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INTERREGIONAL ALLOCATION OF INVESTMENTS

FOR SOCIAL AND ECONOMIC DEVELOPMENT

An elementary model ~~framework for~~ approach to analysis

by

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Covering Note

The aim of this paper is to analyse the problems of proper interregional allocation of investments, which is a fundamental one in relation to regional disaggregation of national development plans. [1]

The basic issue involved is whether investments should be spatially concentrated to the already fairly developed areas, or to selected development areas within the large backward hinterlands. Beneath this choice are the under-lying issues of assumed conflicts between national growth and spatial equalization, and, from the opposite point of view, between short and long term considerations. [2]

The paper summarizes and reviews the arguments for and against the two conflicting strategies and concludes that appropriate conclusions can be drawn only on the basis of quantitative analysis related to specific national development goals, and that the time horizon is apt to play an important role in the choice of strategy. Two types of simplified two-region growth-allocation models are formulated and analyzed. In the first, the structural parameters are assumed to be fixed during time; in the second, the parameters are assumed to be gradually changed by means of built-in mechanisms reflecting the impact of the development process upon the social and economic structure of the regions.

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[1] The topic of regional disaggregation of national policies and plans is an important research project in the frame-work of UNRISD programme of regional development.

[2] Compare A.R.Kuklinski: Goals in Regional Policies and Objectivies in Regional Planning, a paper prepared for the Regional Planning Conference Ireland 69, Belfast, 19-21 March 1969.

When the development paths resulting from the two strategies are compared, it can be shown that in the model with fixed parameters, the aims of growth and equalization will be reconciled only in the case of conditions, very rarely fulfilled in developing countries. However, in the model with built-in changes in the parameters - which it is believed reflects the conditions of developing countries better than the former - it can be shown that there are much greater changes for reconcil- iation of the two aims. However, since the allocation of investments to the initially backward region will bring about a loss of income in the first periods, the reconciliation of the two aims are possible only if the time horizon of the planners and policy-makers are long enough to permit this loss to be regained at a later stage.

The paper is presented for critical evaluation in order to stimulate discussion of interregional allocation of investments for social and economic development. Your comments would be greatly appreciated.
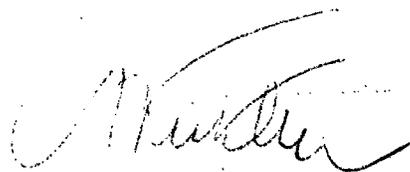
Antoni R. Kuklinski.

Geneva, December 1968.

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1. INTRODUCTION *

1.1. Political and economic issues in interregional allocation

1.1.1. In spite of the facts, which are correctly pointed out by Friedmann and Alonso, that "the decision of where to locate a new project is as important as the decision to invest in it," and that "the question of social justice in the distribution of the fruits of economic development is as important and as difficult in terms of regions as of social classes," [1] there is a great scarcity of well established guidelines for decision-making in this field. [2] One reason for the lack of theoretical achievements may be that the question of efficient regional allocation of investment funds may have equally important political aspects as economic. Two points deserve to be mentioned:

1.1.2. First, since regional groupings rest on the same kind of geographical demarcation that defines the nation itself, they tend to attract similar types of loyalties as mobilized on behalf of the nation. These regional loyalties may, however, constitute a latent threat to central governments and support separatist political actions if the national loyalties are overstrained by regional inequalization in the level of welfare and power of influence. Therefore, no n tion can pursue allocation policies aiming at efficiency in the limited economic sense only, but have to make allowances for political aims which eventually may conflict with the economic aims. [3]

1.1.3. Secondly, such conflicts will often manifest themselves as conflicts between planners and executives on the one hand and politicians on the other. The reason for this is that planning is mainly carried out in the executive branch – usually divided into functional sectors – while the legislative branch, through which the politicians exercise their influence, is based on territorial elections. Therefore, in so far as planning involves decisions with strong territorial implications capable of promoting or hampering growth in various areas, this will necessarily be of direct concern to the legislators as individuals and groups of politicians. [4]

1.2. Essential characteristics of regional development

1.2.1. However, the political aspects of interregional allocation are by no means the sole reason for the difficulties involved in establishing proper decision-criteria, and perhaps even not the most significant. When limiting ourselves to the question of economic efficiency only, difficult problems of how to delineate regions, of allocation procedures – whether to start with sectorial criteria and then proceed to the spatial, or the opposite way around –

and methodological questions related to the <u>peculiarities of regional economies</u> as opposed to national and sectorial have to be tackled. Because of phenomena like economies of scale, external economies, factor movements and mobility-limitations are important characteristics of regional economies, and the fact that regions cannot be run down in the same way as industries, common criteria of efficiency, useful for solving intersectorial allocation problems, cannot be applied directly for problems of interregional allocations. $\frac{5}{}$

1.2.2. Furthermore, since the final end of development is increased human welfare - and we take into account that although regions cannot move, people can and indeed do more - difficult problems arise with respect to defining <u>goals</u> for interregional development in terms of "balance" and "equity". The time factor appears also to be a crucial one in this context, and requires the analysis of interregional efficiency to be made within a dynamic framework. $\frac{6}{}$

1.3. <u>The subject of the paper</u>

1.3.1. The crucial significance for national as well as regional development of interregional allocation decisions, the shortage of theoretical and empirical evidence upon which such allocation decisions can be made, and the need for promoting research in this field are the reasons behind the inclusion of a project on "regional disaggregation of national policies and plans"within the programme of research on regional development of the United Nations Research Institute for Social Development. $\frac{7}{}$ This paper, which is intended to be a first step into this field limits itself to a discussion of some basic issues of economic and social interregional development. This should not be interpreted to mean that the political aspects mentioned above are of minor importance and can be disregarded. However important the political aspects may be, there is nevertheless a need to clarify basic economic issues upon which calculations of trade-offs between various conflicting goals can be attempted.

1.3.2. The paper deals with a particular, simple, but nevertheless illustrating case of a closed two-region economy,aiming at rapid overall economic growth and interregional equalization through proper allocation of their investment funds generated by internal savings. A very simple dynamic model-framework is suggested, within which the problems of short- and long-term trade-offs between the goals of efficiency and equity and the dependency of the allocation strategy upon the time horizon of planning can be analysed.

2. <u>GENERAL ASPECTS OF INTERREGIONAL ALLOCATIONS IN DEVELOPING COUNTRIES</u>

2.1. <u>The limited choice possibilities</u>

2.1.1. In most developing countries, the problem of interregional allocation

of investments presents itself as a choice between a fairly well developed part of the country, consisting of one or a small number of geographically limited urban areas, and a large backward hinterland. The developed area usually contains the administrative and institutional centre of the country, it has some modern industries, and a level of income considerably higher than the hinterland. The developed areas of the country are, as a rule, better mutually integrated and also often tend to be more integrated with developed areas in other countries - through trade and communication - than with their hinterland. [8]/ The urban areas are furthermore characterized by; a very high inflow of migrants from the hinterland; a large amount of unemployment; big disparities in income, and unbalanced internal growth leading to problems of overcongestion, diseconomies and social unrest.

2.1.2. The hinterland, on the contrary, is characterized by a very low income, subsistence agricultural economy, weakly developed internal and external communications, low levels of education and skills, and an increasing out-migration to the developed areas. This polarity, which is the spatial manifestation of a dual economy, raises the question of the possible overdevelopment of the urban areas to the detriment of the rest of the country, as a paramount issue of interregional policies and planning in many developing countries. [9]/

2.2. The goals of development

2.2.1. The prime goal of development in economically backward countries is generally rapid increase in total production and national income leading to an increased standard of living for the masses of people, and particularly for those belonging to the low-income groups. Growth in production through capital formation and increased productivity appears therefore to hold the key to development. Besides the aim of rapid overall economic growth, justice in the distribution of the fruits of development, leading to a gradual equalization of the standard of living and reduction of unemployment, appear also to be vital aspects of the objectives of national development policy.

2.2.2. Among the various problems of income distribution, the problem of interregional disparities seems, for many reasons, to be a more difficult one than those of personal, functional and industrial disparities within the same geographical area. This is partly due to the higher mobility between occupations and industries within a developed area, and partly to the fact that regional economies grow or decline as entities rather than have their income changed as the outcome of a sum of independent variations in particular activities located in the region. [10]/ Interregional disparities must be seen as resulting from

structural differences among the regions. Therefore, reduction of these disparaties cannot be attained by income transfers, but requires certain structural changes.

2.2.3. Against the background of what has been said above, it would seem useful to classify the goals of national development in two groups. First, there are the permanent goals of income growth and gradual equalization in standards of living between sectorial and functional groups as well as between regions. Secondly, there are structural goals, which are instrumental for the attainment of the permanent ones, and which are concerned with deliberate secular transformation of the industrial, social and spatial structures of the nations, so as to obtain future structures which are conducive to the attainment of the permanent goals. 11/ The deliverate transformation of the social and industrial structures of the underdeveloped regions and corresponding adjustments of the spatial structure of the national economy appear to be necessary conditions for a gradual reduction of interregional disparities.

2.2.4. One particular structural goal related to the regional problem deserves to be specifically mentioned, namely, the goal of integration of national space. This goal bears on the facilities for transportation and communication, as well as on interregional trade, and on the distribution of political influence in the national state, and is of a long-term nature. Although there is no quantitative method available for evaluating the trade-off between the attainment of the goal of national integration and the goal of economic growth - if there is a conflict - the efforts to create a well integrated modern nation out of a collection of disintegrated regions are perhaps of equally paramount significance for newly liberated countries as the increase in total production. 12/

2.3. Means and instruments

2.3.1. What means are at the disposal of a central government for attaining the goals discussed above? To give a complete answer to this question is not the purpose of this paper. However, it is obvious that the allocation of funds for fixed capital formation, and for other developmental expenditures such as for education, vocational training, public health etc., are key factors, together with means aiming at curbing the influx of migrants to the overcongested urban area and promoting increased mobility among skilled labour and management personnel. Another important set of means are those directed towards checking the consumption and increasing the saving rates of industries as well as for regions.

2.3.2. The latter set of means are closely related to the fiscal policy which, in turn, largely depends on an appropriate and efficient taxation administration. In general, the role and tasks of public administration seem to be a very neglected field in development analysis.[13] However, it may be well justified to look at current expenditures in this sector as being investments which in time are accumulated in an administrative apparatus conducive to growth in the future. Parts of the fruits of present expenditure are thus distributed over future time periods. Since all efforts initiated by a central government, in practice, have to be channelled through and implemented by administrative procedures, unreliable and inefficient administration may sometimes be among the most serious obstacles to growth.

2.3.3. A similar point of view regarding short- and long-term effects can also be applied to the question of material resource allocation. Since the efficiency of a new industrial project is affected by complementary, competitive and income-demand relations to already existing industries, the establishment of the project in question is bound to have reciprocal effects on the efficiency of these and, what is more important, also on the structure, location and efficiency of future projects. This dynamic interdependence requires that the use of means aimed at securing efficiency in resource utilization and allocation must be based on carefully elaborated dynamic plans.[13a]

2.3.4. The significance of efficient use of resources for development is clearly pointed out by Lefeber,[14] who argues that efficient resource use will:

a)   increase the investment potential in the short run
     (more projects can be undertaken with the same amount
     of resources);

b)   increase savings in the intermediate run (higher returns
     on investments); and

c)   accelerate the rate of development and capital formation
     (due to the above factors).

2.4.   Stages in development planning

2.4.1. While the aim of planning is to achieve the development goals as these emerge from the goal-setting process, the purpose of planning (in this case of the interregional allocation of investment funds and other developmental expenditures) is to formulate guidelines and rules for coordination of present and future actions in order that the goals are achieved in an efficient way.[15] Hence, the planning process must involve a conception of sequence of allocative

decisions over a series of future time-periods. [16]/

2.4.2. It is useful to distinguish between project planning, i.e. the planning of separate investment projects including their location, and comprehensive planning. [17]/ In project planning, most of the attention is concentrated on the detailed technical and economic specifics internal to the project and, therefore, there is a tendency to assume that the structural environment is fairly constant, i.e. that the project only marginally alters the environmental structural matrix.

2.4.3. Comprehensive planning on the other hand is concerned with the interplay effect of many projects generating structural changes industrially and socially as well as spatially. Comprehensive planning derives its objectives from the structural goals, and is essentially of a long-term co-ordinative nature. Comprehensive planning aims at establishing guidelines for project planning, for example, that the location of a given project is changed from what would seem to give the highest direct return, to a location which is the best when the effects on existing and future projects are taken into account.

2.4.4. Efficient use of resources requires both types of planning. However, inasmuch as development necessarily depends upon structural transformation, comprehensive structural planning appears to be the more important. Rational interregional allocation of investment projects can be achieved only when the decision criteria to be used in project planning are based on guidelines derived from comprehensive plans which take stock of the effects the project has on existing and future projects. [18]/ Comprehensive planning can be conceived of as consisting of three phases: first, the identification of all feasible development paths; secondly, the choice of the most desired path among those that are feasible; and thirdly, the elaboration of guidelines to be applied in the project planning stage. [19]/

2.4.5. Before leaving this topic, it should also be mentioned that in spatial planning it is useful to distinguish between two levels, interregional and intraregional or interlocal. [20]/ Planning at both levels is mutually interdependent and conditioned on each other. For example, planning of the location pattern within a region cannot be done without a knowledge of what activities playing a part in the interregional division of labour are to be located in the region. However, what activities are to be located in a region depends in turn on the pattern of location within the region, since the actual pattern and the planned transformation of this may affect the productivity of different projects differently. It is therefore a strong case for co-ordination of interregional and interlocal planning.

2.5.   Agruments for concentrating development efforts in the
       more developed areas

2.5.1. Recalling that the choice of location for an actual project - and
consequently also for long-term strategy of interregional allocation - are
limited to two broad alternatives,   the actual strategy to be followed will
depend on the prospective advantages and disadvantages of each of these and how
they are distributed over the future time periods.

2.5.2. The most commonly used arguments in favour of concentrating
development efforts to the already developed areas are:

a)   Such areas usually have natural advantages due to the
     existence of natural resources;[21/]

b)   Due to their earlier development, such areas enjoy
     advantages derived from accumulation of capital resources,
     skilled labour and growth oriented management;

c)   Often the fairly well developed areas are favourably
     situated in relation to the national and the export markets;[22/]

d)   Already developed urban areas will benefit from
     agglomeration economics:

     1)   Relatively short distances between various linked
          plants, residential areas and terminals reduce
          the cost of intra-area transportation;[23/]

     2)   Close location of several plants and concentration
          of demand will allow for specialization in the
          auxiliary and the service sectors;[24/]

     3)   The size of the labour market will allow for
          exploitation of internal economies of scale in
          the plants;

     4)   Economies of scale can be exploited in the economic
          infrastructure;

     5)   The industries can benefit from technical external
          economies due to easy dissemination of market
          information and technical information, rapid spread
          of innovations, and massing of reserves in the sharing
          of pools of skilled labour and repair services.[25/]

The factors mentioned so far are arguments that explain why
return on investments may be higher in the urbanized developed
areas than in the underdeveloped non-urbanized hinterland
areas. These factors contribute of course also to the
explanation of why these areas appear to have entered a
stage of self-sustained growth, which, as will be argued
later, can be too rapid, leading to the detriment of the
hinterland and slowing down the national growth rate.

2.5.3. The complete explanation of the sustained growth rests also on
some additional factors:

e) The urbanized developed areas may benefit from dynamic
external economies, [26]/ such as:

1) The development of techniques and acquisition of skills
among labourers as well as in management and organization
which occur as a growth process, and in time create a
social environment conducive to further growth. [27]/

2) The existence of inter-industry linkages through which
impulses to expansion and investments are transmitted
forwards and backwards. [28]/

3) The income multiplier effect which results from an initial
expansion in the areas external trade and production.
In the short term this effect raises the wages and increases
employment. In the intermediate term more migrants are
attracted leading to continual investment   activitiy
and at the same time extended market for the local trades
leading to new import-substitution activities and de-
clined import leakage. In the long run the competitive-
ness of the other industries may also be strengthened
because of higher productivity in the local auxiliary
industries. [29]/

f) The already developed areas, due to the larger size of their
labour market and the diversification of their production
activities, usually enjoy a higher flexibility in their
adaptions to changes in demand, production techniques and
supply, and they have a fairly high resistance to external
shocks. [30]/

g) The already developed areas will finally have a <u>higher savings</u> <u>rate</u> and therefore expand their productive capacity and the "up-to-dateness" of their capital equipment much faster than the hinterland where the actual saving rate is much lower.[31]

2.5.4. The arguments for concentrating most of the national-development efforts in the already developed areas are, however, not limited to the productivity factors of these areas alone, but also include <u>arguments referring</u> <u>to the backward hinterland</u>. The most important of these are:

h) The fruits of the development originally generated in the urban areas will be distributed in space through relative <u>price-</u> <u>lowering effects</u> reflecting the higher productivity of inter-regionally traded commodities produced in the urban areas.[32]

i) The growth in the urban areas may <u>increase the demand for</u> raw materials as well as intermediary and agricultural <u>products</u> <u>purchased from the hinterland</u>.[33]

j) The growth in the urban areas will <u>relieve some of the popula-</u> <u>tion pressures in the hinterland</u> through increased out-migration.[34]

k) In order to undertake such large-scale investments which are indispensable to induce growth in the backward areas, the total amount of investable resources must be broadened by furthering growth in the urban area for still some years.[35]

l) The <u>underdeveloped areas have initially a too low absorptive</u> <u>capacity</u> to successfully exploit large-scale capital investments. In the first periods, while development efforts are concentrated to the developed areas, the investments in the underdeveloped areas should be of a preparatory character, relying mostly on local resources, particularly on unemployed labour, aiming at broadening the absorptive capacity for future investments. Among such preparatory projects, land reclamation, reafforesta-tion, road and school-building and vocational training appear to be the more important.[36]

2.5.5. The above-mentioned arguments lead to the conclusion that the process of national economic and social development requires that growth is unevenly distributed in space. If an underdeveloped country, characterized by a dual economy, tries to develop its underdeveloped areas ahead of time, this will necessarily be at the cost of better opportunities lost in the already fairly well developed areas, lead to slowing down of the rate of national development,

and delay the start of the efficient development of the former. Loss of savings
and investment potential is furthermore a direct concomitant to lowering
efficiency and to higher costs of production.

2.6.   Arguments for concentrating development efforts in the lagging areas

2.6.1.   Although the spokesmen for concentrating more development effort in
the lagging areas to a large extent base their arguments on the intolerability
of the present discrepancy in standards of living - not to speak of widening
the gap - and the human and political necessity for gradual equalization, they
are also able to advance arguments that this strategy also will contribute more
to long-term national welfare than the opposite. These arguments fall into
several groups.

2.6.2.   The first group of arguments refers to the welfare effects of
equalization.

a)   In national welfare consideration attention is paid to the
income as well as to the distribution components.

This means that even though equalization may slow down the income
growth, this can be more than offset by improvements in the distribu-
tion components. This argument can be strengthened by taking into
account that:

b)   The marginal utility of income is normally higher in the low-
income area than in the high-income area.

This means that although growth in total income may be somewhat
lower, there may nevertheless be a net gain in the total welfare
resulting from the utility of income. Even though it may not be
difficult to reach concensus on the two income redistribution argu-
ments above, these may not carry too much weight in an economy where
attention has to be paid first of all to efficiency in utilization
and allocation of resources in order to speed up the rate of develop-
ment.

2.6.3.   Disagreement is, however, apt to occur with respect to the geo-
graphical dispersion of the fruits of further growth in the already developed
area, when spokesmen for deconcentrated development argue that:

c)   The fruits of growth in the already developed areas for several
reasons have a strong tendency to be concentrated in these areas.

1)   The failure of any significant price-lowering effects due
to productivity gains caused by economies of agglomeration
to occur.

This failure is partly due to the strong tendency that such gains are accumulated in the industries because of a high degree of monopoly prevailing in the markets, and partly due to the fact that many of the benefits in question serve the local population only because of their immobility.[37]

2) The tendency often found in developing countries to fix wage rates above the opportunity costs of labour, which concentrate the market for consumer goods and give rise to multiplier effects as mentioned above.[38]

3) The usual failure of the hinterland to respond to the enlarged market created in the urban areas for raw material and agricultural products. Instead, the urban areas will rely on increased imports from other countries.[39]

In general, the polarization and backwash effects are likely to dominate over the possible spread- and trickling-down effects, and the fruits of the national development will be concentrated in the already fairly well developed areas, and the gap will be widening. The draining of the best human resources and large parts of eventual savings from the backward to the growing regions, due to the better prospects of higher and quicker returns inherent in this spatially unbalanced process of development, reinforce the backwardness of the underdeveloped areas. Instead of preparing the ground for future large-scale projects, a feeling of hopelessness is likely to occur which will increase the difficulties in turning the trend later on.[40]

2.6.4. There are, however, arguments which suggest that although the private investors find it most advantageous to invest in the developed urban areas, this may not be the case for the society as a whole. Two points are particularly important:

d) External diseconomies of agglomeration which may occur when the urban areas expand their size, and particularly if the expansion is very fast and internally unbalanced.[41]

e) The tendency for the total investments in the growing areas to exceed the absorptive capacity.[42]

Both these factors mean that private investors not only tend to overestimate the return of their investments but that they also fail to take into account the costs induced in other industries and the public sector following their investments. While external economies of agglomeration may to some extent be internalized, this is not the case for external diseconomies. When the private investors

do not take into account the diseconomic effect on other projects and industries present in the area today, they certainly do not take into account the accumulated effect upon future projects. There is therefore strong reason to believe that when external diseconomies are present, this will lead to a widening gap between private productivity estimates and realized productivity for the society as a whole. The overall efficiency of capital will be slowed down and the factor cost will rise. The most important of such technical external economies are overcrowding of transportation and communication systems and housing areas, increased travel and transport distances, air and water pollution, lowering of standards of public health, etc.

2.6.5. The results of overinvestments, i.e. investment activity exceeding the absorptive capacity, are closely related to the technical external economies above, in that the latter may partly result from the former. The most important diseconomic effects of overinvestment are, however, that many investment projects started will never be fulfilled or will only be fulfilled after long delays, and thus slow down the productivity of the capital. The other effect is inflation which leads to higher factor and commodity prices, which again counteracts the tendency to disperse the fruit of the growth in the urban areas to the hinterland. Lack of skilled personnel is the most prominent limit to the capacity to absorb investments, and the enlargement of job opportunities for unskilled labour. Since creation of skills is a time-consuming process, the increase in factor prices, i.e. wages, will lead to increased migration of unskilled labour which will only add to the social problems already existing and reinforce the external diseconomies.

2.6.6. The next link in the chain of arguments for deconcentrated development efforts are:

    f) Advantages of accumulated external economies in the urban areas
       are of a temporary character.

First, further expansion may lead to external diseconomies. Secondly, external economies can by means of a carefully planned expansion be created in selected growth centres within the backward hinterland. Thus, expansion outside the urban area may be advantageous from the point of view of interregional equalization, as well as from the point of view of national growth. External diseconomies of agglomeration and overinvestments may be limited in the already developed areas, and prevent a decline in the overall efficiency there, while at the same time favourable external economies are created in the selected growth centres in the hinterland.

2.6.7. There is, however, still one important factor left. If the saving
rate is very low in the hinterland as compared to the urban areas, deconcentra-
tion of investment projects will merely imply a transfer of consumption
possibilities, and notwithstanding the above arguments, lead to a slow-down of
the rate of national growth. To this contention the spokesmen for deconcentrated
development reply: What is more significant than the average saving rate is the
marginal. This may well be made equally high or even higher in the hinterland
than in the urban areas, partly by means of policy measures, and partly because
the new atmosphere of local growth may generate new inducements to save.⁴²ᵃ/

2.7   The problem of reconciliation

2.7.1. As is clearly shown above many "good" arguments can be put forward
for concentrated as well as for deconcentrated development. The paramount
problem to analyse is therefore the possibilities for reconciliation of the two
contradictory strategies.

The first observation to make is that since none of the arguments can give
the final answer by itself - all the factors are simultaneously at work - any
choice of strategy has to be based on quantitative analysis. The task is to
arrive at a strategy which implies the most favourable resultant of all the
forces taken together. The factual conditions in each country will play a
decisive role, and it is reason to expect that countries at different stages of
development, with different sizes of population and of geographical area, with
different resource endowment, with different patterns of settlement, etc., will
arrive at different strategies.

2.7.2. The next observation to make is that the choice of strategy is
essentially of a long-term nature. As it was pointed out, comprehensive
planning can be seen as a problem of identifying all feasible development
paths, and choosing the most desirable among these. This necessarily raises
difficult problems of estimating future productivities, and of assessing how
these can be influenced by external economies and diseconomies created, future
savings rates, future elasticities of demand, price-flexibilities, etc. One
could be tempted to argue that because of the fundamental uncertainty, and
because of all technical problems of measurement and forecasting, one should
stick to short-term considerations only. However, this cannot be a good
solution since all theoretical considerations support the hypothesis that vital
interdependencies in time is a most prominent feature of social and economic
development. There seems to be no way of escaping the need for making "bold"
forecasts. These should, however, be subject to revision and changes within
a framework of continuous regional development control.⁴³/

2.7.3. A third observation to make is that the _time horizon_, with which the planning body surveys the alternative timepaths of development, would appear to have a significant impact on the choice of strategy. The reason for this is that the eventual advantages of deconcentrated development as well as eventual disadvantages of concentrated development both occur as accumulated effects during time. Consequently the rate of discount of future income may also affect the choice of allocation strategy.

3. APPROACHES TO MODEL ANALYSIS OF INTERREGIONAL ALLOCATIONS

3.1. Growth and equalization - conflicts, complementarity and the time horizon

3.1.1. It is clear from the enumeration of arguments for and against concentration of the development efforts to the already developed areas, versus to new carefully planned development centres in the backward hinterland, that there may be deviations between what is the most efficient allocation in the short-term and in the long-term. Seen from a short-term point of view, location of investment projects in the backward part of the country represents an attempt to equalize the level of living among the regions. One can therefore ask what the price of this equalization is in terms of production and income cost. However, since successful development projects do generate some development and corresponding changes in the social, economic and physical structures of the areas concerned after some time, they also increase these areas' potentialities for future growth, and their potential contribution to future national growth. Therefore, in the long run the aims of equalization and national development may not be conflicting but complementary.

3.1.2. If this is the case, the proposition made by Lefeber,[44] that development efforts should be concentrated to the most promising areas from the point of view of immediate return, may not be entirely valid. In addition to estimating the _immediate and direct productive effects_ of investment projects, it is also necessary to estimate their effects on other existing projects, on prospective savings, on the channelling of savings into new projects, on the efficiency of these projects, etc. If this way of viewing development projects is accepted, a crucial question to be raised is how long will it last before these advantageous _indirect effects_ have manifested themselves? Or, to put it another way: what conditions have to be fulfilled in order to obtain the gain in future income-created by the loss in immediate income-within a reasonable time horizon? That is, how does the future point of time at which the immediate loss

in income is made good by higher income later on depend on the initial,
unescapable conditions of the regional economies? Closely related to this
question are what impact does the time horizon have on the choice
of allocation strategy, and how should the time horizon be chosen so as to take
into account direct as well as time-delayed indirect effects of development
projects. These are the main problems to be analysed in the remaining part
of this paper.

3.2.   Rahman's dynamic programming approach

3.2.1.   That the time horizon does play a role in the choice of strategy
is clearly demonstrated in Rahman's well known study.[45/] Working with a dynamic
programming model of a two-region economy where the saving rates and incremental
capital-output ratios for each region are given and constant, Rahman shows that
the maximum growth of total income is not necessarily achieved by allocating all
investments to the most productive region throughout the entire planning period.
Given the relative incremental capital-output ratios, the decisive factors are
the saving rates. If the technically more developed region also has the higher
saving rate, the less developed region has no economic claim to turn the alloca-
tion policy in its favour. However, if the less developed region has the higher
saving rate, then the optimal strategy from the point of view of maximum total
growth may be to concentrate the investments to this region in a number of initial
periods, even though this leads to an immediate loss in production and income.
This strategy is, however, optimal only if the planning period is long enough
to permit the initial loss of income to be repaid later on in the planning period
by the higher saving rate of this region.

3.2.2.   Rahman shows that the precise condition for the contention above is
that the internal rate of growth of the less developed region is higher than
that of the most developed region, the internal rate of growth being defined as
the rate of growth of the regional income which would be realized if the growth
grew out of its own saving only. If the less developed region has the higher
internal rate of growth, the optimal allocation strategy for national growth
would be to concentrate the investments there for a certain initial period -
provided the planning period is long enough - and then switch to the most pro-
ductive region for the rest of the planning period. If the planning horizon
is not long enough, the investment should be concentrated to the more productive
region for the entire period, regardless of the relative internal rates of
growth.

3.2.3. Rahman's model is well suited to shed light on the crucial signifi-
cance of saving and capital formation in determining the long-term rates of
growth and the choice of allocation strategy in a regionalized economy. Con-
sequently, it demonstrates that location criteria cannot be based on the pro-
ductivity estimates alone, as opposed to the case of intersectorial allocation
within a region where the saving rates as a rule do not vary between groups of
people tied to different sectors. Since regions often exhibit characteristic
differences with respect to saving and consumption patterns, this is a factor
which has to be taken into account. Rahman's model is also well suited for
demonstrating the significance of the time horizon. Since the impact of
higher internal rates of growth in the less developed region on the total
national growth manifests itself only after a certain period of accumulation,
the loss of income in the initial period can be viewed as "investments" with a
certain gestation period. In order to take advantage of this effect during
preparation of plans, it is necessary to have a time horizon of sufficient
length so that the return of this "investment" can be taken into account.

3.3. Some shortcomings of the programming approach

3.3.1. Without disregarding the value of the conclusions which can be
drawn on the basis of dynamic programming models of the type used by Rahman
and others, one should be aware of their shortcomings. First, the existence
of interregional interdependences reflected in industrial complementarities
and interregional trade are not taken into account. The only relation between
the regions explicitly stated is their competition for the same investment funds.
Implicitly this means that all projects are free to be located in one or the other
of the regions. Obviously, this is not the case in reality, where comple-
mentarities, competition and trade, generating spatial spread and polarization
effects are crucial issues.46/ Secondly, the dynamic programming approach
usually leads to very extreme and therefore often also unpractical solutions.47/
Even though it can be proved that a country will be better off by concentrating
all investment in a given period in one region and then switch all investments
in the next period to the other region, it is most unlikely that any government
could and/or would pursue such a policy? From a practical point of view, it
would therefore be useful to work with models of a less restricted character.

3.3.2. A third shortcoming of the dynamic programming resource allocation
model, which is pointed to by, among others, Vietorisz,48/ is that such models
over-emphasize the scarcity of material goods in the course of development and

gives too little attention to the fact that this scarcity diminishes as a con-
sequence of the process of development itself. According to Vietorisz, this
leads to <u>neglect of the feedback effects</u> from the process of development itself
to the supply of efforts, savings, skills and innovations, all of which pertain
to the human side of the development process. These are crucial factors which
may lead to spontaneous processes of industrialization, emerging from handicrafts
and agriculture. They must be seen not only as dependent on, but also mutually
contingent on the gradual qualitative transformation of the entire economic,
social and culture structures of the regions in question.[49] When such feedback
effects are not taken into account, development plans may give too much attention
to large-scale investment projects, around which enclaves of development occur
while the remainder of the regions are left untouched.[50]

3.3.3. A <u>fourth</u> shortcoming of the dynamic programming resource allocation
model is closely related to those already mentioned, but refers to the formal
properties of such models. In order to solve them, it is necessary to assume
that all the parameters characterizing the structural equations are constant
and that they do not change over the period within the time horizon of the
planners. The failure of the programming models to allow for such changes
casts great doubt on their usefulness in long-term development planning, as the
development process by its very nature is characterized by just the type of
structural changes which manifest themselves in changing the parameters of the
type of models in question here.

3.4. Vietorisz's "orientation towards growth" approach

3.4.1. The effects of systematic changes in the parameters of growth models -
generated by the development process itself - on the growth paths of regional
economies, and consequently on the impact of the time horizon and the choice on
allocation criteria are clearly demonstrated by Vietorisz.[51] His point of
departure is that if in an underdeveloped region a <u>social and cultural transforma-
tion can be induced that orients people individually and collectively towards
growth</u>, the process of growth will by its very nature throw off the necessary
capital required, enlarging the absorptive capacity and increase the productivity.
Referring to theories developed by B. Horvat,[52] Vietorisz assumes that when a
growth process is initiated within a region, the saving rate will normally
advance steadily up to some limit. However, if savings are drained out of the
region for the purpose of investing in another, say a more developed region
within the country - which may well be the normal case - the saving rate will
not undergo such a steady advance.

3.4.2. Vietorisz studies a model of a two-region economy consisting of
one developed and one underdeveloped region, and compares the growth rates of
the two regions individually and for the nation as a whole when savings are
transferred from the poor to the developed region, and when savings of the poor
region are invested within the region. The result of this comparison is that
although the transfer of savings from the poor to the rich region may bring
higher total income in the initial periods, the effect of increased saving rate -
if such transfers do not take place - allow total income very soon to catch up
with and pass by the total national income of the alternative strategy.

3.4.3. Vietorisz's analysis is well apt for demonstrating the crucial
impact of advanced saving rates on the rate of growth. The particular results,
however, are of course fundamentally dependent on his assumption concerning the
strength of the incentive effects. While he assumes a strong disincentive effect
of transfer of savings from the poor region, he does not assume a corresponding
incentive effect in the receiving region. The precise mechanisms behind the
incentive/disincentive effects are not stated, and the analysis is therefore
not capable of shedding light on the more complex policy questions involved.

3.4.4. Vietorisz shows similar effects of induced changes in the absorptive
capacity and in labour productivity. He concludes that although the developed
region may initially have a higher absorptive capacity and marginal productivities
of labour, the long-term aim of rapid national development nevertheless coincides
with the long-term aim of inter-regional equalization, because the scope for
inducing favourable structural changes is much higher in the backward region
than in the developed one. More specifically Vietorisz argues the case for a
"trade-not-aid" approach. Resource transfers from the poor to the developed
region should according to Vietorisz be restricted, and the strategy of industrial
location should aim at a planned promotion of new export industries in the back-
ward regions based on spatial division of labour where both regions can benefit
from steadily increasing markets for their products.

3.5.   Elements of a more flexible model framework

3.5.1. The strength of the Vietorisz analysis is that it demonstrates that
the effects of structural changes inherent in the process of development, which
are reflected in systematic changes in the parameters of a planning model, tend
to modify - in the same directions - the conclusions drawn from the neo-classical
versions of these models. The joint impact of these effects are bound to have
a decisive influence on the choice of strategy for interregional allocation of
development projects. The weakness of the analysis is that it does not consider

carefully the processes through which these changes emerge. Instead of analysing the possible impact of external economies, creation of skills through learning by doing, economies of agglomeration, economies of scale, and the opportunities to generate and exploit such economies by means of careful planning, Vietorisz refers to the creation of an orientation towards growth as the main motive and driving force behind the changes discussed. However, without disregarding the crucial importance of the cultural transformation upon which Vietorisz bases his argument, there nevertheless appears to be close relations between the effects he discusses and relevant economic aspects of development such as income growth, economics of scale, and external economies and diseconomies. A more appropriate method of analysis from the point of view of economic development policy would therefore seem to be first to take stock of these economic factors in as much detail as possible, and then to analyse how these are mutually related to the process of cultural and social transformation.

3.5.2. The model framework to be discussed in the following paragraphs is based on this point of departure. The framework is designed to analyse the relation between short and long-term criteria for location of investments and the impact of the time horizon on the choice of criteria. The models are dynamic and generate the time paths of the relevant variables over the future time periods. They focus attention on the allocation of investment funds among the regions, and contain therefore one degree of freedom. For the purpose of analysing shifts in allocation policy the models are time-recursive, period to period, models. That is, the value of the variables by the end of a certain period are determined by their initial values and by the allocation policy of the preceding period. This is an important property for two reasons. First, the models acquire a flexibility which is desirable from the point of view of experimentation in the planning stage. Secondly, this reflects the usual practice in planning and budgeting, that final decisions are made only for the coming period, although the long-term effects are taken into account. When a model is formulated in this way it cannot always be solved in a conventional way, but on the other hand it lends itself conveniently to analysis by means of simulation.

3.5.3. The models to be considered are two-region models. They are quite similar to the Rahman model in that they only deal with the competitive allocation of investment funds, entirely disregarding the possible complementary relations between the regions reflected in the pattern of interregional trade.

The analysis proceeds in two steps. First, a basic model is formulated, in which all parameters are assumed to be constant during the process of development.

This model is analysed in order to assess the effects of different parameter values. However, since the parameters are not permitted to change during time, it will be seen that they are not particularly well suited to shed light upon the particular problems related to structural changes. In the second step, the peculiarities of regional development are taken into account by assuming that the development process itself generates changes in the parameters in a systematic but different way in the two regions. As it will be demonstrated, this model is much more useful for analysing the relation between the time horizon and allocation criteria. Finally, various possible extensions of the model are discussed in order to take into account population growth, interregional migration, interregional trade and more realistic production functions.

4. A TWO-REGION ALLOCATION-GROWTH MODEL WITH FIXED STRUCTURAL PARAMETERS

4.1. Formulation of the model

4.1.1. The model to be outlined in the following is a very simple one, which takes into account only the production-income generating and saving behaviour of the two regions. It is assumed that increases in production and income result from growth in capital only. All variables are assumed to be measured in real terms. The model contains the following variables:

Y_t^i: i = 1.2: Total production/income generated in region i during period t

S_t^i: i = 1.2: Total savings in region i during period t

S_t^T: Net transfer of savings between the two regions during period t (T : Transfer)

K_t^i: Capital resources in region i by the start of period t.

4.1.2. The model contains the following equations: [53]/

$$4.1 \quad Y_t^1 = Y_{t-1}^1 + \Delta Y_t^1$$

$$4.2 \quad Y_t^2 = Y_{t-1}^2 + \Delta Y_t^2$$

$$4.3 \quad \Delta Y_t^1 = \gamma_1 \Delta K_{t-1}^1$$

$$4.4 \quad \Delta Y_t^2 = \gamma_2 \Delta K_{t-1}^2$$

$$4.5 \quad \Delta K_{t-1}^1 = S_{t-1}^1 - S_{t-1}^T$$

$$4.6 \quad \Delta K_{t-1}^2 = S_{t-1}^2 + S_{t-1}^T$$

$$4.7 \quad S_{t-1}^1 = s_1 Y_{t-1}^1$$

$$4.8 \quad S_{t-1}^2 = s_2 Y_{t-1}^2$$

$$4.9 \quad Y_t = Y_{t-1}^1 + Y_{t-1}^2$$

Equations 4,1-4,2 define the (net) regional income in period t. Equations 4,3-4,4 describe the production structure. It is assumed that increased income can be achieved only by increasing the stock of capital. The capital has a gestation lag of one period, i.e. capital investments in period t-1 become productive in period t. The coefficients γ_1, γ_2 are the incremental output-capital ratios of regions 1 and 2 respectively. Equations 4,5-4,6 describe the investment behaviour. The investment in any of the regions results from the saving of the regions modified by the net transfer of savings between them. For the sake of convenience, S^T is assumed positive for net transfer from region 1 to region 2. The amount of savings to be transferred is limited by the amount of savings available. Equations 4,7-4,8 describe the saving structure. The coefficients s_1 and s_2 are the average saving rates in regions 1 and 2 respectively. Hence, the transfer of savings in period t is limited by

$$- s_2 \, Y_t^2 < S_t^T < s_1 \, Y_t^1$$

It is implicitly assumed that there is no transfer of income between the regions. Equation 1,9 defines the net national income.

4.2. Solution of the model

4.2.1. The model can easily be solved so that all variables are expressed as functions of initial data and the transfer of savings between the two regions. By combining equations 4,1-4,3-4,5 and 4,7, and 4,2-4,4 - 4,6 and 4,8 respectively, we get the following formulas for the <u>total income generated in the two regions</u> in period t:

$$4.10 \quad Y_t^1 = (1 + \gamma_1 \, s_1) \, Y_{t-1}^1 - \gamma_1 \, S_{t-1}^T$$

$$4.11 \quad Y_t^2 = (1 + \gamma_2 \, s_2) \, Y_{t-1}^2 + \gamma_2 \, S_{t-1}^T$$

4.2.2. If there are no transfers, the regional economies will grow according to their <u>"internal" rates of growth</u>.

$$r_1^i = \frac{\Delta Y_t^1}{Y_{t-1}^1} = \gamma_1 \, s_1 \qquad r_2^i = \frac{\Delta Y_t^2}{Y_{t-1}^2} = \gamma_2 \, s_2$$

While the incremental output-capital ratios determine the short-term returns of investments in the two regions, the internal rates of growth reflect the regions' growth potentials. Since the <u>growth potential</u> depends on the saving rates as well as on the marginal efficiency of capital, the region with the lowest productivity may well have higher growth potential, if it has a sufficient high saving rate. This simple fact is already an indication of the possible discrepancy between short- and long-term investment criteria.

4.2.3. Total _national income_ is now given by

4.11. $Y_t = Y_{t-1} + \gamma_1 s_1 Y^1_{t-1} + \gamma_2 s_2 Y^2_{t-1} + S^T_{t-1} (\gamma_2 - \gamma_1)$

Since the model is recursive, i.e. that the income in year t depends entirely on the distribution of income and the allocation of investments in the preceding year, the policy maker must look ahead at least one period when he considers how to allocate the investments. It is easily seen that if he looks only one period ahead, and he aims at maximizing the national income, he will always allocate the investments to the most productive region.

4.3.   **Properties of the development paths generated by the model**

4.3.1. As Rahman has demonstrated, the short-term productivity criterion will not necessarily lead to the highest income in the long-term. If the low productive region has a saving rate which is high enough to give it a higher internal rate of growth than the high productive region, it may well pay to invest in this region for some periods in order to exploit its ability to accumulate capital. A similar conclusion can be drawn on the basis of this more simple model. The _feasible area for the allocation policy_ in this model is limited by the two extremes: all investments to the high productivity region, or all investments to the low productivity region. If the initial income in the two regions in year 0 are denominated Y_o^1 and Y_o^2 respectively, it follows from the assumptions that if all investments are allocated to one region, the other region will have no growth, and, hence, the transfer will be constant period for period. Therefore, the two alternative extreme policies can be formulated in the following way:

Alt. 1. All investments in region 1

$$S_t^T = -s_2 \bar{Y}_o^2$$

Alt. 2. All investments in region 2

$$S_t^T = s_1 \bar{Y}_o^1$$

The dashes over $\bar{Y}_o^1$ and $\bar{Y}_o^2$ are only to indicate that they are constants.

4.3.2. For Alt.1, the following is the formula for regional income and the rate of growth of _region 1_:

4.12 $Y_t^1 = (1 + \gamma_1 s_1) Y^1_{t-1} + \gamma_1 s_2 \bar{Y}_o^2$

4.13 $r_t^1 = \gamma_1 s_1 + \gamma_1 s_2 \dfrac{\bar{Y}_o^2}{Y^2_{t-1}}$

For Alt. 2, the corresponding formulas for <u>region 2</u> are:

$$4.14 \quad Y_t^2 = (1 + v_2 \, s_2) \, Y_{t-1}^2 + v_2 \, s_1 \, \overline{Y}_0^1$$

$$4.15 \quad r_t^2 = v_2 \, s_2 + v_2 \, s_1 \, \frac{\overline{Y}_0^1}{Y_{t-1}^2}$$

We can furthermore express the <u>national income</u> and the national <u>rate of growth</u> for year t for each of the two extreme alternatives

Alt. 1:

$$4.16 \quad {}^1Y_t = {}^1Y_{t-1} + v_1 \, s_1 \, Y_{t-1}^1 + v_1 \, s_2 \, \overline{Y}_0^2$$

$$4.17 \quad {}^1R_t = \frac{v_1 \, s_1 \, Y_{t-1}^1 + v_1 \, s_2 \, Y_0^2}{Y_{t-1}^1 + \overline{Y}_0^2}$$

Alt. 2:

$$4.18 \quad {}^2Y_t = {}^2Y_{t-1} + v_2 \, s_2 \, Y_{t-1}^2 + v_2 \, s_1 \, \overline{Y}_0^1$$

$$4.19 \quad {}^2R_t = \frac{v_2 \, s_2 \, Y_{t-1}^2 + v_2 \, s_1 \, \overline{Y}_0^1}{Y_{t-1}^2 + \overline{Y}_0^1}$$

Here the figure above Y_t i.e. ${}^1Y_t$ and ${}^2Y_t$ respectively denominate the alternative, and must not be confused with the variables Y_t^1 and Y_t^2 which refer to regions 1 and 2 respectively.

4.3.3. It can be seen from the formulas above that the <u>rate of growth of the receiving region</u> will slow down gradually and converge towards its internal rate of growth during time. Since the transfer is assumed to be constant for all periods, the share of the investments paid for by the region's own saving will increase as total income increases. However, the actual rate of growth may be much higher than the internal rate during the first periods depending on the magnitude of the savings transferred. <u>The rate of growth of the national economy</u> is expressed as a weighted average of the internal rate of growth of the receiving region and the potential rate of growth found by applying the marginal productivity of the receiving region on the saving rate of the source region, with the total income of the two regions as weights. If the internal rate of growth of the receiving region is higher than that of the source region, the national rate of growth will increase and converge towards the internal rate of growth of the receiving region. If the internal rate of this region is lower the national growth rate will gradually decline. However, when the two extreme

allocation policies are compared, the declining growth rate may nevertheless
initially be much higher than the increasing, depending on the initial situation.

4.4. Analyses of allocation strategies under different assumptions

4.4.1. It is easily recognized that if one of the regions has higher
productivity as well as the higher saving rate, the highest national income
period for period and the highest rate of growth of the total economy will be
achieved by investing all the savings there. The national rate of growth will
increase towards the internal rate of this high productivity region, which will
utilize its own saving maximally, but also get a higher return on the savings
of the other region than this would have achieved if its savings had been invested
at home.

4.4.2. If we still assume that one region is superior with respect to
productivity, but has a lower saving rate than the other region, it is still
easy to recognize that the highest national income will be attained by investing
in the more productive region, if this has the higher internal rate of growth,
i.e. $\gamma_1 > \gamma_2$ and $s_1 < s_2$ but $\gamma_1 s_1 > \gamma_2 s_2$. In the case of transfer to the most
productive region, the national growth rate will increase slightly, while it will
decline in the case of the opposite policy. The most productive region has the
highest return on its own savings as well as on the savings of the other region.
Even though the latter will save proportionally more, the total outcome of the
saving and production-processes will still be highest when all savings are in-
vested in the most productive region. However, if the internal rate of growth
in the low productivity region is higher than in the more productive region, the
transfer of all savings to this region will always, after some time, bring about
a higher rate of national growth as well as a higher national income than transfer
in the opposite direction which would have been chosen on the basis of the short-
term, directed productivity criterion.

4.4.3. A closer look should therefore be taken at the situation characterized
by

$$\gamma_1 > \gamma_2 \qquad \gamma_1 s_1 < \gamma_2 s_2$$
$$s_1 < s_2$$

The reason for the conclusion already stated above is, of course, that the
national rate of growth converges towards the internal rate of growth of the
receiving region. In the case of transfer to the region with the lowest internal
rate, but highest productivity, the national rate of growth will start at a high

level since the highest productivity is applied on the high saving rate of the
delivering region. The rate of growth will, however, decline as the share of
investment paid for by its own saving increases. In the case of the transfer
of savings from the high productivity to the low productivity region, the national
rate of growth will start at a low level, since the low productivity is applied
on the low saving rate of the delivering region. However, what is lost immed-
iately by a low return on the investments is regained during time because the
high saving rate can be applied to a gradually increasing income. The national
rate of growth will therefore increase, and, after some time, it will be higher
than the rate of growth resulting from the opposite strategy. The same is the
case with total income, total accumulated income, and total accumulated discounted
income, which will all be higher after different time periods than what would
have been obtained by the opposite strategy.

4.4.4. However, one thing is to show that the crossing of the time path
curves of the two alternative strategies inevitably will take place after some
time, quite another thing is to demonstrate that the crossing will take place
within reasonable time in order that it may have a decisive effect on the choice
of allocation strategy. The answer to this question depends on two sets of
factors: first, the values of the parameters characterizing the region economies,
and secondly, the initial situation with respect to the relation between the
total income in the two regions. Instead of solving this problem analytically,
i.e. determining the t for which the difference equations of the strategies are
equal, the effects of different assumptions are demonstrated by means of four
numerical examples:

Alt. A.	Alt. B.	Alt. C.	Alt. D.
$v_1 = 0.4$	$v_1 = 0.4$	$v_1 = 0.4$	$v_1 = 0.4$
$v_2 = 0.3$	$v_2 = 0.3$	$v_2 = 0.3$	$v_2 = 0.35$
$s_1 = 0.1$	$s_1 = 0.05$	$s_1 = 0.05$	$s_1 = 0.05$
$s_2 = 0.05$	$s_2 = 0.1$	$s_2 = 0.20$	$s_2 = 0.20$
$v_1 s_1 = 0.04$	$v_1 s_1 = 0.02$	$v_1 s_1 = 0.02$	$v_1 s_1 = 0.02$
$v_2 s_2 = 0.015$	$v_2 s_2 = 0.03$	$v_2 s_2 = 0.06$	$v_2 s_1 = 0.07$
$Y_0^1 = 500$	$Y_0^1 = 500$	$Y_0^1 = 750$	$Y_0^1 = 500$
$Y_0^2 = 1000$	$Y_0^2 = 1000$	$Y_0^2 = 750$	$Y_0^2 = 1000$

Region 1 is assumed to be the more efficient in all alternatives, with a marginal
output-capital ratio of 0.4, while the corresponding ratio of Region 2 is assumed
to be 0.3 and 0.35 alternatively.

4.4.5. In alternative A, which is shown in fig. 1, Region 1 is as well
assumed to have the higher saving rate and, hence, the higher internal rate of
growth. As it is shown in fig. 1, allocation strategy 1, i.e. all investments
in Region 1, gives higher national rate of growth and the higher national income
as compared to strategy 2. And, moreover, while the rate of growth of the
national economy is increasing for strategy 1, it is decreasing for strategy 2.
It is therefore obvious that in this case the curves will never cross each other.

4.4.6. In alternatives B-D, Region 1 has still the higher productivity,
but its saving rate is lower than that of Region 2 and not high enough to prevent
Region 2 from having a higher internal rate of growth. In alternative B, shown
in fig. 2, Region 2 has the double saving rate of Region 1, and, initially, also
the double income. As it is shown in fig. 2, the process of gaining back what
is lost by investing all savings in the less productive region is very slow.
The rate of growth of strategy 1 is certainly declining and that of strategy 2
increasing, but due to the initial conditions, the initial growth rate of
strategy 1 is so much higher than that of strategy 2 that it will take a very
long time before the process of regaining even starts, and under these assumptions,
it would hardly be justified to consider applying strategy 2.

4.4.7. In alternative C, shown in fig. 3, Region 2 is assumed to have a
saving rate two times as high as Region 1; the incremental output-capital ratios
are the same as in alternative B; and the regions are assumed to have the same
initial level of income. As in alternative B, the growth rate curve of strategy 1
starts at a higher level than that of strategy 2, but declines while the curve
of strategy 2 is rising. When strategy 2 is compared to strategy 1, it can be
seen that it will bring seven meagre years before the process of regaining starts,
and seven years more before the income level has grown to the same level as would
have been achieved by using strategy 1. Before total accumulated and discounted
income are equalized for the two strategies, it will still take many years. If
a high rate of discount is applied, which seems natural in developing countries,
it will take more years before the discounted accumulated increases are equalized
than if a low rate is applied.

4.4.8. In alternative D, the saving rate assumptions are kept from
alternative C, but the incremental output-capital ratio of Region 2 is assumed
to be a little closer to that of Region 1. The initial conditions with respect
to income levels are the same as in alternatives A and B. As is shown in fig. 4,
this is a case where the use of direct productivity criteria alone would bring
about a loss of income in the long term. Even though there will be an immediate
loss when all savings are poured into Region 1, the process of regaining starts
after less than two years, and it takes only four years to reach the same income
level as that which would have been generated by strategy 1. The figure shows
also that only a few additional years are required to equalize the total accumulated
and discounted incomes. The rate of growth of strategy 2 converges towards
7 percent per year, compared to only 2 percent per year, and the processes of
convergence are very rapid. This case is therefore well apt to demonstrate
the necessity of not applying productivity criteria only in the location of
investment projects.
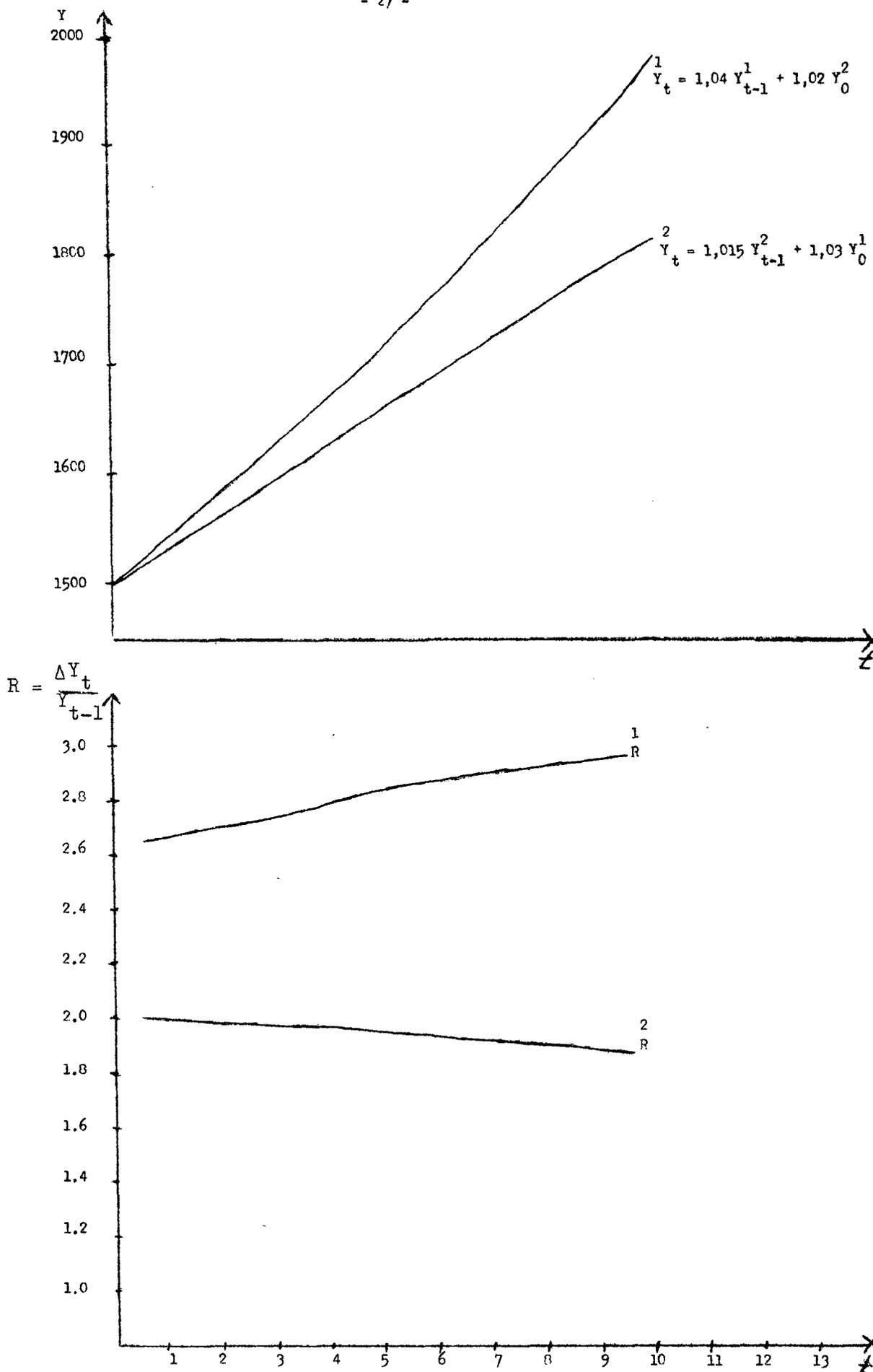
$$Y^1_t = 1,04\ Y^1_{t-1} + 1,02\ Y^2_0$$

$$Y^2_t = 1,015\ Y^2_{t-1} + 1,03\ Y^1_0$$

$$R = \frac{\Delta Y_t}{Y_{t-1}}$$

Fig. 1

$$Y^1_0 = 500$$

$$Y^2_0 = 1000$$

$v_1 = 0.4$	$s_1 = 0.1$
$Y_2 = 0.3$	$s_2 = 0.05$

$$Y^1_t = 1.02 \ Y^1_{t-1} + 1.04 \ Y^2_0$$

$$Y^2_t = 1.03 \ Y^2_{t-1} + 1.015 \ Y^1_0$$

$$R = \frac{\Delta Y_t}{Y_{t-1}}$$

Fig. 2

$$Y^1_0 = 500$$
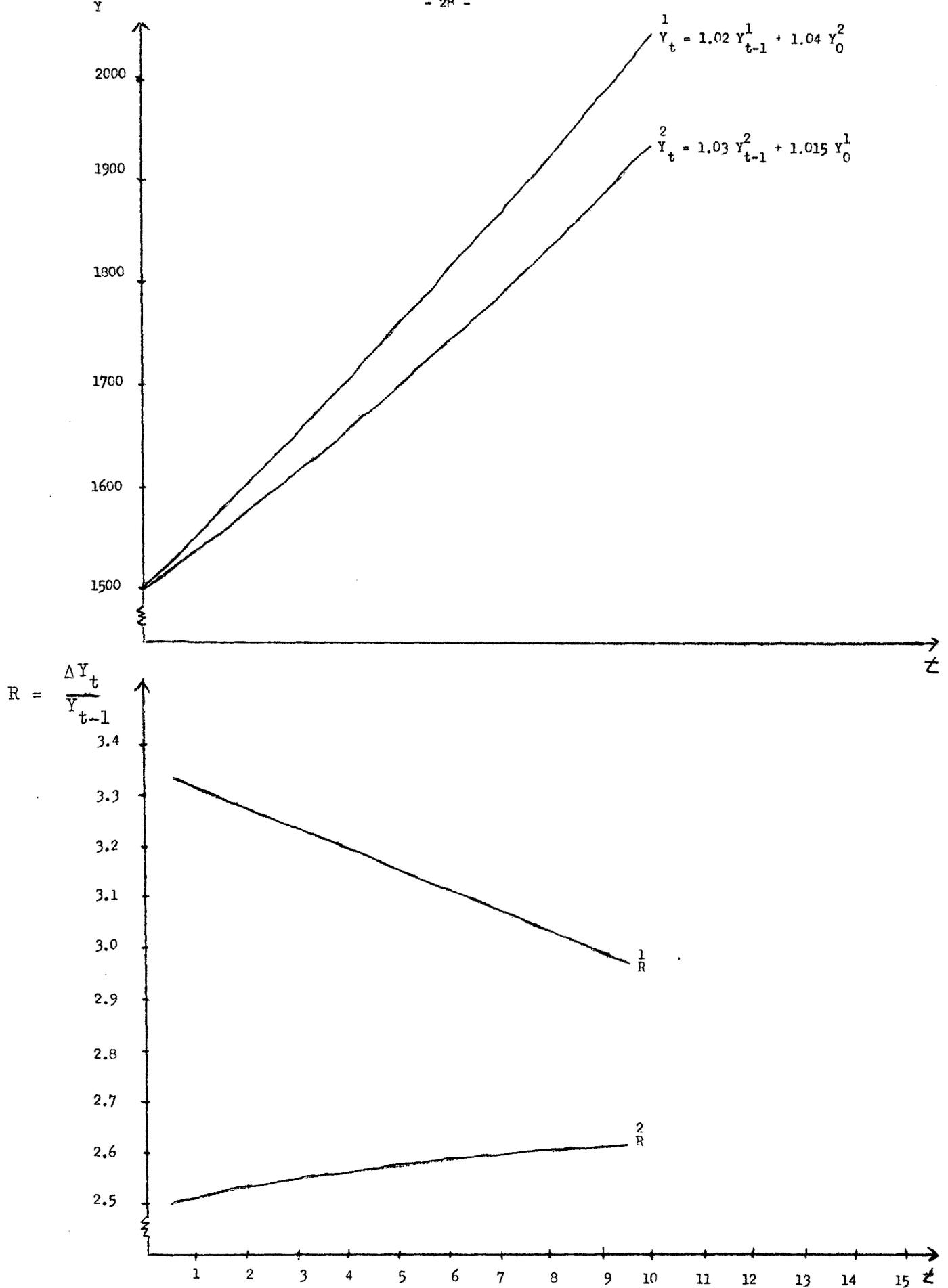
$$Y^2_0 = 1000$$

$$v_1 = 0.4 \qquad\qquad s_1 = 0.05$$

$$v_2 = 0.3 \qquad\qquad s_2 = 0.10$$
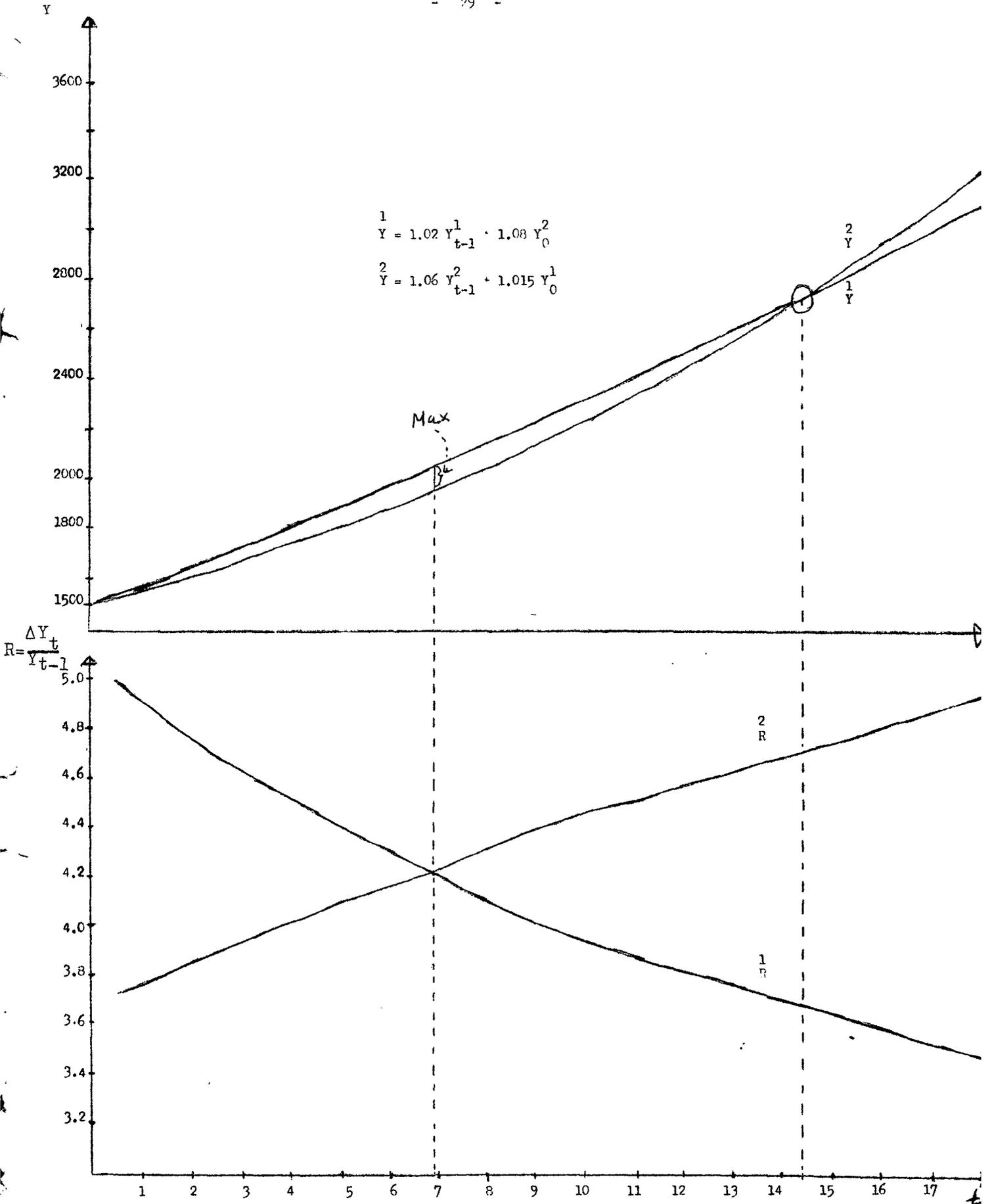
$$\overset{1}{Y} = 1.02\ Y^{1}_{t-1} \cdot 1.08\ Y^{2}_{0}$$

$$\overset{2}{Y} = 1.06\ Y^{2}_{t-1} + 1.015\ Y^{1}_{0}$$

$\overset{2}{Y}$

$\overset{1}{Y}$

Max

Y

3600

3200

2800

2400

2000

1800

1500

$$R = \frac{\Delta Y_{t}}{Y_{t-1}}$$

5.0

4.8

4.6

4.4

4.2

4.0

3.8

3.6

3.4

3.2

$\overset{2}{R}$

$\overset{1}{R}$

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 t

Fig. 3

$v_1 = 0.4$ $\qquad$ $s_1 = 0.05$

$v_2 = 0.3$ $\qquad$ $s_2 = 0.2$

$$Y^{1}_{0} = 750$$

$$Y^{2}_{0} = 750$$

$$Y_t^2 = 1.07\ Y_{t-1}^2 + 1.08\ Y_0^2$$

$$Y_t^1 = 1.02\ Y_{t-1}^2 + 1.0175\ Y_0^1$$

$$R = \frac{\Delta Y_t}{Y_{t-1}}$$
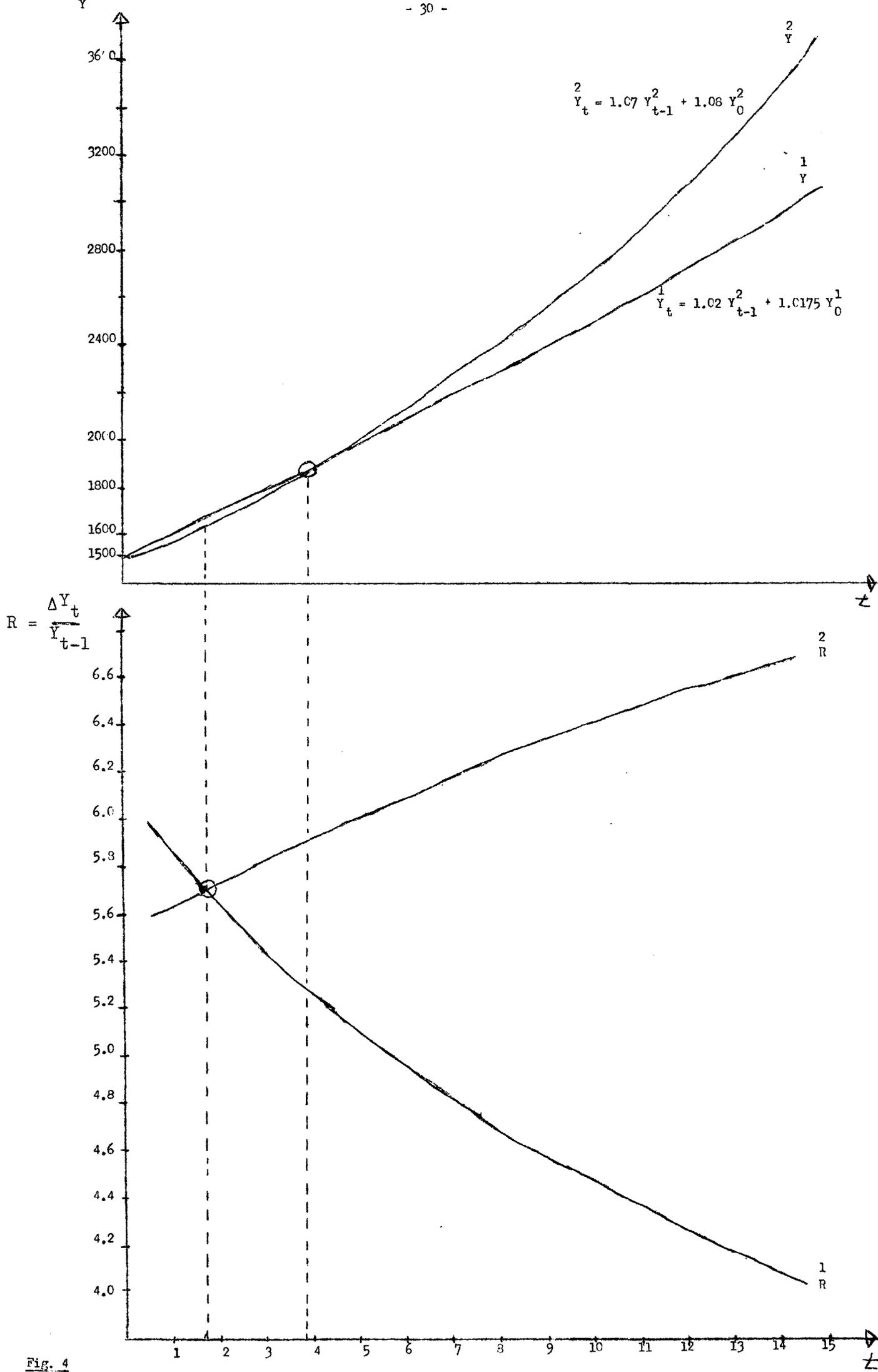
Fig. 4

$$\gamma_1 = 0.4 \qquad\qquad s_1 = 0.05$$

$$\gamma_2 = 0.35 \qquad\qquad s_2 = 0.20$$

$$Y_0^1 = 500 \qquad\qquad Y_0^2 = 1000$$

4.4.9. In order to exploit the maximum long-term benefits of savings, it is necessary to have a time horizon in the planning process which is sufficiently long to identify the combined effects of productivity and capital formation. It is therefore necessary to survey the range of feasible time paths and choose the one among them which is the most desirable. This means that long-term comprehensive planning is a necessary stage because the feasible time paths cannot be identified if there is no conception of the time sequences of investment projects to be undertaken.

4.5. Time horizons and the choice of allocation strategy

4.5.1. In the very simple model with fixed coefficients discussed above, it is shown than the time horizon under certain conditions may affect the choice of allocation strategy. However, even though allocation strategy 2 in the case of higher internal rate of growth in region 2 than in region 1 may be better than allocation strategy 1, the best strategy may well be a combination of these. If for some years all savings are transferred to the less productive region, there will always be an immediate gain in national income by switching over to the region with the highest productivity. As is shown by Rahman by means of dynamic programming, and which can also be intuitively understood from the model discussed here, such a switch will occur only once. If the time horizon is longer than the regaining period of strategy 2 as compared to strategy 1, and the goal is to maximize total income by the end of the period, a gain can always be achieved by exploiting all savings with the most efficient technique - i.e. in region 1 - in the last years of the planning period. This holds true even though the rate of growth after the immediate increase will begin to decline again. The situation is illustrated in the following diagram.

$R = \frac{\Delta Y_t}{Y_{t-1}}$

Fig 5
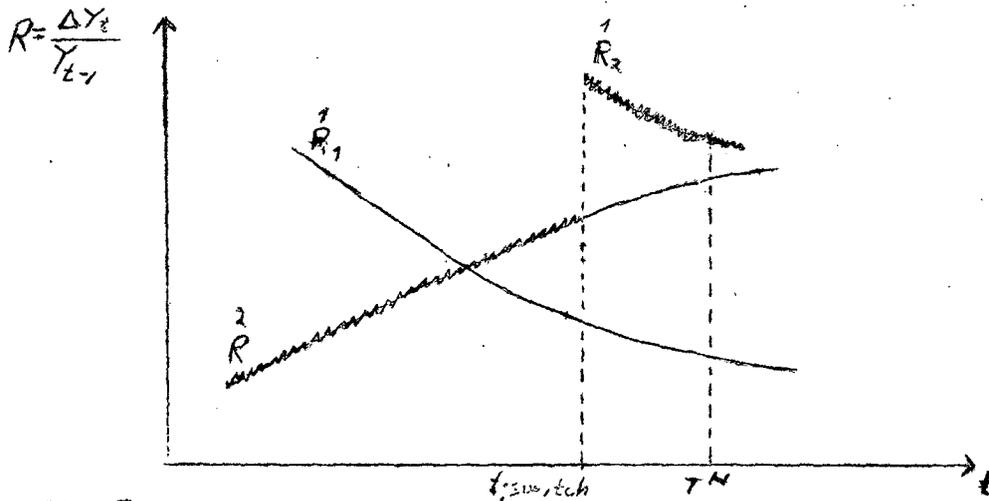
4.5.2. If the aim is to maximize national income within a given time horizon, and the less productive region has the highest saving rate and internal rates of growth, the <u>time horizon will affect the choice of strategy</u> in two ways:

        a) If the time horizon is shorter than the regaining period, the most productive region is chosen for all years;

        b) If the time horizon is longer than the regaining period, the less productive region is chosen in the first years, and the most productive in the last years.

The failure to choose the latter strategy is not necessarily due to shortsightedness. On the contrary, the planners may be well aware of the advantages of strategy 2, but the initial conditions may be such that the regaining period is much longer than a reasonable time horizon for planning of interregional allocation.

4.6. Weaknesses of the model

4.6.1. Two main weaknesses of the model discussed above have been pointed out in a previous section, namely, that it tends to generate extreme solutions when some optimalization procedure is applied, and that it has fixed structural parameters. These two features are, of course, two sides of the same corner. The criticism for yielding extreme solutions has not, however, the same validity when the model is used to survey feasible time paths by means, for example, of simulation. The failure to take stock of the changes in the parameters during time generated inherently in the process of development still remains. The model is therefore not particularly well suited for the analysis of long-term development processes.

4.6.2. A third weakness should also be mentioned referring to the analysis above. Even though the model is capable of generating a significant discrepancy between short and long-term allocation criteria, the preconditions for this, namely, that the saving rate of the less productive region is sufficiently higher than that of the most productive to give it a higher internal rate of growth, would rarely be fulfilled in any developing country.[54/] As it is discussed in section two of this paper, the spatial structure of the less developed countries is usually characterized by a fairly developed urban core and a large backward hinterland. Theoretical considerations as well as practical experiences support the hypothesis that low productivity and low saving rates go together in such regions because they are both essential characteristics of underdevelopment. A realistic analysis should therefore take this as a point of departure, but

take into account the possibility to generate the characteristic changes in the structural parameters by means of the allocation policy. In the following section, a simple two-region model - an extended version of the one discussed above - designed for this purpose is formulated and analysed.

5. A TWO-REGION ALLOCATION-GROWTH MODEL WITH BUILT IN CHANGES IN THE STRUCTURAL PARAMETERS

5.1. Introductory remarks

5.1.1. In the following the simple model discussed in the previous section will be extended and made more realistic by taking into account some of the peculiar characteristics of the regional economic growth processes. It goes without saying that in such a simple model as the one employed here, these peculiarities can only be introduced and taken care of in a very simplified and indirect way. When the structure of the model is to be kept as it is, the only way to allow for these factors is to permit the coefficients of the equations to change during the growth process. Two such types of changes will be introduced: in the incremental output-capital ratios and in the saving rates.

5.2. The mechanism for changing the incremental capital-output ratio

5.2.1. It is suggested that the structure of production of each region is described in the following way:

$$\Delta Y_t = \gamma_t \, \Delta K_{t-1}$$

$$\gamma_t = \gamma_{t-1} + k \, \Delta K_{t-1}$$

This means that the incremental output-capital ratio increases when the amount of capital increases if $k > 0$ and decreases if $k < 0$. The coefficient k can be denoted as the progress coefficient, since it expresses the rate of progress in the marginal productivity of capital as the amount of capital grows. The last equation can be written

$$\gamma_t = \gamma_0 + k \left(K_t - K_0 \right) = \gamma_0 + k \sum_{i=0}^{t-1} \Delta K_i$$

An eventual discrepancy between the incremental output-capital ratios of the two regions at a given point of time can then result from three causes, viz: different initial conditions, different progress coefficients, and different capital accumulation.

5.2.2. Several arguments can be advanced for formulating the production structure of the regional economy in the way done here. The arguments fall into two groups. The first group is composed of arguments referring to the

production functions of the regions. Each region is assumed to have a production function which can be written Y = F(K), with a shape as in the figure below
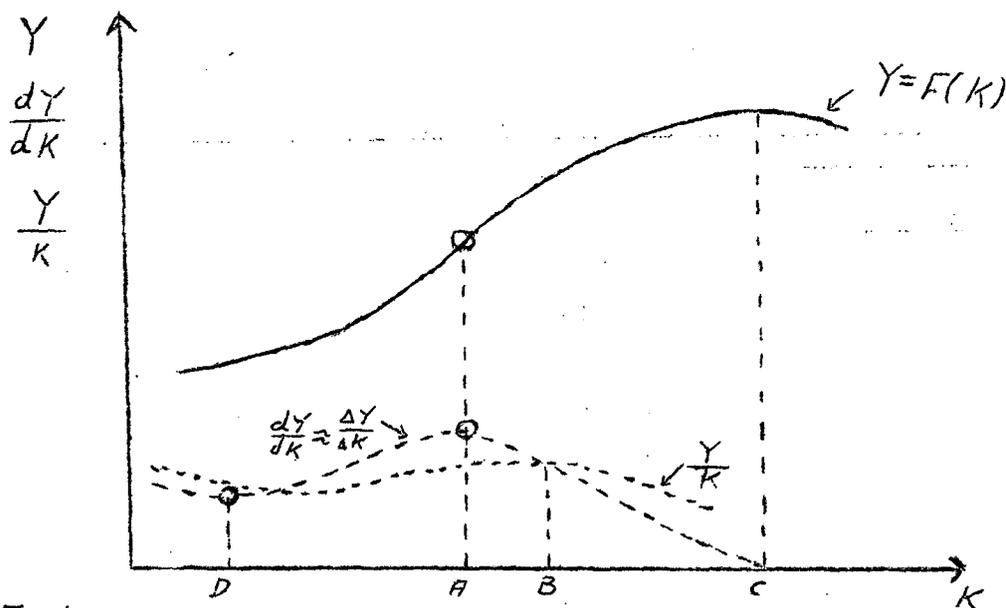
Fig 6

The curve of the marginal productivity of capital is rising until the amount of capital has reached level A, and then starts to turn downwards. This curve is a macro-curve and it is by reasons of analogy drawn in the same way as the more common micro-curve referring to a single productive unit.55/ The curve is furthermore drawn on the assumption of constant techniques/ of the actual produc-

and composition

tion processes that take place in the regions. The curves are not necessarily similar in the two regions, but they are assumed to have the same characteristic look. If a region is situated to the right of its A-point, the progress coefficient is negative and further investments force the marginal productivity of capital down. If a region is situated to the left of its A-point, its progress coefficient is positive and further investments bring the marginal productivity up.

5.2.3. The effect discussed here does not result from technical innovations or progress in the normal sense, but is a characteristic of the regional production

and industry mix

function defined by constant techniques/and is based on the following arguments:

a) Due to _indivisibilities_, capital investment in infra-structure, etc., which have to be undertaken in the less developed region in order to create a basis for more productive investments, will usually have an initial over-capacity. The marginal output-capital ratio curve will therefore first slope downwards, but when the "productive" investments are undertaken, start to rise.

b) As the income level increases and enlarges the regional market, _economies of scale_, particularly in the intraregional industries, may be increasingly exploited and reinforce the rise in marginal productivity.

c) _External economies_ created by newly established industrial plants will have favourable effects on the efficiency of the already existing industries, and hence reinforce the rise in the marginal productivity curve.

d) _External diseconomies_ may after some time, particularly if the expansion takes place within a geographically limited area, become stronger than external economies, while the possible economies of scale already are exploited and thus turn the marginal productivity curve downwards.

e) The _need for economic infrastructure_ such as urban transportation, water, sewerage, and energy, may _grow at an increasing rate_ when the urban area grows in size, and so may the costs in counter-acting pollution and health problems created, which reinforce the decline in the marginal productivity.

On the basis of these factors, it can be argued that it is reasonable to assume that the backward hinterland is situated to the left of its A-point, and, furthermore, if the most basic infrastructure is laid down, also to the right of its D-point. Similarly, it is reasonable to assume that the developed urban area is situated to the right of its A-point.

5.2.4. However, in reality techniques are not entirely given from outside and are not constant. On the contrary, inventions of new techniques and the transmission of innovations and the adaption to such, as well as the acquiring of new skills and learning by doing, are all prominent features of the process of development. This is the core of the second group of arguments for formulating the production structure as it is done in this section. These arguments, as opposed to the former ones, are of a true dynamic nature. The following three are of particular importance:

f) Introduction of <u>new techniques</u> takes place usually in close connexion to investments in new capital equipment. The assumption, which appears to be a quite realistic one, is that every piece of capital has a certain technique built into it which can be altered only slightly afterwards.$\underline{56/}$

g) <u>Learning by doing</u>, which appears to be a most important way to acquire new skills in underdeveloped regions, takes place in a similar way in connexion with the increase in the amount of capital.

h) Finally, the <u>creation of new skills</u> by formal education and systematic training require a corresponding investment in the construction of schools and equipment, and can therefore also be seen as a function of capital formation.$\underline{57/}$

All of these three factors can be summarized in the above figure by assuming that they shift the total and the marginal production curve upwards and to the right.
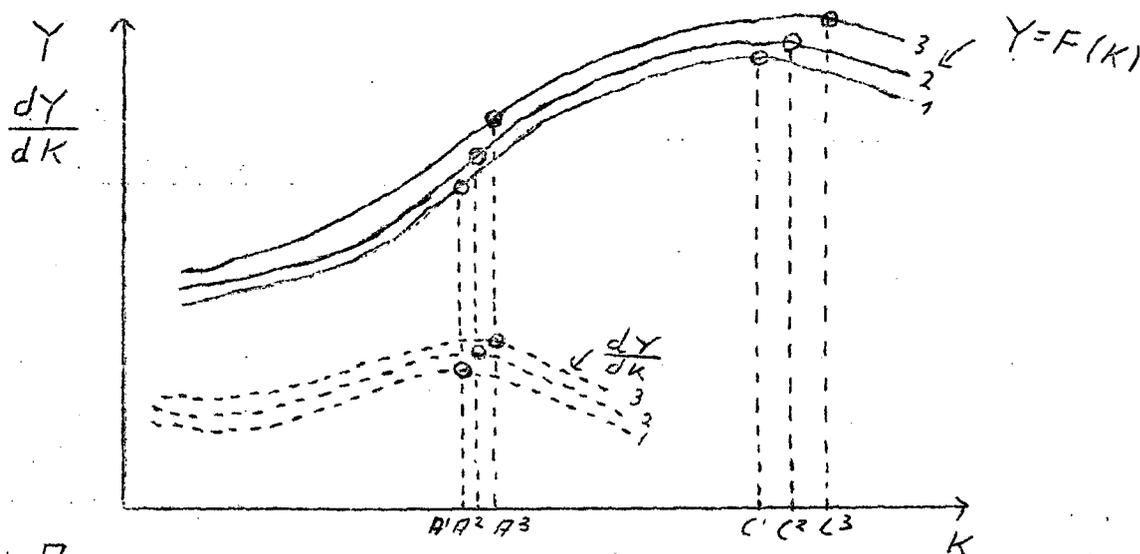
Fig 7

It is easily recognized from fig. 7 that the technological progress works to increase the value of the progress coefficient k when $k > 0$, and to check the decrease of it when $k < 0$.

5.2.5. The last argument for the dynamic production structure refers to the <u>absorptive capacity</u> of investments in the region. If the absorptive capacity is low, the initiating of investment projects, which surpass the capacity ceiling, will force the marginal productivity down. For different

reasons, the absorptive capacity may be quite low both in the underdeveloped and in the overdeveloped region. There is, however, reason to believe that this limit to development may, to a large extent, be removed by careful planning, and transfer of skills from abroad. Furthermore, there is reason to believe that the absorptive capacity increases with an increase in the level of development. Initially, this factor may well affect the underdeveloped region most but in the long run it may be easier lifted here than in the overdeveloped region. To conclude, the effect of the limited absorptive capacity will partly counteract the effect of technological progress, but not so much that the basic picture of the production functions will be changed.$\underline{58}$/

5.3. Mechanism for changing the average saving rate

5.3.1. The next typical change which is to be taken into account is in the saving rate. It is suggested that the saving-structure is described by the following formula.$\underline{59}$/

$$S_t = S_{t-1} + s \, \Delta Y_t = \bar{s} \, Y_0 + s \, (Y_t - Y_0)$$

If the marginal saving rate is higher than the initial, the average saving rate will increase as a function of increased income. If it is lower, the average saving rate will decrease.

5.3.2. There are at least four reasons why the average saving rate is expected to increase in the course of the development process:

a) The initial saving rate is, as a rule, very low.

b) When the development process is initiated, the expectations of the people about the future may be changed and an orientation towards growth may emerge.$\underline{60}$/

c) Establishing of financial institutions and improved communication possibilities will facilitate people's efforts to save.$\underline{61}$/

d) As the level of income increases, it will be easier for the government to enforce savings on the people by means of taxes and other fiscal measures than when the income is closer to the subsistence level.

In accordance with the points made above, the suggested saving function should be seen partly as a behavioural and partly as a policy enforced relation.

5.4. Formulation of the model

5.4.1. When the various relations are put together, the complete extended model reads as follows:

$$5,1 \quad Y_t^1 = Y_{t-1}^1 + \Delta Y_t^1$$

$$5,2 \quad Y_t^2 = Y_{t-1}^2 + \Delta Y_t^2$$

$$5,3 \quad \Delta Y_t^1 = v_t^1 \, \Delta K_{t-1}^1$$

$$5,4 \quad \Delta Y_t^2 = v_t^2 \, \Delta K_{t-1}^2$$

$$5,5 \quad v_t^1 = v_0^1 + k_1 \sum_{i=0}^{t-1} \Delta K_i^1$$

$$5,6 \quad v_t^2 = v_0^2 + k_2 \sum_{i=0}^{t-1} \Delta K_i^2$$

$$5,7 \quad \Delta K_{t-1}^1 = S_{t-1}^1 - S_{t-1}^T$$

$$5,8 \quad \Delta K_{t-1}^2 = S_{t-1}^2 + S_{t-1}^T$$

$$5,9 \quad S_{t-1}^1 = \bar{s}_1 \, Y_0^1 + s_1 \, (Y_{t-1}^1 - Y_0^1)$$

$$5,10 \quad S_{t-1}^2 = \bar{s}_2 \, Y_0^2 + s_2 \, (Y_{t-1}^2 - Y_0^2)$$

$$5,11 \quad Y_t = Y_t^1 + Y_t^2$$

The model contains 12 variables and 11 independent equations. There is one degree of freedom corresponding to the problem of determining the allocation of investment S^T. Since the coefficients v^1, v^2 in equation 5,3-5,4 are endogenous variables, this model cannot be solved in the same way as the basic model. However, it is possible to bring it on a more convenient form and, because of its time recursiveness, solve it numerically by means of step by step calculations for various assumptions with respect to coefficients and initial conditions.

5.4.2. _Regional income_ in the two regions in a certain period t can be expressed as:

$$5,12 \quad Y_t^1 = (1 + v_t^1 \, s_1) \, Y_{t-1}^1 + v_t^1 \left[(\bar{s}_1 - s_1) \, Y_0^1 - S_{t-1}^T \right]$$

$$5,13 \quad Y_t^2 = (1 + v_t^2 \, s_2) \, Y_{t-1}^2 + v_t^2 \left[(\bar{s}_2 - s_2) \, Y_0^2 + S_{t-1}^T \right]$$

where

$$v^1_t = v^1_0 + k_1 \sum_{i=0}^{t-1} \Delta K^1_i$$

$$v^2_t = v^2_0 + k_2 \sum_{i=0}^{t-1} \Delta K^2_i$$

If there are no transfers of savings between the regions, the rate of growth of each of them are given by:

$$r^i_1 = v^1_t s_1 + \frac{v^1_t Y^1_0 (\bar{s}_1 - s_1)}{Y^1_{t-1}}$$

$$r^i_2 = v^2_t s_1 + \frac{v^2_t Y^2_0 [\bar{s}_2 - s_2]}{Y^2_{t-1}}$$

The _internal rates_ of growth will, if $k >$ and $\bar{s} > s$ rise, first, because the marginal output-capital ratios increase, and secondly, because the average saving rates increase.

The _national income_ in year t can be expressed as:

5.14
$$Y_t = (1 + v^1_t s_1) Y^1_{t-1} + (1 + v^2_t s_2) Y^2_{t-1} + v^1_t Y^1_0 (\bar{s}_1 - s_1) + v^2_t Y^2_0 (\bar{s}_2 - s_2) + s^T_{t-1} (Y^2_t - Y^1_t)$$

5.4.3. Due to the recursiveness of the model, the income of the two regions and the national income in year t is completely determined by the income distributions and the allocation policy in the foregoing year. The policy-maker must look at least one year ahead when the allocation of investments is to be determined. If he has the extreme short time horizon of one year, he will always choose the region which at present has the highest incremental output-capital ratio. However, the _danger of shortsightedness_ is far greater in this model than in the one with fixed coefficients. There are three reasons for this:

     a) As in the case of the model with fixed parameters, the region with the lowest productivity may have a sufficiently higher saving rate to have a higher internal rate of growth.

     b) Capital investments have in this model first a _direct production effect_, and secondly, indirect "_infraeffects_". Projects undertaken today influence the productivity of future projects.

c) Besides the direct income effect of capital investments, there
is a second infraeffect, namely, of the increase in income on
the saving rate, i.e., increased income today has a positive
speeding up effect on future capital formation.

The two infraeffects are both of an accumulative character and they manifest
themselves first after some time. It is obvious that when these three effects
are taken together, they can have a very significant impact on the development
process. It seems therefore to be of the utmost importance for rational alloca-
tion that attempts are made beforehand to assess these effects.

5.5. Properties of the development paths generated by the model

5.5.1. The feasible area of allocation strategies is, as in the former
model, limited by the two extremes; either all investment to the one region
or all to the other one. Since the region from which all savings are drained
gets no increase in income, it will also have a constant saving rate. Therefore,
if all investments are undertaken in region 1 throughout the planning period,
this region will receive a constant transfer of savings from the other region
of the size $-\bar{s}_2 \, Y_0^2$. If the opposite strategy is followed, the transfer of
savings from region 1 to region 2 will be constant equal to $\bar{s}_1 \, Y_0^1$. The two
extreme alternatives to be examined are therefore:

Alt.1: All investments in region 1

$$S_t^T = -\bar{s}_2 \, Y_0^2 \qquad t = 1\text{------}$$

$$Y_t^1 = (1 + \gamma_t^1 \, s_1) \, Y_{t-1}^1 + \gamma_t^1 \left[Y_0^1 \, (\bar{s}_1 - s_1) + \bar{s}_2 \, Y_0^2 \right]$$

$$\hat{Y}_t = Y_t^1 + \bar{Y}_0^2$$

Alt.2: All investments in region 2

$$S_t^T = \bar{s}_1 \, Y_0^1 \qquad t = 1\text{------}$$

$$Y_t^2 = (1 + \gamma_t^2 \, s_2) \, Y_{t-1}^2 + \gamma_t^2 \left[Y_0^2 \, (\bar{s}_2 - s_2) + \bar{s}_1 \, Y_0^1 \right]$$

$$\hat{Y}_t = \bar{Y}_0^1 + Y_t^2$$

5.5.2. When the coefficients $(\bar{s}_1, \, \bar{s}_2, \bar{s}_1, \, \bar{s}_2, \, \gamma_0^1, \, \gamma_0^2, \, k_1, \, k_2)$ and the
initial conditions Y_0^1 and Y_0^2 are given, the time paths for the national
income and the growth rates can be numerically calculated for the two extreme
strategies. If one of the regions has an initially higher internal rate of
growth, e.g., $\gamma_0^1 \, \bar{s}_1 > \gamma_0^2 \, \bar{s}_2$ and also the higher marginal saving rate and progress

coefficients, there are no doubts that the fastest national growth is achieved
by allocation of all investments to this region. However, more interesting is
the case where the region with the lower productivity has the higher marginal
saving rate and the higher progress coefficients. If this region has also an
initial saving rate high enough to give it the highest initial internal rate of
growth, the two infraeffects will shorten the regaining period of investing there,
i.e., the period before the immediate loss in income due to the low productivity
is regained because of the higher saving rate. If the region with the higher
progress coefficient and the higher marginal saving rate has an initially lower
internal rate of growth, the infraeffects of the investments will increase its
internal rate of growth during time so that after some periods it will enjoy a
higher rate of growth than the other region. This is perhaps the most realistic
situation which may be found in most developing countries.

5.5.3. In order to demonstrate these effects, the model has to be solved
numerically for the different sets of assumptions. The two cases demonstrated
in the following correspond to the two first alternatives calculated in the
model with fixed parameters as far as initial conditions are concerned. The
assumptions about initial conditions and coefficients of the two alternatives
are as follows:[63]/

Alt. A	Alt. B
$\bar{s}_1 = 0.10$	$\bar{s}_1 = 0.05$
$\bar{s}_2 = 0.05$	$\bar{s}_2 = 0.10$
$s_1 = 0.12$	$s_1 = 0.10$
$s_2 = 0.20$	$s_2 = 0.15$
$v_0^1 = 0.40$	$v_0^1 = 0.40$
$v_0^2 = 0.30$	$v_0^2 = 0.30$
$k_1 = -0.00005$	$k_1 = -0.0001$
$k_2 = 0.000075$	$k_2 = 0.0001$
$Y_0^1 = 500$	$Y_0^0 = 500$
$Y_0^2 = 1000$	$Y_0^2 = 1000$

Region 1 is assumed to be the more developed in both cases, with the highest incremental output-capital ratio. In alternative A, region 1 has also the higher initial saving rate, but region 2 is assumed to have the higher marginal saving rate. Region 1 is furthermore assumed to be in a situation where external diseconomies are strong enough to force the incremental output-capital ratio down, while region 2 is assumed to be in its initial stage of development, i.e., on the rising parts of its incremental output-capital ratio-curve. The value of the progress coefficient is assumed to be somewhat lower negative in region 1 than the positive one of region 2, in accordance with what was said about the impact of technical progress above. In alternative B, region 2 has the higher initial internal rate of growth, but the initial conditions are so disadvantageous that the regaining period under the assumption of fixed coefficients was very long. It is assumed that in this alternative the progress coefficients are of the same value in both regions, but negative in region 1. Region 2 is assumed to have the higher marginal saving rate.

5.5.4. The results of the calculations are given in the following tables and figures. The table below shows, for alternative A, the growth paths of total national income, the absolute and relative growth period for period, the induced changes in the marginal output-capital ratio and the accumulated income differentials between the two extreme strategies.

	ALT. A1				ALT. A2				
	Y_t^1	ΔY_t^1	$\dfrac{\Delta Y_t^1}{Y_{t-1}^1}$	v_t^1	Y_t^2	ΔY_t^2	$\dfrac{\Delta Y_t^2}{Y_{t-1}^2}$	v_t^2	$\sum(Y_t^2 - Y_t^1)$
0	1500			0.400	1500			0.300	0
1	1540	40	2.67	0.398	1530	30	2.00	0.304	- 10
2	1581	41	2.66	0.393	1563	33	2.16	0.312	- 28
3	1623	42	2.65	0.387	1599	36	2.30	0.320	- 52
4	1667	44	2.71	0.382	1638	39	2.44	0.329	- 81
5	1712	45	2.70	0.376	1681	43	2.63	0.339	-112
6	1759	47	2.74	0.369	1728	47	2.80	0.349	-143
7	1807	48	2.73	0.363	1780	52	3.01	0.360	-170
8	1855	48	2.66	0.356	1838	58	3.26	0.372	-187
9	1905	50	2.69	0.349	1903	65	3.54	0.384	-189
10	1956	51	2.68	0.341	1975	72	3.78	0.398	-170
11	2007	51	2.61	0.334	2056	81	4.10	0.413	-121
12	2059	52	2.59	0.325	2146	90	4.38	0.428	- 34
13	2112	53	2.57	0.317	2248	102	4.75	0.445	+102

When all investments are poured into the backward regions, in order to create external economies and induce the infraeffects, the income will for some periods be somewhat lower than what could have been achieved by investing in the other region. However, the absolute as well as the relative growth are quickly increasing as a result of the investments in the backward region, while the relative growth is varying slightly up and down, but with a tendency to decline in the developed region. It takes only five to six years before the rates of growth are equalized, after six years the yearly absolute growths are equal, and after nine to ten years, the total income of the two alternative policies are equal. The loss of income from the first periods is regained after between 12 and 13 years.

5.5.5. The time paths which emerge from this model are compared to those emerging from the model with fixed coefficients in the figure below. While the gap between the growth rates of the two policies was widening in model 1, so also was the gap between the total income curves, these gaps are fastly closed in model 2. When alternative 2 of model 2 is compared to alternative 1 of model 1 it can be seen that even if no changes are induced in the coefficients of the model of region 1, it takes only one year more than in the case where they do change before the total incomes are equal. The significance of the induced changes in the saving and production structure in the course of the development process for proper allocation of investments is clearly demonstrated by the above example. Although the changes are relatively small, they accumulate them-selves and should therefore be taken into account by means of long-term planning.

5.5.6. In the next table the time paths for total income, additional income, the growth rates and the marginal output-capital ratio are shown for the case where the initial conditions are similar to those of alternative B of the first model.

t	ALT. B1				ALT. B2				$\sum (Y_t^2 - Y_t^1)$
	Y_t^1	ΔY_t^1	$\frac{\Delta Y_t^1}{Y_{t-1}^1}$	v_t^1	Y_t^2	ΔY_t^2	$\frac{\Delta Y_t^2}{Y_{t-1}^2}$	v_t^2	
0	1500			0.400	1500			0.300	0
1	1550	50	3.33	0.398	1539	39	2.60	0.310	-11
2	1600	50	3.23	0.385	1581	42	2.73	0.323	-20
3	1650	50	3.17	0.371	1628	47	2.88	0.337	-43
4	1701	51	3.09	0.367	1678	50	3.08	0.350	-66
5	1752	51	2.99	0.353	1734	56	3.34	0.365	-84
6	1802	50	2.85	0.338	1795	61	3.52	0.381	-91
7	1852	50	2.77	0.322	1862	67	3.73	0.398	-81
8	1901	49	2.65	0.306	1936	74	3.97	0.416	-46
9	1949	48	2.52	0.290	2019	83	4.29	0.435	36
10	1995	46	2.36	0.273	2112	93	4.61	0.455	153
11	2039	44	2.21	0.255	2215	103	4.88	0.477	329
12	2081	42	2.06	0.233	2334	119	5.37	0.500	582

When all investments poured into the initially technically backward region, it
takes under the assumptions made only four to five years before the rate of growth
as well as the absolute increase in income and the incremental output-capital
ratio are equal to what would have resulted from the opposite strategy. The
total incomes are equal after between six and seven years, and the initial loss
in income resulting from investing in the technically backward region is more
than repaid three years after the total incomes are equalized. In fig. 9, the
two extreme alternatives of model 2 are compared to the two corresponding
alternatives of model 1. As in the previous example, the growth potential of
the technically backward region under the assumption of induced changes in the
coefficients is very well demonstrated.

5.6. Further remarks on the infraeffects

5.6.1. In spite of the striking effect of the induced infraeffects on the
growth paths of income and rates of growth, and the significance of these on
the proper allocation of investments demonstrated above, it should not be for-
gotten that even though the existence of such factors as those behind the
infraeffects seem evident, the strength of these effects may be much lower than
what it is assumed in the above examples. Furthermore, the effects are built
into the model by means of linear approximations which obviously may overstate
their magnitude if they are in reality non-linear. This is particularly the
case when wide variations are discussed. It goes without saying that neither

Y

2300

2200

2100

2000

1900

1800

1700

1600

1500

Model 2, Alt. 1.2

Model 2, Alt. 1.1

Model 1 Alt. 1.1

Model 1 Alt. 1.2

1 2 3 4 5 6 7 8 9 10 11 12 13 t

$$R = \frac{\Delta Y_t}{Y_{t-1}}$$

4.6

4.4

4.2

4.0

3.8

3.6

3.4

3.2

3.0

2.8

2.6

2.4

2.2

2.0

1.8

Model 2, alt. 1.2

Model 1, Alt. 1.1

Model 2, Alt. 1.1

Model 1, Alt. 1.2

1 2 3 4 5 6 7 8 9 10 11 12 13 t
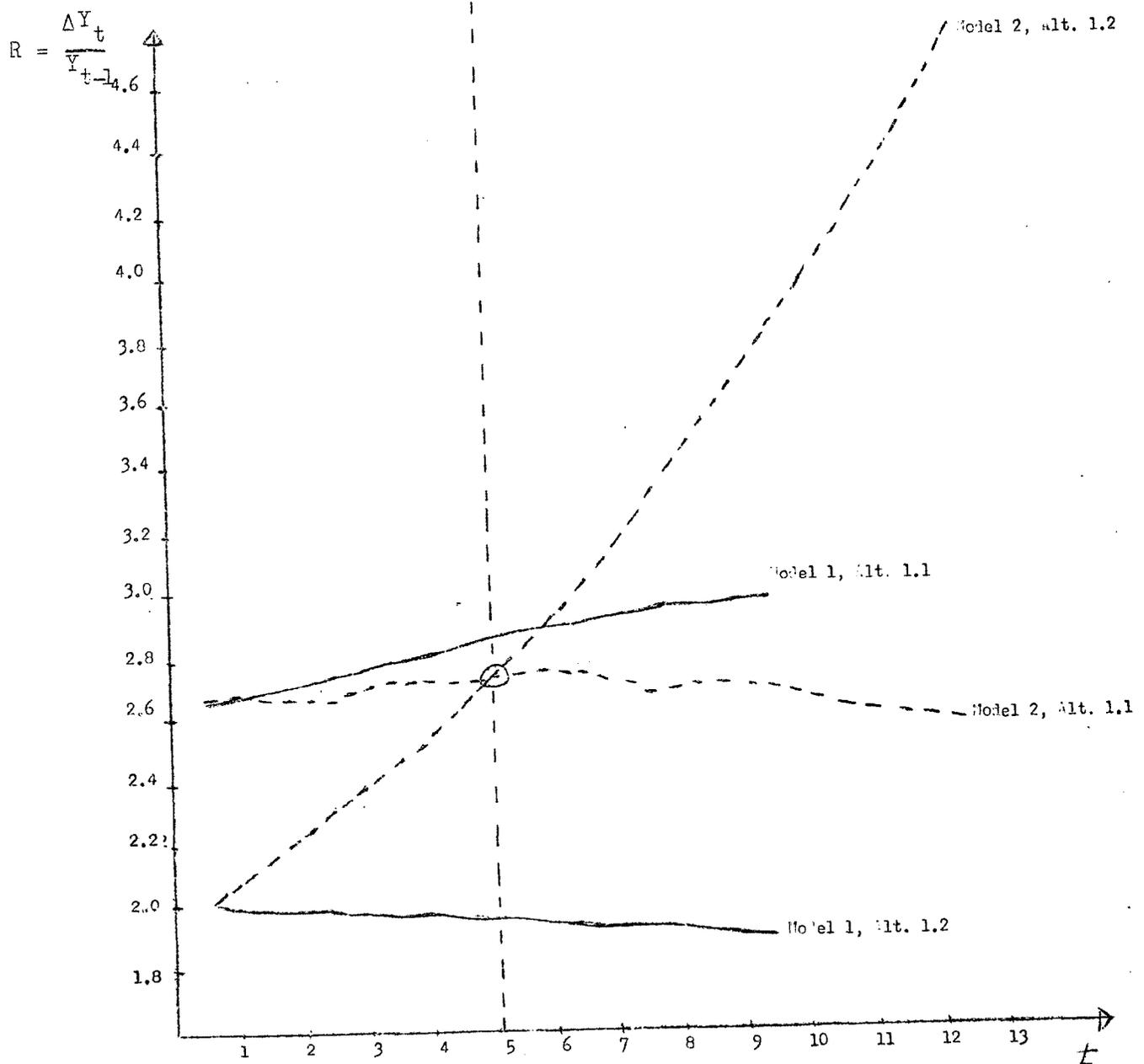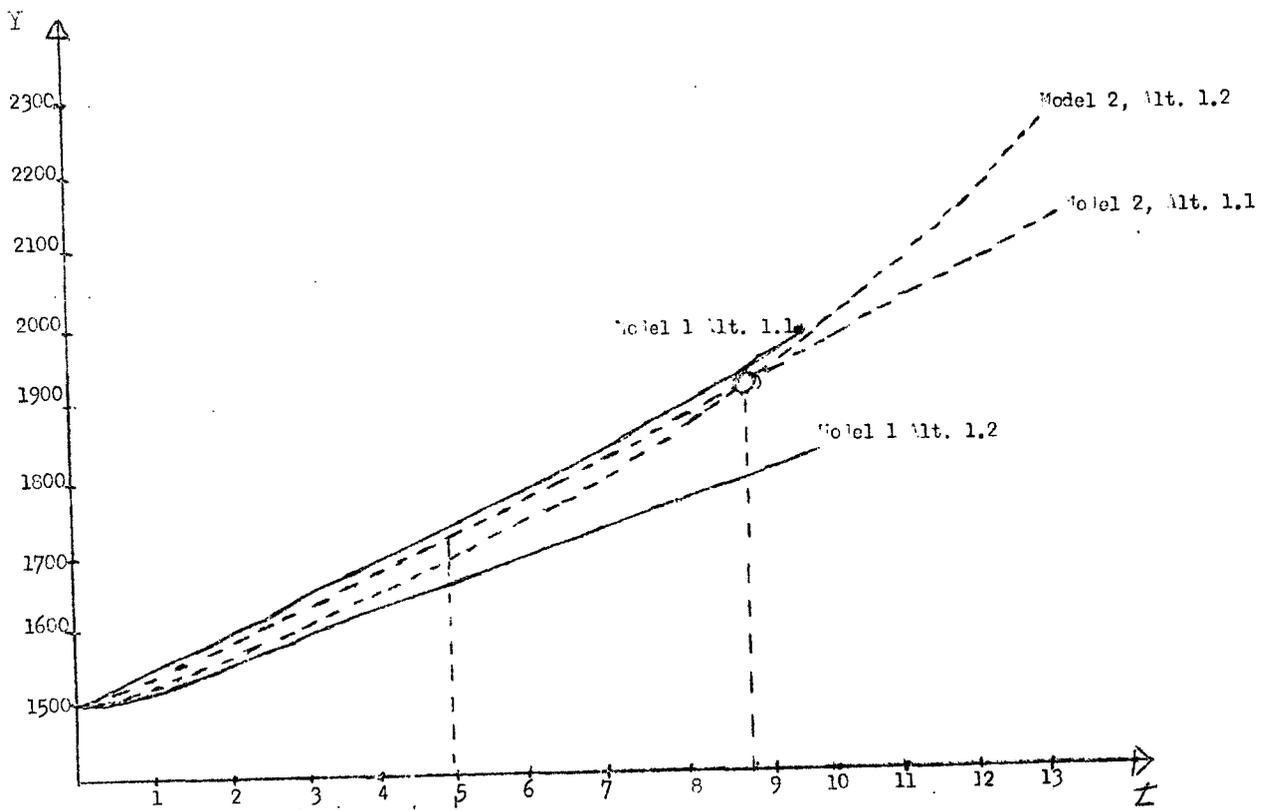
Fig. 8
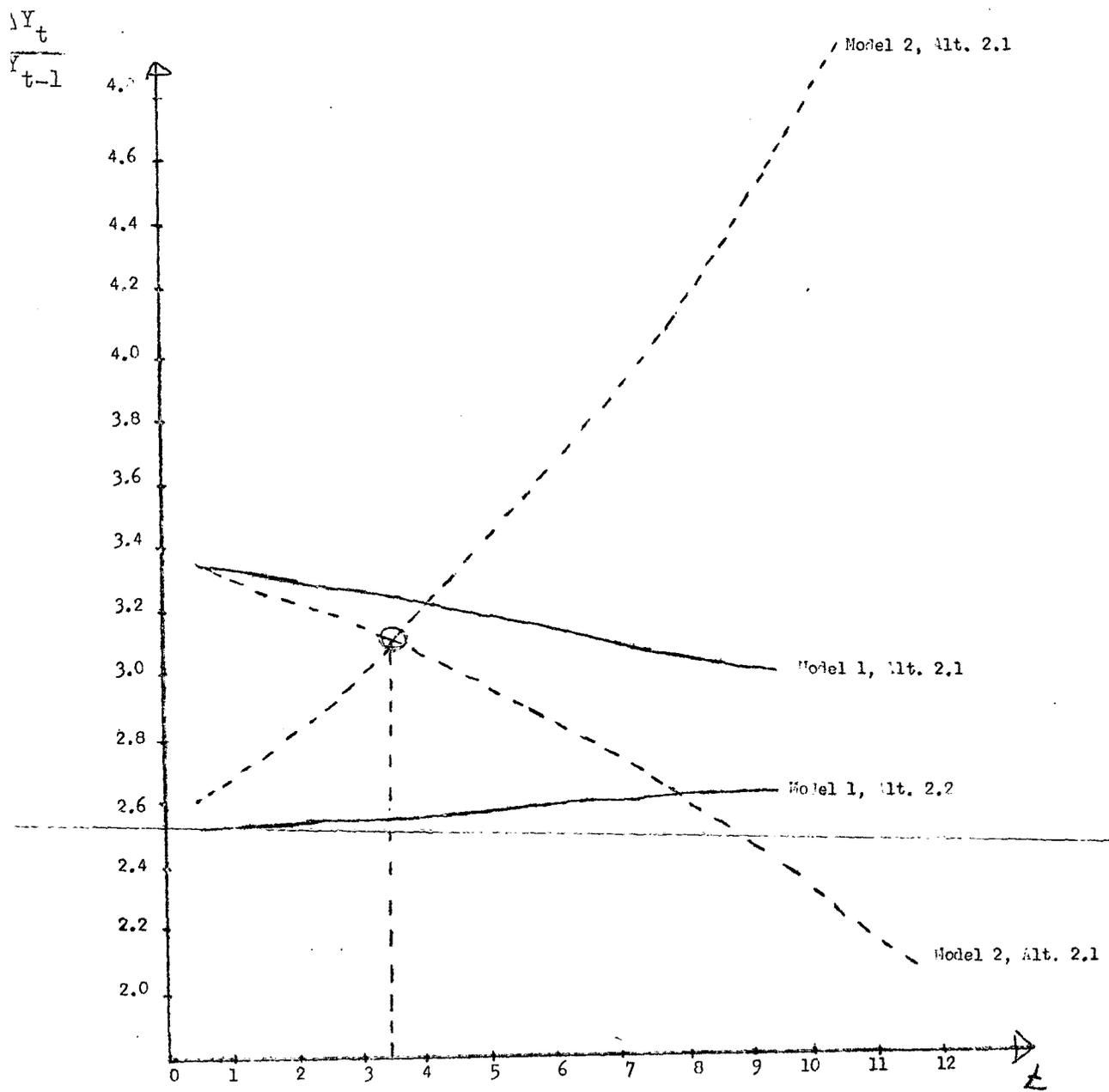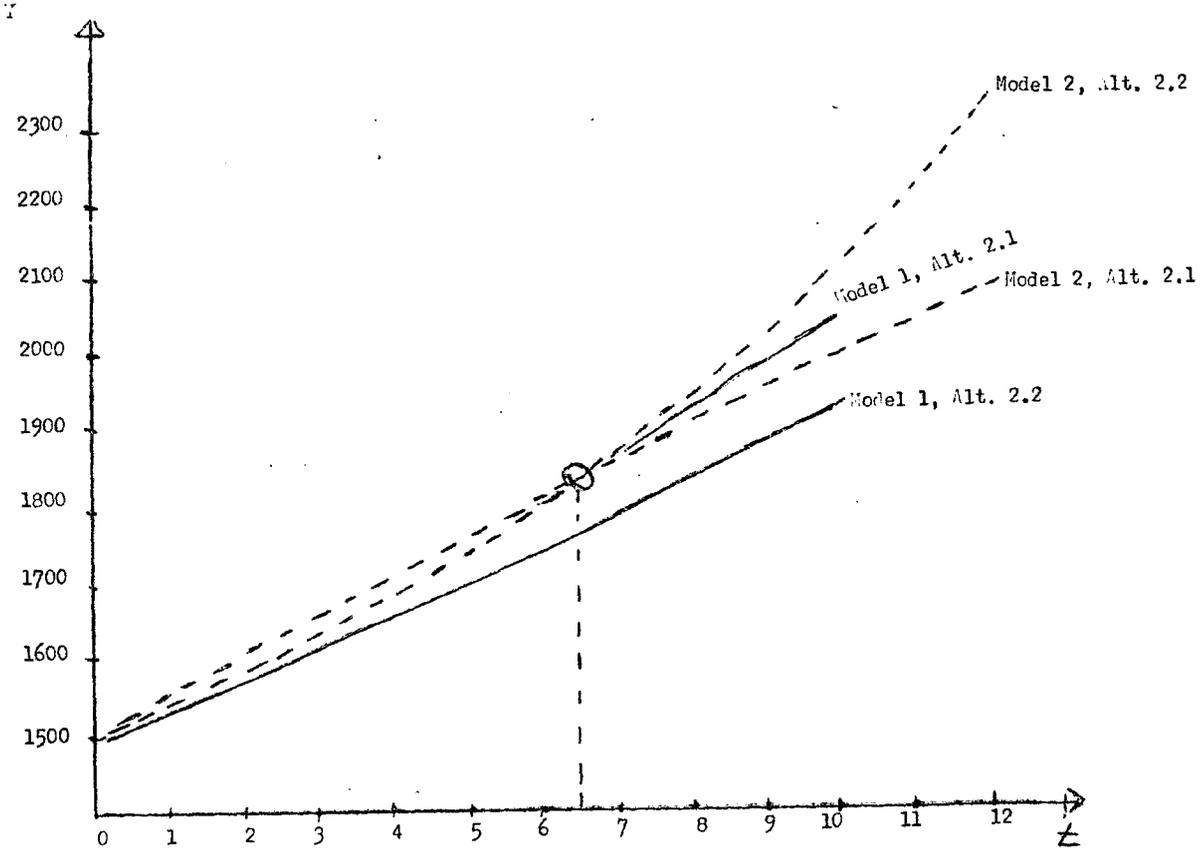
Fig. 2

the average saving rate nor the marginal output-capital ratio and the rate of growth will continue to increase without limitations. These limitations may, however, be built into the model by using successive approximations instead of single ones for the whole area of variation.

5.6.2. With respect to the <u>marginal saving rates</u> deviation from the averag some evidence suggests that not too much should be expected by this effect. For example, N.H. Leff[64] has shown that the saving rate showed no tendency to rise during the course of development in Brazil. On the other hand, it is nevertheless clear that a characteristic feature of the long-term development of the present developed countries is the rising share of the total income used for capital accumulation during the "take-off stage" of their development.[65] It seems pertinent to agree with N.H. Leff that the existing knowledge of what factors which in reality determine the saving rate in less developed countries is very meagre, and add that even less is known about the interregional differences in average and marginal saving rates, and the factors behind such differences. However, since increased saving appears to be a "sine qua non" for development, and most development plans are based on assumptions of, or goals for, increasing saving rates, the assumptions made in the model calculations above may well be justified. In view of the significant impact of regional differences in average and marginal saving rates on the proper interregional allocation of investments, and on the time horizon of planning, it should be stressed that more research in this field is urgently needed.

5.6.3. With respect to the assumed existence of positive and negative <u>progress coefficients</u> which determine the changes in the incremental output-capital ratios, even less empirical evidence can be referred to. While the factors particularly discussed, i.e., external economies, diseconomies, indivisibilities, and economies of scale all support the assumption of induced changes in the marginal output-capital ratio, other factors like better organizations, learning by doing, introduction of new techniques, etc., can be taken as arguments for working with other production functions. Obviously, if it is assumed that capital is the only factor of production, and the output increases faster than the amount of capital employed, this phenomenon can in such a model only be explained by increased incremental output-capital ratio. However, if the "real" production function involves more factors, for example, labour and organization, the increase in output could be attributed to these factors and not to the change in the output-capital ratio.

5.6.4. If, for example, the "real" regional production functions are of the Cobb-Douglas type with a trend-factor to represent organizational and technological improvements and better education, i.e.,

$$Y = CK^a N^b e^{zt}$$

where N denotes labour, the incremental output-capital ratio for any period can be written

$$\frac{\Delta Y}{\Delta K} = \frac{Y}{K} \cdot \frac{a \frac{\Delta K}{K} + b \frac{\Delta N}{N} + z}{\frac{\Delta K}{K}}$$

In this production function, the marginal output-capital ratio will increase when the rate of growth in employment increases and when the organizational and technological development is speeded up, while contrary to the assumptions made in model 2 above, the marginal output-capital ratio will decrease if the rate of growth in investments increases.[66] On the other hand, the Cobb-Douglas production function is not able to give a satisfactory representation of the conditions for production when external economies and economies of scale are developed, since these will affect the values of the coefficients a and b. It would nevertheless seem appropriate to work with a more complex production function than is done in this paper. Interregional differences in productivity and production functions are, however, very little surveyed theoretically or empirically. It is obvious that if proper allocations are to be made between regions, it is necessary to establish a much greater body of knowledge, not only about to what extent such differences actually exist, but it is even more important to identify how these differences are brought into existence and how the underlying structure of production gradually changes during the process of development. [66a]

6. FINAL REMARKS

6.1. Summary of problems raised and methods of analysis

6.1.1. The purpose of this paper has been to analyse to what extent the time horizon affects the proper allocation of investment funds between regions. This has been done in a simplified aggregate/ way, assuming a two-region economy of a developing country where the one region consisted of an already fairly well developed urban area and the other of a large backward hinterland. It was assumed that the most basic physical infrastructure was laid down in the backward region, and that the developed urbanized area was facing problems of unbalanced expansion and congestion.

6.1.2.   Two types of planning have been distinguished;

project planning, consisting of identification appraisal and selection of projects, and comprehensive planning.   Project planning focuses attention on the characteristic feature of the project itself, taking most of the structu conditions as given, and do not take into account the external economies/dis- economies which are, or can be, created for other industries existing today, or which can affect the productivity of future industries.   Project planning does not take into account the chain of structural changes in social and cultura variables which are likely to be set in motion by the establishing of projects, but tends to select projects which give the highest and fastest return on the capital invested, i.e., the highest output-capital ratio.

6.1.3.   Comprehensive planning on the contrary focuses attention particularl on the interrelations between various projects and industries in a dynamic setting, taking into account also the characteristic changes which are induced in social and cultural variables that may have strong feedback effects on economic development.   Comprehensive planning represents attempts to assess the functional as well as secular relations between projects in the entire set of functional sectors and geographical regions from the point of view of nationa development goals comprising growth as well as equalization.   Besides qualitati structural assessment, the identification of regional growth potentials appears to be a most useful tool for appraising interregional allocation of investments and identifying the range of feasible time paths for the development process from which the most desired one should be selected for implementation.   The growth potential of a region is defined as its prospective rate of growth in total income which, in turn, is determined by the average saving rate and the incremental output-capital ratio.   The problem raised can also be formulated as: under what conditions are the allocation criteria in project planning complementary to those of comprehensive planning, and under what conditions are they, not?

6.2.   Conclusions drawn on the basis of the model with fixed structural parameters

6.2.1.   Since the effects of a project on other projects, and on the income- generation and saving-capital formation works through time, it is clear that the time horizon must be a most important variable.   If the planners are looking only one year ahead, the direct production effects will normally be the dominatin and since saving-capital accumulation is by definition not taken into account, project criteria will be sufficiently also from a comprehensive planning point of view.   However, as the time horizon is lengthened, this may change.   This

problem is analysed in the paper by means of two different simplified allocation growth models. The first model, which is similar to the Rahman-type programming models, was used to examine the effect of different growth potentials on the allocation of investments between the two regions and on the choice of proper time horizon. The developed urbanized region was assumed to have the higher incremental output-capital ratio, determined on the basis of project appraisal. This ratio was furthermore assumed to be constant over the planning period.

6.2.2. Three different cases could be distinguished:

a) The urbanized region has also the higher growth potential, either because it has the higher saving rate or if it has the lower saving rate, it is nevertheless high enough to give the region the higher prospective rate of growth.

In this case, the allocation of investments according to project criteria will also give the proper allocation from an overall point of view. The highest national income is attained when all funds are invested in the most productive region.

b) The backward region has the higher prospective growth potential and the regaining period for the initial loss of income resulting from investing in the backward region - which is determined by the given initial conditions - is relatively short.

In this case the allocation of investment according to project criteria would be too shortsighted to yield a proper allocation from an overall point of view. If the planners have a time horizon in the comprehensive planning which is shorter than this reasonably short regaining period, they can be said to be too short-sighted. The optimal strategy would be to invest in the region with the highest growth potential in the first years and then switch over to the most productive region in the final years.

c) The backward region has the highest growth potential, but, due to the unfavourable initial conditions, the regaining period is longer than a reasonable time horizon.

In this case the optimal strategy from a comprehensive point of view would (in spite of the fact that the backward region has the highest growth potential) coincide with the project criterion. All investments should be made in the urbanized region. So far, the conclusions are the same as those in the Rahman study.

6.3. Conclusions drawn on the basis of the model with built-in changes in the structural parameters

6.3.1. However, as it was pointed out in the paper, the analysis so far has been unsatisfactory. First, because it failed to take into account the external economies manifested in the relations between existing, new, and future projects, economies of scale, etc. Secondly, because the effect of increased income on social and cultural factors and the feedback of social changes on growth through increased saving rates was not taken care of. Finally, because a situation characterized by one region with high productivity and low saving rate and another with low productivity but high saving rate would rarely be found in practice. In other words, it would be superficial to regard saving rates and marginal output-capital ratios as given constants. On the contrary, they should be seen as endogenous variables of the planning model in which change could occur during the growth process.

6.3.2. A second model was therefore formulated, based on the same framework of relations as the first one, but with built-in changes in the strategical coefficients, i.e., in the saving rate and the incremental output-capital ratio. When these infraeffects were brought into the model it could be demonstrated that neither the project criterion nor the simple growth potential criterion would necessarily bring about an optimal allocation. The prospective incremental output-capital ratios would deviate from the project ratios due to external economies and change during time, as would the average saving rate. Therefore, the growth potential of a region could not be seen as a static concept. Because of its dependence on the allocation of investments during time, the time paths of the growth potential had to be calculated on the assumptions of different allocation of the investments. Programming technique can hardly be applied to this type of model. The only way to choose the proper allocation strategy appears to be to simulate the development process under different assumptions, survey the various growth paths that emerge, and choose the one for implementation which seems the most promising.

6.3.3. Comprehensive planning according to this model will then be of an essential dynamic character, and the time horizon should be long enough to enable the planners to assess the likely impact of the various infraeffects on the growth paths and the choice of allocation strategy. Project planning will nevertheless be an essential part of the total planning work, but instead of being enough in itself it has to be subject to guidelines from comprehensive planning which, ideally, should fix the conditions to be taken as given in the appraisal of project-locations between the regions.

6.4. Possible extensions of the model framework

6.4.1. Many weaknesses of the model employed and the analyses undertaken in this paper have already been pointed out. Above all, the picture of the developing countries has been oversimplified, perhaps to the point of unrealism. The justification for not attempting to bring more realism into the analysis by taking into account other vital aspects of the development process are two-fold. First, this could have confused the prime purpose of the paper, namely, to discuss and demonstrate the effects of some factors that are usually not taken into account in models for interregional planning. Secondly, in any analysis attempting to be more realistic, such factors and aspects may be brought into the model framework in various different ways without too many difficulties.

The most important extensions to make in order to provide a more realistic framework are in the fields of population growth, migration, interregional trade relations, production functions, and consumption. The introduction of these factors, perhaps except for the trade relations, are strongly interconnected.

6.4.2. The growth of population can be introduced in the most simple way by means of linear regional national gross increase functions of the type

$$\Delta N_t = n \, N_t$$

where N_t denotes total population in the beginning of year t, and ΔN_t the natural increase, i.e., total number of births minus total number of deaths during year t. If the death and birth rates are changing quickly, the function could be split to read

$$\Delta N_t = b \, N_t - d \, N_t.$$

If in- and outmigration to and from the country are of little significance, the growth in population for the country as a whole can be written simply as:

$$\Delta N_t = \Delta N_t^1 + \Delta N_t^2.$$

6.4.3. Migration between the two regions is an equally important inter-regional relation as capital transfer and should therefore be taken care of by a migration function. Such a function can be formulated in different ways. The simplest formulation is

$$N_t^T = R \left(\frac{Y_{t-1}^1}{N_{t-1}^1} - \frac{Y_{t-1}^2}{N_{t-1}^2} \right)$$

where N_t^T denotes net migration between the region in year t, $\frac{Y}{N}$ average income, and β is the mobility-coefficient. It is assumed that there exists a reaction lag of one year so that high income differential in a given year leads to high migration in the next. This assumption is also convenient from a computational point of view. A more realistic migration function would however be to assume that the migrants are looking not at the differentials in regional income per capita but at differentials in capita consumption, i.e.,

$$ N_t^T = \rho \left(\frac{Y_{t-1}^1 - S_{t-1}^1}{N_{t-1}^1} - \frac{Y_{t-1}^2 - S_{t-1}^2}{N_{t-1}^2} \right) $$

Since the consumption is lagging behind in an expansion process characterized by marginal saving rate higher than the average, the latter migration function would yield a corresponding lag in migration as compared to the former.

6.4.4. When consumption is introduced in the model it would also seem most appropriate to let consumption be the main goal variable, and for the choice of allocation strategy, survey the set of feasible time paths for total consumption.

6.4.5. Explicit introduction of interregional trade in this general model framework has to be based on assumptions about initial comparative advantages referring to particular production sectors. It could be useful to distinguish between national and international sectors on the one hand, and regional and local sectors on the other, as it is suggested in Tinbergen's semi-input-output method.[67] In the first group, a distinction should also be made between shiftabl and non-shiftable production processes. The trade relations could be formulated as linear equations. There are, however, reasons to believe that the coefficient of these equations would be unstable over time. The best solution would therefore perhaps be to use a model without trade relations in the long-term comprehensive planning and introduce the trade relations in a medium term - say five-year model for medium term co-ordination.[68] Such a model should be much more detailed than the very aggregated macro model discussed here.

6.4.6. Finally, the production functions could be formulated in a more realistic way. One possibility, which would seem convenient from a computational point of view, is to use the Cobb-Douglas function

$$ \Delta Y_t = Y_{t-1} \left(a \frac{\Delta K_{t-1}}{K_{t-1}} + b \frac{\Delta L_t}{L_t} + z \right) $$

where L_t denoted labour input in year t. The gestation lag for capital is kept but labour input is assumed to affect production simultaneously. The technical and organizational progress is included in z. The coefficients a and b could be assumed to be fixed or to be variables. The input of labour can be tied to the regional population through a relation

$$L_t = g N_t$$

where the coefficient g denotes the share of population engaged in production. Since the population of a region in year t N_t is determined by the national increase in the period, and the migration by a migration function with a one year lag, the labour input in a region in year t can be written as a function of given coefficient and the situation of the foregoing year. Thus, the time recursiveness is kept through the entire model, which would greatly facilitate the computation.

F O O T N O T E S

* The author is indebted to Dr. A.R. Kuklinski for initiating this study, and to S. Cohen for valuable discussions during the preparation of the paper.

1. J. Friedmann and W. Alonso: "Regional Development and Planning: A Reader Cambridge, Mass. 1964, p.1.

2. See, e.g. N. Sakashita: "Regional Allocation of Public Investment", R.S.A. Papers, Vol.19, 1967, p.161.

    For a survey and discussion of interregional allocation criteria, see: R.A. Reiner: "Subnational and National Planning: Decision-Criteria", R.S.A. Papers, Vol.14, 1965.

3. This point is strongly argued in: T. Vietorisz: "The Planned Interregional Location of Industry: Argument in Favour of a "Trade-not-Aid" Approach". Paper prepared for the UNIDO Seminar on Industrial Location and Regional Development, Minsk, 1968, pp.10-17.

4. See e.g. W. Alonso: "The Location of Industry in Developing Countries", Paper prepared for the UNIDO Seminar on Industrial Location and Regional Development, Minsk, 1968, p.44.

5. For a criticism of traditional programming techniques applied to this field, see T. Vietorisz, op.cit.

6. See A.R. Kuklinski: "Goals in Regional Policies and Objectives in Regional Planning". Paper prepared for Regional Planning Conference, Ireland 1969, Belfast, 1969.

7. United Nations Research Institute for Social Development Programme of Research in Regional Development, Geneva July 1968, p.4.

8. See e.g. P.R. Odell: "Economic Integration and Spatial Patterns of Economic Development in Latin-America". Paper read to the Latin American Regional Conference of the International Geographical Union, 1966.

9   C.f e.g. W. Alonso, op.cit.

10. C.f, J.G.M. Hilhorst: "Regional Development Theory: An Attempt to Synthesise", The Hague, 1967

    See also: B.Balassa: "The Theory of Economic Integration", London 1962, ch.9.

11.   For further discussion on this point, see:
      K. Allen and T. Hermansen: "Economic Growth - Regional Problems and
      Growth Centres".
      Chap.2 in: "Regional Development in EFTA. An Examination of the Growth
      Centre Idea". Geneva, 1968. Also published by Oliver and Boyd,
      Edinburgh as occasional paper No.10, Social and Economic Studies
      University of Glasgow.

12.   This point is particularly stressed by J.Friedmann. See for example:
      "Integration of the Social System: An Approach to the Study of Economic
      Growth". Diogenes 1967.

13.   For discussion of administrative aspects of planning and plan
      implementation, see for example:
      B. Knall: "Requirements for Effective Plan Implementation".
      Paper prepared for the Conference of African Planners, Addis Ababa,1967.
      W.F. Ilchman and R.C. Bhargava "Balanced Thought and Economic Growth".
      Economic Development and Cultural Change No.4, 1966.
      Ch.E. Lindblum: "Economics and the Administration of National Planning",
      Public Administration Review 1966.

13.a C.f. W.F. Stolper "External Economies from a Planning Standpoint".
      Zeitschrift für die gesamte Staatswissenschaft, 1963, No.2.

14.   L. Lefeber: "Regional Allocation of Resources in India"
      ch. 33 in J. Fridemann and W. Alonso, op.cit., p.644.

15.   Compare: Y.Droor: "The Planning Process - a Facet Design"
      International Review of Administrative Sciences No.1, 1963.

16.   C.f. I. Svennildson: "Planning in a Market Economy"
      Weltwirtschaftliches Archive 1965.

17.   For recent discussions of the characteristics of comprehensive planning,
      see for example the articles in
      "Essays in Honour of Professor Jac. P. Thijsse", The Hague, 1967.

      See also:
      A.R. Kuklinski: "Trends in Research in Comprehensive Regional Planning",
      UNRISD Paper, Geneva 1967.

18.   The need for comprehensive structural planning as guide lines for
      project-decisions is stressed in for example:
      C. Furtado: "Intra-country discontinuities: Towards a theory of spatial
      structures".
      Social Science Information, December 1967.

      C.T. Stewart jr.: "Regional Allocation of Public Funds for Economic
      Development".
      Land Economics, November 1967.

      N.M. Hansen: "Towards a New Approach in Regional Economic Policy"
      Land Economics, November 1967.
      and in:
      "Criteria for Location of Industrial Plants, Changes and Problems"
      United Nations, New York, 1967.

19. C.f: L. Johansen and A. Sørsveen: "Notes on the Measurement of Real Capital in Relation to Economic Planning Models" Institute of Economics, University of Oslo, 1966.

20. The term "interlocal" is introduced by A.R. Kuklinski, Nov. 1968, op.cit

21. C.f. H. Perloff: "Natural Resource Endowment and Regional Economic Growth", ch.11 in J. Friedmann and W. Alonso, op.cit.

22. The significance of the situation relative to the market is stressed for example by B. Balassa, op.cit.

    See also: J.V. Krutilla: "Criteria for Evaluating Regional Development Programs" in J. Friedmann and W. Alonso, op.cit.

23. See e.g. K. Allen: "Growth Centres and Growth Centre Policy" in "Regional Development Policy in EFTA - An Examination of the Growth Centre Idea", op.cit.

24. For a survey of the role of the auxilliary industries, see for example: E.S. Tosco: "Relevance of Intermediate Industries and Industrial Services for Correct Location Planning". Paper prepared for the UNIDO Seminar on Industrial Location and Regional Development Minsk, 1968.

25. These points are stressed in: B. Thorngren: "Regionala External Economies", Stockholm, 1967 (Mimeographed).

    Thorngren pays most attention to the dissemination of information and innovations.

26. For a general discussion and classification of technical (static) and pecuniary (dynamic) external economies, see for example: B. Balassa, op.cit., ch.7.

27. C.f. B. Balassa, op.cit., pp.146-147.

28. For a discussion and interesting attempt to appraise and measure the impact of forward and backward linkages in relation to economic growth a growth policy, see: C. Michalopoulos: "Inter-Industry Relations, External Economies and Regional Economic Development". Paper prepared for the UNIDO Seminar on Industrial Location and Regional Development, Minsk, 1968.

29. For further discussion, see: T. Hermansen: "Service Trades and Growth Centres", ch.6, in "Regional Development Policies in EFTA:An Examination of the Growth Centre Idea", op.cit.

30. This point is stressed by among others T. Hägerstrand in:
    "Regionala Utvecklingstendenser och Problem: Urbaniseringen",
    in Svensk Ekonomi, 1966-1970. Stockholm, 1966.

31. C.f. T. Vietorisz, op.cit.

32. C.f. L. Lefeber, op.cit.

33. For a discussion on this point, see:
    J.G.M. Hilhorst, op.cit. pp.14-19.

34. C.f. L. Lefeber: "Location and Regional Planning",
    Athens 1966, ch.IX, "Development and Regional Growth. The Absorption of
    Surplus labour".

35. C.f. L. Lefeber, 1964, op.cit.

36. This argument is based on the so-called "Stage-theory of Economic
    Development".
    See W.W. Rostow: "The Stages of Economic Growth",
    Cambridge, 1960.

37. This point is most strongly argued by C. Furtado, op.cit.

38. Ibid.

39. C.f. J. Krutilla, op.cit.

40. This is argued strongly in T. Vietorisz, op.cit.

41. See for example:
    H. Once: "Economic Criteria in Comprehensive Planning":
    ch.V. in Essays in Honour of Jac. V. Thijsse, op.cit.

42. C.f. T. Vietorisz, op.cit.

42.a This is a cornerstone in the argumentation of Hirschman in his "Strategy
    for Economic Development, New Haven, 1958.

43. The skeleton of such a framework is presented in:
    T. Hermansen: "Information Systems for Regional Development Control",
    Paper presented to the RSA Meeting in Budapest, 1968.

44. L. Lefeber, 1964, op.cit.

45. M.A. Rahman: "Regional Allocation of Investments"
    Quarterly Journal of Economics, February 1963,
    Reprinted in J. Friedmann and W. Alonso, op.cit.

46.   C.f. e.g. A. Hirschman: "The Strategy of Economic Development",
      New Haven, 1958, ch.10.

      and

      G. Myrdal: "Economic Theory and Underdeveloped Regions",
      London, 1959.

      which are the "classics" in the discussion of transmission of economic
      growth in space.

      Among the more recent contributions, reference should be made first of
      all to:
      J. Friedmann: "Regional Development Policy",
      Cambridge, Mass., 1966, Particularly ch.2.

47.   C.f. N. Sakasita, op.cit.

48.   T. Vietorisz, 1968, op.cit.

49.   For a comprehensive analysis of this aspect of the development process,
      see for example:
      E. Hagen: "Planning Economic Development",
      Homewood Ill. 1963.

50.   This point is relevant also to regional development projects in more
      advanced countries. See for example:
      M. Penouil: "An Evaluation of Regional Development Policy in the
      Aquitaine Region".
      Paper presented at the International Economic Associations Conference,1

      See also, T. Hermansen: 1968, op.cit., ch.6.

51.   T. Vietorisz, op.cit.

52.   See B. Horvat: "The Optimum Rate of Investment",
      The Economic Journal, December, 1958.

53.   The model is essentially similar to the one used by Rahman referred to
      above, except for the programming procedures and the constraints which
      are omitted here.

54.   Rahman (op.cit.) points, however, to Pakistan as an example, where the
      saving rate of East Pakistan, which is widely believed to have the
      lowest productivity, is higher than that of West Pakistan.

55.   The use of such aggregated macro production functions analogeous to
      micro-functions has become quite common in economics. For a discussion
      of the concept and its justification, see for example:
      T. Haavelmo: "A study in the Theory of Economic Evolution",
      Amsterdam, 1954, Part 1.

56.   C.f. L. Johansen: "Ivesteringsrate og vekstrate",
      Ekonomiska Samfundets, Tidskrift, 1960

57. C.f. e.g. S. Cohen: "Identification and Treatment of Bottlenecks in Social Planning, a Pilot Case Study", UNRISD, Geneva, 1968, (mimeographed).

58. Empirical evidence that supports the assumption of increasing return on capital during a development process can be found for example in Norway. See: "Trends in Norwegian Economy 1865-1960" Statistisk Sentralbyraa, Oslo, 1966. See also: S.J. Patel:"A Note on the Incremental Capital-Output Ratio and Rates of Economic Growth in Developing Countries" Kyklos, No.1, 1968.

59. This saving function is similar to the one used by Chenery and Strouts in their article "Foreign Assistance and Economic Development" American Economic Review 1966. Sep.

60. C.f. T. Vietorisz, op.cit.

61. C.f. R. von Gersdorff: "Proposals for the Financing of Projects in Africa", U.N. Economic Commission for Africa, Addis Ababa 1968, ch.1.

62. The term infra-effect as a reference to the effects investment projects have on the parameters of a model, as suggested in:

    R. Frisch: "Preface to the Oslo Channel Model. A Survey of Types of Economic Forcasting and Programming".

    R.C. Geary (ed.): "Europe's Future in Figures", p.270, Amsterdam, 1962.

    The infraeffects introduced here are closely related to the productivity effects of social growth introduced by J. Drewnowski. See: J. Drewnowski: "Social and Economic Factors in Development" UNRISD Report No.3. Geneva 1966, pp.28-29.

63. It should be admitted that, while the choice of values for the initial and marginal saving rates are fairly realistic, the values chosen for the incremental output-capital ratios may be unrealistically high, as compared to the national ones found for a large sample of developing countries by Chenery and Strout, op.cit. As regards the progress coefficients, the values are chosen without any empirical basis. The justification for the somewhat high values chosen has been that the purpose of the calculations is to demonstrate their impact.

    For some statistical evidence, see however, S.J.Patel op.cit.

64. N.H.Leff: "Marginal Saving Rates in the Development Process: The Brazilian Experience", The Economic Journal, Sup.1968.

    Chenery and Strout (op.cit.) found however evidence for increasing average saving rates for most of the countries they surveyed.

65. C.f. e.g. "Trends in the Norwegian Economy 1865-1960", op.cit.

66.   An interesting example of this is given by Chenery and Strout, op.cit.,
      in table Al, where they found a high marginal capital-output ratio -
      corresponding to a very low marginal output-capital ratio - and a very
      high saving rate during the period 1957-1962 for Argentina.

66.a For an interesting analysis see two recent papers by F.W. Bell
      "The Role of Capital-Labour Substitution in the Economic Adjustments
      of an Industry Across Regions". Southern Economic Journal, 1964, No.2.
      and:
      "The relation of the Region, Industrial Mix and Production Function to
      Metropolitan Wage Levels".
      The Review of Economics and Statistics, Aug. 1967.

67.   See. J. Tinbergen "A Method of Regional Planning".
      Paper prepared to the Workshop on Regional Programming,
      Institute of Social Studies, The Hague, 1967.

68.   The so-called stage method of planning is also developed by
      J. Tinbergen. For a brief description referring to the place of
      interregional coordination see:
      J.G. Waardenburg "Space in Development Programming"
      R.S.A. Paper Vol.18, 1967.