000	36.0000	49.1000	56.7000	207.6938
MIDDLE EAST - INPUT-OUTPUT TABLES 1990									
AGRICULTURE	9.0702	0.0000	5.2390	0.0000	51.3374	0.3920	17.2000	13.7000	69.5385
MINING&QU.	0.0000	22.9533	30.8126	6.6329	0.0000	34.4013	63.4000	5.7000	160.5000
MANUFACTUR.	10.2479	5.4257	15.4428	21.9976	107.6758	21.1028	13.9000	87.5000	108.2927
OTHER SECT.	5.0204	3.7210	4.3983	25.8409	98.4868	29.5039	29.6000	15.0000	181.5714
VALUE ADDED	45.2000	128.4000	44.4000	127.1000					
TOTAL OUTPUT	69.5385	160.5000	108.2927	181.5714	257.5000	85.4000	124.1000	121.9000	519.9026
MIDDLE EAST - INPUT-OUTPUT TABLES 2000									
AGRICULTURE	26.9142	0.0000	14.6109	0.0000	121.8465	0.9284	41.8000	26.1000	180.0000
MINING&QU.	0.0000	55.8559	115.9096	20.1388	0.0000	87.0956	115.7000	12.7000	382.0000
MANUFACTUR.	31.0511	12.5778	43.9365	63.7088	260.8239	50.9019	59.2000	212.2000	310.0000
OTHER SECT.	14.0346	7.9663	11.5429	69.0216	220.1297	65.6740	83.2000	34.8000	436.7692
VALUE ADDED	108.0000	305.6000	124.0000	283.9000					
TOTAL OUTPUT	180.0000	382.0000	310.0000	436.7692	602.8000	204.6000	299.9000	285.8000	1308.7692

INDUSTRIALISED COUNTRIES

	TOTAL	AGRICULTURE	MINING	MANUFACTURING	OTHER
OUTPUT IN BILL. 1972 U.S. $					
1972	3439.3	240.7	154.7	1038.6	2005.1
1980	4591.6	275.4	206.6	1421.5	2688.0
1990	6796.8	373.8	305.8	2104.2	4013.0
2000	10058.7	502.9	452.6	3114.0	5989.1
YEARLY RATE OF GROWTH OF OUTPUT					
1972-1980	0.03612	0.01685	0.03612	0.03922	0.03663
1980-1990	0.03922	0.03052	0.03922	0.03922	0.04007
1990-2000	0.03919	0.02966	0.03919	0.03919	0.04004
OUTPUT SHARE (IN PERCENTAGES)					
1972	100.0	7.0	4.5	30.2	58.3
1980	100.0	6.0	4.5	30.9	58.5
1990	100.0	5.5	4.5	30.9	59.0
2000	100.0	5.0	4.5	30.9	59.5
OUTPUT PER CAPITA IN THOUS.1972 U.S. $					
1972	3.10406	0.21728	0.13968	0.93743	1.80965
1980	3.82638	0.22958	0.17218	1.18458	2.24003
1990	5.18055	0.28493	0.23312	1.60381	3.05869
2000	7.07860	0.35393	0.31853	2.19141	4.21472
YEARLY RATE OF GROWTH OF OUTPUT PER CAPITA					
1972-1980	0.02615	0.00688	0.02615	0.02924	0.02666
1980-1990	0.03029	0.02159	0.03029	0.03029	0.03114
1990-2000	0.03121	0.02168	0.03121	0.03121	0.03205

ASSUMPTIONS

AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES	0.0400		
ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80,1980-90,1990-2000	1.1	1.0	1.0
ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80,1980-90,1990-2000	4.5	4.5	4.5

INDUSTRIALISED COUNTRIES

	GOVERNMENT	CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS
FINAL DEMAND IN BILL. 1972 U.S. $					
1972	567.2	2044.0	833.5	438.1	443.5
1980	757.6	3019.7	733.0	471.5	390.3
1990	1121.4	4385.6	1176.4	746.1	632.9
2000	1659.6	6455.5	1739.9	1121.2	917.6
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA					
1972-1980	0.03618	0.04878	-0.01605	0.00920	-0.01597
1980-1990	0.03922	0.03731	0.04730	0.04588	0.04832
1990-2000	0.03919	0.03865	0.03913	0.04072	0.03715
FINAL DEMAND SHARE (IN PERCENTAGES)					
1972	16.5	59.4	24.3	12.7	12.8
1980	16.5	65.7	15.9	10.2	8.5
1990	16.5	64.5	17.3	10.9	9.3
2000	16.5	64.1	17.2	11.1	9.1
FINAL DEMAND PER CAPITA IN THOUS.1972 U.S. $					
1972	0.51192	1.84478	0.75227	0.39539	0.40031
1980	0.63135	2.51645	0.61087	0.39298	0.32528
1990	0.85479	3.34274	0.89666	0.56874	0.48239
2000	1.16797	4.54293	1.22442	0.78908	0.64580
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA					
1972-1980	0.02621	0.03881	-0.02602	-0.00076	-0.02594
1980-1990	0.03029	0.02839	0.03837	0.03696	0.03940
1990-2000	0.03121	0.03067	0.03115	0.03274	0.02917

ASSUMPTIONS

AVERAGE ANN.GROWTH RATE OF MANUF.OUTPUT IN INDUSTR.COUNTRIES 0.0400

ELASTICITY OF MANUF.OUTPUT TO TOTAL OUTPUT 1972-80;1980-90;1990-2000	1:1	1:0	1:0
ACCELERATOR OR INCR.CAPITAL OUTPUT RATIO 1972-80;1980-90;1990-2000	4.5	4.5	4.5

	AGRICULTURE	MINING&QU.	MANUFACTUR.	OTHER SECT.	CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS	TOTAL OUTPUT
INDUSTRIALISED COUNTRIES - INPUT-OUTPUT TABLES 1960									
AGRICULTURE	110.2608	0.2383	300.0096	3.1014	135.6515	4.7384	68.2000	71.4000	550.8000
MINING&QU.	10.2119	8.7976	116.7808	108.4736	105.3898	0.9925	17.5000	50.3000	317.8462
MANUFACTUR.	100.9107	46.9969	1461.3091	602.0808	1145.6404	270.1516	341.2000	229.5000	3740.7895
OTHER SECT.	54.0166	53.2133	441.1900	733.7288	2390.7184	457.1175	44.7000	39.3000	4135.3846
VALUE ADDED	275.4000	206.6000	1421.5000	2688.0000					
TOTAL OUTPUT	550.8000	317.8462	3740.7895	4135.3846	3777.4000	733.0000	471.6000	390.5000	8744.8202
INDUSTRIALISED COUNTRIES - INPUT-OUTPUT TABLES 1990									
AGRICULTURE	179.7799	0.3206	471.4783	4.2094	192.7377	7.4407	74.2000	99.5000	830.6667
MINING&QU.	16.7404	12.7847	184.8246	158.7604	150.9365	1.6149	10.5000	65.7000	470.4615
MANUFACTUR.	170.1382	73.0424	2374.7549	905.4901	1684.0067	436.3677	605.0000	403.8000	5845.0000
OTHER SECT.	90.2081	76.5139	709.7421	1092.3862	3479.4191	730.9768	56.6000	64.0000	6173.8462
VALUE ADDED	373.8000	305.8000	2104.2000	4013.0000					
TOTAL OUTPUT	830.6667	470.4615	5845.0000	6173.8462	5507.1000	1176.4000	746.3000	633.0000	13319.9744
INDUSTRIALISED COUNTRIES - INPUT-OUTPUT TABLES 2000									
AGRICULTURE	293.4561	0.4778	717.9620	6.3227	278.1080	10.7235	69.2000	119.0000	1257.2500
MINING&QU.	27.4553	18.6090	281.7764	232.6630	218.2155	2.3884	7.3000	92.1000	696.3077
MANUFACTUR.	282.4270	107.8017	3675.9118	1347.4886	2471.0033	642.0106	984.3000	613.8000	8897.1429
OTHER SECT.	151.0115	116.8192	1107.4927	1638.4257	5147.7731	1084.5774	60.7000	92.8000	9214.0000
VALUE ADDED	502.9000	452.6000	3114.0000	5989.1000					
TOTAL OUTPUT	1257.2500	696.3077	8897.1429	9214.0000	8115.1000	1739.7000	1121.5000	917.7000	20064.7005

WORLD

	TOTAL	AGRICULTURE	MINING	MANUFACTURING	OTHER
OUTPUT IN BILL. 1972 U.S. $					
1972	3957.8	356.8	201.4	1128.9	2270.6
1980	5521.7	511.9	294.9	1602.4	3112.4
1990	8753.1	872.6	503.7	2537.0	4839.7
2000	14184.3	1552.8	899.8	4152.0	7579.6
YEARLY RATE OF GROWTH OF OUTPUT					
1972-1980	0.04162	0.04513	0.04762	0.04377	0.03941
1980-1990	0.04607	0.05332	0.05353	0.04594	0.04414
1990-2000	0.04827	0.05763	0.05801	0.04926	0.04486
OUTPUT SHARE (IN PERCENTAGES)					
1972	100.0	9.0	5.0	28.5	57.3
1980	100.0	9.2	5.3	29.0	56.3
1990	100.0	9.9	5.7	28.9	55.2
2000	100.0	10.9	6.3	29.2	53.4
OUTPUT PER CAPITA IN THOUS.1972 U.S. $					
1972	1.34759	0.12149	0.06860	0.38438	0.77311
1980	1.58716	0.14716	0.08477	0.46059	0.89462
1990	2.03750	0.20312	0.11726	0.59054	1.12656
2000	2.71108	0.29680	0.17199	0.79357	1.44870
YEARLY RATE OF GROWTH OF OUTPUT PER CAPITA					
1972-1980	0.02045	0.02396	0.02645	0.02260	0.01824
1980-1990	0.02497	0.03222	0.03244	0.02485	0.02305
1990-2000	0.02856	0.03792	0.03830	0.02954	0.02514

WORLD

	GOVERNMENT	CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS
FINAL DEMAND IN BILL. 1972 U.S. $					
1972	631.0	2387.2	939.6	537.2	537.2
1980	873.2	3718.6	929.8	606.0	606.0
1990	1367.1	5788.2	1597.7	1053.7	1053.7
2000	2183.6	9368.9	2631.8	1794.5	1794.5
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA					
1972-1980	0.04060	0.05540	-0.00130	0.01507	0.01507
1980-1990	0.04482	0.04424	0.05413	0.05530	0.05530
1990-2000	0.04682	0.04815	0.04990	0.05324	0.05324
FINAL DEMAND SHARE (IN PERCENTAGES)					
1972	15.9	60.3	23.7	13.5	13.5
1980	15.8	67.3	16.8	10.9	10.9
1990	15.6	66.1	18.2	12.0	12.0
2000	15.3	66.0	18.5	12.6	12.6
FINAL DEMAND PER CAPITA IN THOUS.1972 U.S. $					
1972	0.21485	0.81281	0.31992	0.18291	0.18291
1980	0.25099	1.06889	0.26727	0.17420	0.17420
1990	0.31822	1.34735	0.37192	0.24528	0.24528
2000	0.41735	1.79069	0.50303	0.34300	0.34300
YEARLY RATE OF GROWTH OF FINAL DEMAND PER CAPITA					
1972-1980	0.01943	0.03423	-0.02247	-0.00609	-0.00609
1980-1990	0.02373	0.02315	0.03304	0.03421	0.03421
1990-2000	0.02711	0.02844	0.03019	0.03353	0.03353

	AGRICULTURE	MINGEQU.	MANUFACTUR.	OTHER SECT.	CONSUMPTION	INVESTMENT	EXPORTS	IMPORTS	TOTAL OUTPUT
WORLD - INPUT-OUTPUT TABLES 1980									
AGRICULTURE	148.5513	0.2582	355.9211	6.0651	364.2869	6.1638	107.0000	107.0000	881.2465
MINGEQU.	10.2119	24.0350	163.3624	115.3302	105.3898	14.4335	68.8000	68.8000	435.7629
MANUFACTUR.	139.4637	56.8376	1552.6687	664.7502	1401.6206	348.7628	369.6000	369.6000	4164.1034
OTHER SECT.	71.3145	62.9319	483.7513	810.5660	2720.0027	560.2398	60.6000	60.6000	4708.8115
VALUE ADDED	511.7000	294.7000	1602.4000	3112.1000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL OUTPUT	881.2465	438.7629	4164.1034	4708.8115	4591.3000	929.6000	606.0000	606.0000	10192.9241
WORLD - INPUT-OUTPUT TABLES 2000									
AGRICULTURE	282.8706	0.3595	611.7242	11.7761	663.2165	10.5474	158.1000	158.1000	1540.9642
MINGEQU.	16.7404	47.1124	313.0626	175.5935	150.9365	36.0162	93.9000	93.9000	739.4615
MANUFACTUR.	275.7029	90.4636	2625.6791	1066.1386	2232.4287	612.3553	696.3000	696.3000	6902.7683
OTHER SECT.	133.2503	98.0260	815.0325	1269.8110	4108.4182	938.4812	105.4000	105.4000	7363.0193
VALUE ADDED	872.4000	503.5000	2537.0000	4839.5000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL OUTPUT	1580.9642	739.4615	6902.7683	7363.0193	7155.0000	1597.4000	1053.7000	1053.7000	16586.2133
WORLD - INPUT-OUTPUT TABLES 1990									
AGRICULTURE	566.5315	0.5631	1071.1047	25.6099	1285.8613	17.4606	216.4000	218.4000	2967.1309
MINGEQU.	27.4553	96.5539	593.2723	274.3265	218.2155	89.4340	147.8000	147.8000	1299.3077
MANUFACTUR.	565.6366	146.6652	4325.6559	1747.6965	3675.8975	1030.5914	1248.9000	1248.9000	11492.1429
OTHER SECT.	254.9073	155.8256	1350.1099	2033.6363	6372.3258	1493.9639	179.4000	179.4000	11660.7693
VALUE ADDED	1552.6000	899.7000	4152.0000	7579.5000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL OUTPUT	2967.1309	1299.3077	11492.1429	11660.7693	11552.3000	2631.5000	1794.5000	1794.5000	27419.3506

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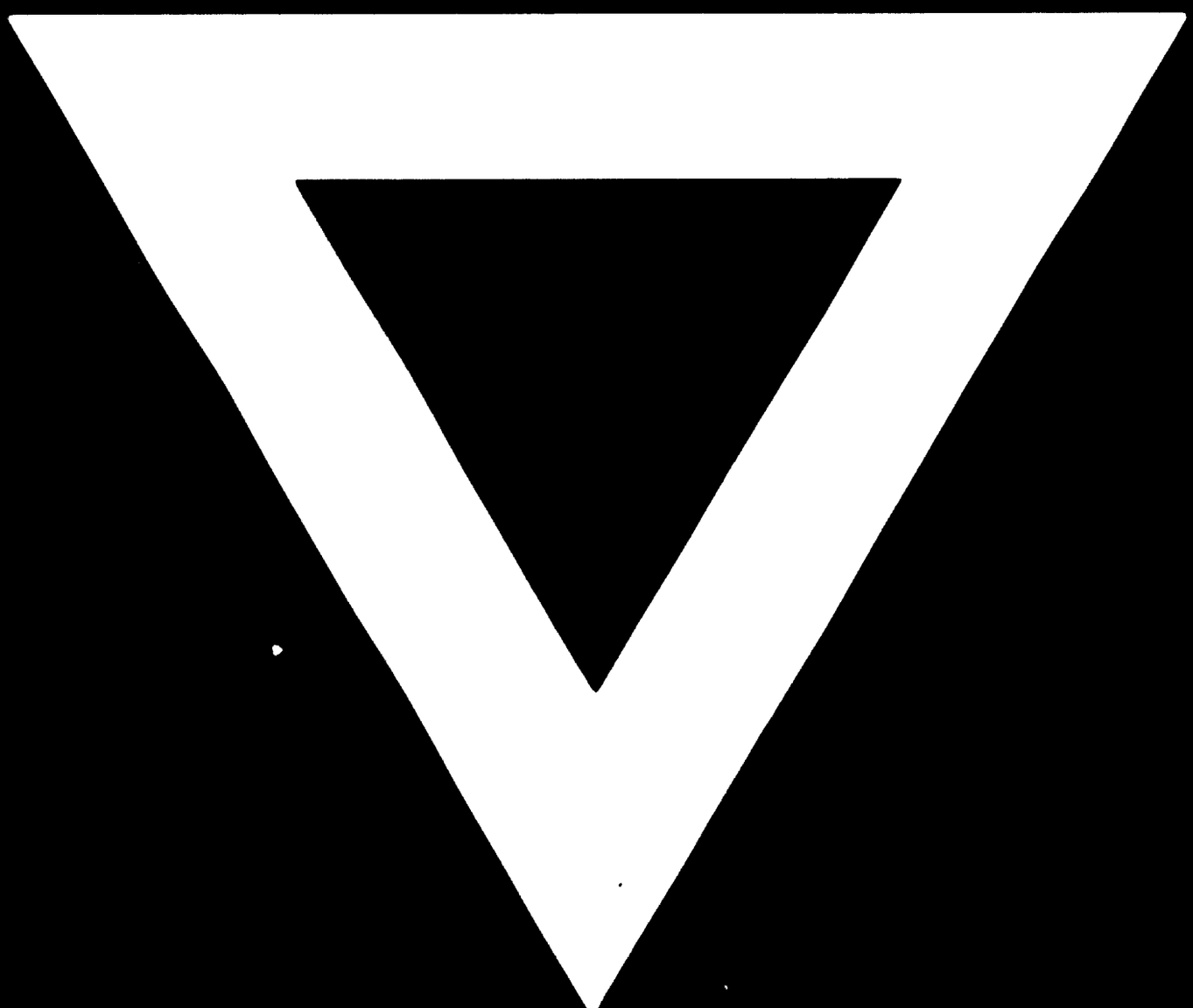

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