OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

Distr.
LIMITED

ID/WG.9/13 SUMMARY*
27 March 1968

Original: ENGLISH

United Nations Industrial Development Organization

Interregional Seminar on Industrial Location
and Regional Development
Minsk, August 1968

THE PLANNED INTERREGIONAL LOCATION OF INDUSTRY: ARGUMENT IN FAVOUR OF A "TRADE-NOT-AID" APPROACH 1/

SUMMARY

by

Thomas Vietorisz
Professor of Economics
The New School for Social Research

* This is a summary of a paper issued under the same title as ID/WG.9/13

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO.

id.68-203

1. The paper of which this is a summary presents an argument in favour of an industrial location policy that is based on regional self-financing and joint planning of the industrial development of advanced and backward regions within an interregional system. Such a policy is the interregional counterpart of the well-known "trade-not-aid" policy that has been extensively discussed in the international context but that is equally applicable, and in fact considerably easier to apply, at the level of regions within a single country.

2. This policy recommendation is contrary both to established free-trade policies and to policies of global product maximization. It is shown to flow from a shift in the point of view adopted towards the basic motive forces of economic development, replacing the stress on material factors, stock accumulation, and resource allocation by an emphasis on economic development as a process of cultural transformation in which orientation to growth plays a crucial role. Conventional mathematical programming models which underlie the more sophisticated versions of project evaluation and industrial location criteria have a series of major deficiencies in coping with the kind of information that assumes key importance under the changed point of view towards development. In their customary versions, such models can be expected to yield fundamentally biased and misleading results.

3. Some of the modifications that these models require are sketched out at a highly aggregated level, by means of three simple interregional growth models. These models embody systematic shifts in the savings behaviour, capital absorption capacity, and productivity characteristics of each region. The shifts are in part autonomous, representing what is regarded as the normal course of development, and in part induced. In particular, interference with development in the form of syphoning off the savings of backward regions is assumed to stifle autonomous growth tendencies. The inability of converting savings into investment, due to a shortage of capital goods, is likewise assumed to result in an induced retardation of the normal autonomous course of development.

4. An interregional "trade-not-aid" policy is shown to be generally beneficial not only to the backward region, but to the system as a whole, often including the advanced region as well. The conclusions apply with particular force to the extent that the social and political preconditions for an orientation to growth are already present.

- - - - -

D03002

United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.9/13
27 March 1968

ENGLISH ONLY

Interregional Seminar on Industrial Location
and Regional Development
Minsk, August 1968

THE PLANNED INTERREGIONAL LOCATION OF INDUSTRY: ARGUMENT IN FAVOUR OF A "TRADE-NOT-AID" APPROACH 1/

by

Thomas Vietorisz
The New School for Social Research, United States

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO.

id. 67-246

C O N T E N T S

A. INTRODUCTION

1. General framework of the inquiry

The main policy issue in regard to industrial location and regional development is often posed as the choice between geographical centralization or decentralization. While strong arguments have been put forward for either alternative, the [illegible]n of professional opinion, under the influence of an increasingly clear recognition of the technological advantages of large-scale production and industrial concentration, has recently swung towards favouring centralization. The importance of growth poles, following the work of François Perroux[1/], is widely recognized. Developing countries and regions are thus strongly cautioned against spreading their scarce investment resources too thin by attempting to follow a policy of geographically balanced growth. It is argued that such a policy would, among other things, drastically impair their capital/output ratios and thereby directly reduce their growth rates, while the resulting increased production costs would also damage their balance-of-payments positions with the outside world, with obvious further ill effects.

There can be no question concerning the validity of the technical/economic phenomena underlying this point of view. The existence of economies of scale and the closely related economies connected with the sharing of pooled productive facilities and resources (processes, machines, inventories, skilled work-force, technical services, organizational know-how, social-overhead facilities and services) is established beyond doubt, and is in many instances quantified or on the point of quantification. Elaborate economic models can be and in some instances have been defined for the detailed numerical exploration of these phenomena; this line of inquiry will undoubtedly be pursued with increasing vigour in the near

---

1/ For a brief exposition, see F. Perroux, "Economic Space: Theory and Applications," Quarterly Journal of Economics, February 1950; "Note sur la notion de 'Pole de Croissance' ", Economie Appliquée, Institute de Science Economique Appliquée, Paris, January-June 1955; and "La firme motrice dans la région et la région motrice," in Théorie et Politique de l'Expansion Régionale, Transactions of the International Colloquium of the Institute of Economic Science, Liège, Bruxelles, 1961.

future, particularly with the coming of age of analytical techniques that can explicitly deal with indivisibilities and increasing returns to scale (integer programming, simulation).[2/] Yet something essential is missing from these models as currently formulated, notwithstanding their broad coverage and great sophistication. These models are based on a conceptual framework of resource allocation, emphasizing the accumulation of capital stocks and the productivity of these stocks under a given technology, taking into account alternative production processes, alternative geographical locations, and (in so far as data permit) alternative time phasings. What is underplayed or missing is content having to do with motivation, social interaction, institutionalization, and political action. These elements, it is often asserted, should properly be introduced at the level of political decisionmaking, based upon the backdrop provided by the models that admittedly cover only some aspects of reality. But what if the

---

2/ Some basic texts on mathematical programming are: Koopmans, T.J., ed., Activity Analysis in Production and Allocation, New York, Wiley, 1951; Dantzig, G.B., Linear Programming and Extensions, Princeton University Press, 1963; Hadley, G., Linear Programming, Reading, Mass., Addison-Wesley, 1961; Graves, R.L., and Wolfe, P., eds., Recent Advances in Mathematical Programming, New York, McGraw-Hill, 1963. For applications to economic and planning problems, see R. Dorfman, P. A. Samuelson, and R. Solow, Linear Programming and Economic Analysis, New York, McGraw-Hill, 1958; H. B. Chenery and P. G. Clark, Interindustry Economics, Wiley, New York, 1959; and A. S. Manne and H. M. Markowitz, eds., Studies in Process Analysis, Economy-Wide Production Capabilities, New York, Wiley, 1963. Mathematical programming models encompassing entire economies have been published in: Chenery, H.B., "The Role of Industrialization in Development Programs", American Economic Review, May 1955; Frisch, R., Main Features of the Oslo Median Model, Social Economic Institute, University of Oslo, Norway, 1956; J. Sandee, A Demonstration Planning Model for India, New York, Asia Publishing House, 1960; Manne, A.S., "Key Sectors of the Mexican Economy", in Manne and Markowitz, eds., Studies in Process Analysis, op.cit.; R. S. Eckaus, "Planning in India", in M. F. Millikan, Ed., National Economic Planning, National Bureau of Economic Research, New York, 1967; and J. B. Nugent, Programming the Optimal Development of the Greek Economy, 1954-1961, Center of Planning and Economic Research, Athens, Greece, 1966. For integer programming techniques, see

orientation provided by such one-sided models is inherently and greatly misleading?

The point of departure of the present paper is that economic development must be viewed first and foremost as a process of qualitative cultural transformation involving human beings and societies, rather than primarily as a process of capital accumulation. The post-war experience of rapid physical reconstruction in war-damaged countries, reflected by phenomenal measured growth rates over limited periods of time and typically terminated by a petering out of the so-called economic miracle, has already cast serious doubt upon the primacy of physical stock accumulation as the nucleus of the economic development process. This impression is reinforced when reflecting upon the tremendous and discontinuous expansion of the economic capabilities of a society under the impact of outside threat or radical structural transformation, well documented by the descriptions of a number of war economies, or of the economic feats of revolutionary societies that have utterly dumbfounded conservative observers. While the economic processes in countries or regions that are successfully undergoing economic development may on many occasions and over relatively long historical periods be less dramatic than the phenomena just mentioned, we cannot prejudge that they are utterly devoid of the salient qualitative features of cultural transformation that characterise these more dramatic instances which cannot be interpreted primarily in terms of capital accumulation.

The fundamental objection to geographically centralised economic development, if pursued without a proper recognition of the fact that economic development means primarily a change in people rather than in

---

(footnote continued)

Hadley, G., Integer Programming, Reading, Mass., Addison-Wesley, 1966; M. L. Balinski, "Integer Programming: Methods, Uses, Computation," Management Science, Vol. 12, 1965, 253-313; and Chapter 26 in Dantzig, op.cit. On simulation methods applied to economy-wide problems, see E. P. Holland and R. W. Gillespie, Experiments on a Simulated Underdeveloped Economy: Development Plans and Balance-of-Payments Policies, M.I.T. Press, Cambridge, Mass., 1963.

things, is that it induces progress at selected growth centers while leaving large segments of the population untouched. As long as the focus is on capital, and on the fact that at any given moment the existing stocks of capital are by definition scarce since they cannot be expanded in the wink of an eye, development policy will favour strategies that maximize the productivity of currently available stocks. Yet once the focus shifts to people, capital will appear in a different light. Instead of being just a scarce resource that must be husbanded with the greatest parsimony, capital will appear more than anything as a byproduct of growth. If, therefore, a cultural transformation can be induced that will orient people individually and collectively toward economic growth, this process of growth itself will throw off the necessary capital required from moment to moment for the expansion of the economic base.[3/] Consequently, if the process of cultural transformation is limited to a few geographical growth centres, this will simply waste the human potential of the untouched segments of the population, and will necessarily cut out the capital formation that would have been induced as a byproduct of a more generalized growth process. The end result will be a narrowly based developmental structure whose prototype is the contrast between the capital city and the overpopulated regions in the remote countryside of almost any Latin American country, with trickle-down effects to the latter, if any, painfully slow and inadequate. The nearly century-long time lag between the industrialization of the Italian North and South should be

---

3/ The idea of capital as a byproduct of growth finds convincing expression in some of the writings of Branko Horvat. See: "The Optimum Rate of Investment," Economic Journal, December 1958; "Methodological Problems in Long-term Economic Development Programming," Industrialization and Productivity, United Nations, Bulletin 5, 1962; and Towards a Theory of Planned Economy, Yugoslav Institute of Economic Research, Belgrade, 1964. The idea of orientation to growth as an operative concept in economic development is met in the late writings of Joan Robinson. The present paper attempts to arrive at some regional-locational implications of these ideas.

a sharp warning of what may be expected even under relatively favourable circumstances.

This paper is an attempt to marshal arguments for economic development on as broad a front as is consistent with underlying material realities. It is based on the point of view that geographical centralization versus decentralization is a false alternative, grounded in a particularly narrow view of economic development. What is required is a set of criteria for deciding on the desirable degree of centralization or decentralization of particular economic activities, within an overall policy framework that stresses the broad aspects of cultural transformation connected with the process of economic development. This point of view leads to the adoption of regional self-financing as a policy objective for the planned inter-regional location of industry, at least at the level of major regions. To be effective, however, such a policy depends critically on a complementary policy of planned promotion of new, non-traditional export industries for backward regions within a developing inter-regional system. The two complementary policies will be referred to as the "trade-not-aid" approach to inter-regional development.

The general statement given above on the role of human versus technical factors in economic development and on a point of view stressing orientation to growth rather than resource scarcity is intended as a frame of reference for the following inquiry. In order to be useful, this frame of reference has to be translated into analytical terms that lend themselves to creating a quantitative back-up for the social decision process, encompassing whatever is valid in the currently available technical/economic descriptions but going beyond them.

It would be premature to attempt directly the definition of a new analytical structure that grows organically out of the frame of reference discussed above. Since the point of view expressed in this paper is by no means unique to the author, it is a fair guess that a

proper analytical structure will eventually emerge from the efforts of many. The best that can be attempted now is to use the existing technical/economic descriptions and their integrations into economic models of the resource-allocation type as a point of departure, and to indicate the kind of modifications, extensions, or unresolved inadequacies of these models that are immediately suggested by the shift in the point of view that is taken. In this way a gradual transformation of these models is initiated that may eventually lead to fundamental revisions of the analytical approach as a whole.

2. The shortcomings of resource allocation models

The principal shortcomings of current resource allocation models that require modifications are the following:

(1) All mathematical-programming type resource allocation models assume that a single objective function can be constructed that is made subject to maximization. In dealing with separate regions, this is often an impermissible distortion of reality. We may get an entirely false view of the possibilities of inter-regional development if we leave social and political factors out of account that condition the interaction between regions. While not much can be done to quantify the role of these factors, their clear recognition is essential in order to get away from the mechanical application of some global maximization of the benefits achieved by the entire system of regions, treating the division of these benefits as a secondary consideration. On the contrary, the precise nature of the interaction may well determine the key features of the pattern of inter-regional growth.

(2) Resource allocation models formulated in the customary way focus on the technological relationships involving production and transport, relegating to the sidelines relationships that depend on the quantification of motivations and behavior. As a result these models overstress the scarcity of material goods in the course of development, especially when these goods function as stocks (means of production);

while conversely they do not sufficiently emphasize that the scarcity of material goods diminishes as a direct result of the process of development itself. This leads to a neglect of feedback effects from the process of development itself to the supply of effort, savings, skills, and innovations, all of which pertain to the human side of the development process.

The concentration on material goods often falsely suggests that the scarcity of these goods is the sole constraint on development; yet the limitations on the effectiveness of sheer doses of capital are well known to development bankers and foreign aid administrators. Thus the structure of job skills is crucial for determining the absorptive capacity of an economy for given doses of capital. Current models have a bias toward treating the creation of job skills in a manner that is entirely analogous to the production of commodities; they assume that, given the proper input resources (including existing skills) any array of skills can be built up in the same way as a stock of goods. Hence the popularity of the concept of "human capital". Yet many crucial skills cannot be imparted independently from the gradual qualitative transformation of the structure of the entire productive and social fabric of the developing country or region.

(3) The role of economies of scale in regional development is generally recognized as a crucial one, but this recognition has not yet been translated into workable locational or project-evaluation criteria. This is all the more important since many phenomena usually discussed under the heading of <u>external economies</u> or <u>diseconomies</u> also depend on economies of scale. These phenomena include the role played by social overhead capital, the economies of agglomeration and urbanization, and the interrelation of industries in a developing complex via the complementary generation of consumer demand for each other's products.

The required modifications can at present just be sketched out instead of being precisely formulated; none the less, the very consideration of the requirements for these modifications will tend to

affect in a systematic manner the policy conclusions derived from locational and regional-development models. These modifications tend to strengthen the argument for a policy of systematic support to the more backward regions by means of a planned division of industrial development that will offer to all regions the large potential benefits due to economies of scale.

B. REGIONAL DEVELOPMENT: COMMON OR CONFLICTING GOALS?

In reaching efficient planning decisions, it is necessary to assemble and scrutinize the available alternatives and to choose between them. Each of the alternatives has to be self-consistent and feasible, otherwise no meaningful choice is possible. The act of choosing, however, also pre-supposes the consideration of objectives, and this creates serious problems in regard to industrial location decisions whenever the welfare of more than one region is affected. How shall the planner weigh the welfare of separate regions against each other? In fact, the planner does not have full latitude for making binding decisions in this regard, since he cannot put into practice more than what the social and political forces operating in the various regions will ratify. This ratification (or its opposite) may be effected by the direct political acceptance or rejection of a particular proposed plan, or in more subtle ways, either by the reasonably smooth fulfillment of the plan or else by its defeat through an accumulation of unforeseen difficulties, resistances, and inefficiencies.

1. The divergence of welfare interests

The problem posed here in terms of the interests of different regions is not unique to inter-regional planning; it arises whenever a plan covers different groups or different individuals, and is thus an an inescapable feature of all planning decisions. Nor is it an easy problem to tackle analytically. Even if the preferences of individuals

(as defined by neoclassical economics) are accepted as a valid analytical tool, these cannot be synthesized into public or social preferences.[4] Accordingly, all joint decisionmaking (which is the ultimate sanction of planning) depends at its core on the operation of a social or political process that is irreducible to the purely strategic functioning of isolated individuals and thus has to be studied on its own terms. This should hardly come as a surprise, since there is after all no reason to expect that the potentialities of man as a social being should be fully disclosed by his behavior abstractly postulated for a hypothetical condition of total isolation. It is revealing of the preconceptions within which this particular line of economic inquiry has been pursued that the recognition should have come with the force of shock.[5]

In searching for criteria for inter-regional planning decisions, we have to be careful not to permit this approach to lead us into one of two opposite extremes: either to view all attempts at independent consideration of regional interests as arbitrary and therefore inaccessible to rational inquiry; or else, to short-circuit the entire problem through exclusive attention to global optimization.

While attempting to deal with the problem explicitly at the level of regions, it will not be necessary for the purposes of this inquiry to analyze the same problem at the full depth of separate individuals. There remains, even so, the question of how to define a region as a unit of welfare interest. We can choose small or large regions, even supranational regions composed of individual countries, as units of analysis.

4/ See K. J. Arrow, Social Choice and Individual Values, New York, 1951.

5/ This is interestingly evident in the metaphors of the language chosen for stating the fundamental mathematical theorems. In relation to individual preferences, a social preference function is described as being either imposed or dictatorial. Though these terms are given a precise mathematical interpretation, the overtones are unmistakable. Since social choices are irreducible to the preferences of isolated individuals, within this frame of mind they are incomprehensible and are therefore labelled as arbitrary or non-rational (imposed) or even inherently evil (dictatorial).

For planning purposes, it is probably best to work with a hierarchy of regions, explicitly considering the problem of units at the same level of hierarchy while provisionally abstracting from the existence of lower-level units. In this paper, attention will be restricted to regions at the same hierarchical level, since many of the conceptual problems we wish to clarify can be adequately dealt with at this level of abstraction.

This particular focus of attention in no way carries the implication that other than geographical groupings of individuals are irrelevant from the point of view of the divergence of welfare interests. Occupational groups, social classes, nationalities, races, or other social groupings can at times be equally meaningful units of analysis, and for some purposes they are more meaningful. For the planner, however, the welfare implications of inter-regional locational choices are especially important, because within the modern nation-state the crystallisation of individual welfare interests is under normal conditions particularly apt to occur along regional lines.6/

The nation-state itself is an institution that is based on an operational grouping of individuals primarily by geographical criteria, whatever other historical, cultural, or ideological rationalisations may be invoked to reinforce the ascribed role of nationality. The nation-state lays claim to the primary loyalty of individuals, as its citizens, on the ground that it is the repository of their most fundamental common interests, next to which their potential antagonisms are never permitted to play more than a subordinate role. Regional groupings are important because they rest on the same kind of geographical demarcation that defines the nation-state itself, and thus they typically attract to themselves some of the loyalties mobilised on behalf of the nation-state as a whole. Regional loyalties constitute a latent

---

6/ Under other conditions, for example in the course of radical social change, entirely different groupings will play the key role, but these conditions are rarely the ones under which the economic planner will be primarily relied upon for professional advice.

threat to central government since they can serve to support separatist political action whenever the bond of common interests within the state is overstrained by regional inequities. In fact the continuing loyalty of such regional groupings is generally secured by giving them a significant share in the power of central government through some mechanism of political representation.

2. The reconciliation of multiple objectives in programming models

For the formulation of programming models, this situation implies that there exist several partly autonomous goal-setting units instead of a single unit whose welfare aims can simply be maximized. All mathematical programming models, however, presuppose the existence of a unique objective or goal that is being pursued single-mindedly to such lengths as the economic limitations built into the model will permit. When an economic problem presents itself in terms of several autonomous objectives that have to be or are being pursued concurrently, it is mandatory to reconcile these objectives in one way or another before it is even possible to formulate a programming model. The two principal means of achieving a formal reconciliation of multiple objectives are:

(a) The selection of one objective as the principal one that will be maximized.[1/] All the other concurrent objectives must then be treated as constraints; in other words, it has to be prescribed in formulating the model that these concurrent objectives will attain values at least equal to stated lower limits that are acceptable or tolerable. Mathematical programming offers no clue as to how these limits are to be arrived at. In dealing with problems of inter-regional growth, for example, it is customary to treat the growth of the system as a whole as the main objective while assigning lower limits to the growth of

---

1/ Minimisation need not be treated separately, since it can always be converted into maximisation by a reversal of signs.

each region, either in absolute or in percentage terms. It is, however, a moot question how these limits are to be set.

(b) The assignation of stated weights to each objective, and the maximisation of the weighted sum. The weights represent the relative importance of each individual objective. Again, programming offers no clue to the derivation of the weights, even though a great deal depends on just how the relative importance of concurrent goals is quantified by means of this choice of weights. The programming model cannot be formulated until this problem is solved.

The reconciliation of multiple objectives is achieved by both of the above methods in a merely formal sense, without touching the essence of the underlying problem of autonomous goal setting units. The two methods exhibit a close mathematical interrelation: given any one of the two formulations, it is possible to construct a model following the alternative formulation that will have an optimal solution in common with the first one.[8/] Thus from the point of view of flexibility in representing the underlying economic problem there is little to choose between the two methods.

3. The interaction of autonomous goal setting units

Both of the above methods of achieving a formal reconciliation of multiple objectives in programming models presuppose an agreement between autonomous goal setting units in regard to weights or appropriate distribution constraints. It is, however, far from certain that such an agreement can in fact be smoothly reached. While the development of lagging geographical areas may confer important advantages not only upon themselves but also upon their more advanced partners, these advantages often appear uncertain whereas the policies required for initiating the catching-up process for a lagging region may appear as

---

8/ A formal exposition will be found in T. Vietoriss, "Locational Choices in Planning," in M. Millikan, ed., National Economic Planning, National Bureau of Economic Research, New York, 1967.

an immediate sacrifice. When the separate geographical areas have their own institutions that are capable of promoting effectively a regional or other sectional point of view (as is the case for legislative voting districts, more so for politically autonomous regions within a federal government, and overwhelmingly so for sovereign nation-states within a supra-national planning association) the reconciliation of multiple objectives becomes not merely a matter of subordinating sectional views to an overall consensus, but also a matter of bargaining.

In each of the above cases, the balance between the autonomous goal-setting units has two elements. First, these units have common interests which are represented by a central decisionmaking organ with more or less extensive powers for resolving conflicts between the units in the name of the common good. Secondly, the units also have opposing interests which they are more or less free to pursue in the framework of a strategic game in which the attainment of the objectives of any one unit is constrained only by the behavior of the other units. This implies that the power of the central decisionmaking organ must be sufficiently limited to allow some latitude for this strategic contest. Particular cases differ in the emphasis given to each of the above two elements.[2/] In nation-states with centralised

---

2/ Current versions of game theory (for a recent synthesis, see J. C. Harsanyi, "A General Theory of Rational Behavior in Game Situations," Econometrica, July 1966) lose much of their effectiveness in dealing with such problems by failing to recognise in the game situation the presence of an institutionalised representative of the common interests of the participants. This is a consequence of insisting on the conceptualization of individual behavior in terms of preference functions. The latter cannot make constructive use of human interactions, represented by shared psychological fields, in describing the core of the motivational structure of the personality. Yet it is entirely feasible and for many purposes highly fruitful to take a diametrically opposed point of view, and to conceptualise the core of the individual personality in terms of an introjected group situation. This permits a view of individual decisionmaking as consisting of the reconciliation of a number of diverse strivings, as though in the name of some "common

governments the first element predominates and there is only a moderate latitude for bargaining and other strategic behavior on the part of individual legislative districts or other institutions reflecting regional interests. In supra-national planning associations the second element is most likely to predominate, since the individual units typically reserve to themselves veto power over central decisions. Federal governments are intermediate between these two, but probably closer to the first than to the second.

The market mechanism in its ideal form constitutes one possible institutional arrangement for the balancing of common versus opposed interests within a group of economic decisionmaking units, whether these be individuals, regions or nations. The market mechanism makes possible the attainment of common interests (consisting in the gains to be achieved by specialisation and trade) and at the same time it provides a criterion for the distribution of these gains between the individual units. Provided only that all units are subject to the rules of market behavior, their choice of strategy is greatly simplified. (a) They need no longer pay explicit attention to common interests in the formulation of their strategies, since the market mechanism assures the achievement of common benefits while individual objectives are being pursued. (b) They need no longer keep under observation the repercussions of their behavior on the actions of all other units, since these actions are at all times summarised for each participant in the form of price signals which permit the formulation of simple individual objectives. Thus the market mechanism does away

---

(footnote continued)

interest" as represented by the integration of the ego. The resolution of social conflicts can then be viewed as the re-enaction of personal decisionmaking on a larger stage. As contrasted with such a view, the rationality that emerges from much of current game theory has the flavour of a theory of interaction between high-IQ psychopaths who are seemingly in perfect control of their behavior, yet are utterly incapable of forming any human relationships. We must beware of permitting our mathematical models of inter-regional development to be cast in this mould.

both with the need for collective value judgments involving jointly achieved gains and their distribution, and with the need for complex strategic decisions in a constantly shifting precarious power play. The economy of effort on both of these counts is great enough to encourage support for the rules of the game. In addition, the market mechanism creates a link between effort and reward; even though this link is not the only criterion of distribution (as scarcity rents are an equally essential part of the system), it is sufficiently prominent to give the market mechanism something of an aura of fair play that may be valued for its own sake.

The market mechanism in its practical form, although far from ideal in its workings, has been a major social organising principle for a long enough historical period so that its rationalisations - fair exchange, quid pro quo, reward in proportion to effort - tend to be carried over also into situations in which strategic behavior necessarily dominates. Thus, at the international level, it is met as the traditional free-trade doctrine. This doctrine can of course be used as a purely strategic device (in the form of a heavily promoted ideology) for the pursuit of the particular objectives of those players in the strategic game whom the rules of free trade tend to favour most; and it has been so used.[10/] It should be noted, however, that an appeal to the same underlying ideology appears also in the principle, applicable to a supra-national joint planning association, that each nation should obtain a share of the commonly achieved benefits in proportion to its contribution to the creation of these benefits.

This principle certainly appears reasonable on the face of it, but upon reflection it is seen to be subject to serious ambiguities. Commonly achieved benefits could be divided up just as well in proportion to political power: the "lion's share" is an operational

---

10/ For an interesting presentation of this point of view, see Joan Robinson, Economic Philosophy, Aldine, Chicago, 1962, pp.65-66.

principle fully as time-honoured as the principle of sharing benefits in proportion to contributions; on the other hand, sharing benefits to some extent at least in proportion to needs will always have its proponents. Any one of these principles reflects and expresses collective value judgments.

One of the advantages of an ideal market is that its principle of division of benefits translates directly into a quantitative measure: under such a system, price signals express the contribution of each market participant. Under the other two principles, the measurement of power is as ambiguous as the measurement of need. If the criterion of an ideal market is, however, carried over into a practical locational planning decision, even this advantage is lost. The benefits of joint planning are due as much (or often more) to economies of scale obtainable in larger markets (with which no price mechanism can, effectively cope) than to the classical gains of trade through specialization. Moreover, if those effects of locational decisions are also taken into account which have no counterpart in a commodity traded on the market, the price signals will be deficient even in the absence of economies of scale. In the latter category are such phenomena as the welfare effects of migration, urbanization, and land use. Thus a price system is of no conclusive help in the determination of contributions to commonly achieved benefits even if the principle is accepted that the distribution of benefits should be proportional to such contributions.

4. Self-financing and mutual support

Self-financing, coupled with mutual support between regions by a planned expansion of their joint markets, is suggested as a basic principle of inter-regional development policy. While this benefits most directly the backward regions, it also offers significant long-term advantages for the advanced regions. The principles of this policy are offered as a substitute for the policy of maintaining free

inter-regional markets or for the policy of sharing rewards in proportion to contributions.

The basis for the suggested policy is the postulate that individual regions typically have a significant measure of political autonomy but are at the same time also subject to some degree of central decision-making. It is further postulated that regions have both common and conflicting interests. It will be argued that under a sensible policy of planned inter-regional development the common interests can be made to predominate sufficiently over the conflicting ones that the autonomous regional goal-setting units will be motivated to keep the policy going.

The first element of the suggested policy is regional self-financing. This goes counter both to the notion of free capital markets as agents of development, and to the notion of global maximization as represented by conventional linear or other mathematical programming models. It is obvious enough by the silent testimony of the many seriously backward regions of the world presisting in the face of reasonably free inter-regional capital movements that the latter alone will be far from adequate for guaranteeing development. In fact there is reason to believe that under most conditions free capital movements will drain resources away from backward regions rather than contributing to their resources by a capital inflow.

Among the factors working in this direction are the following: first, for movements of goods and capital across regional boundaries, absolute rather than comparative advantage becomes the criterion of investment, and backward regions tend to have a disadvantage on almost all investment projects of interest for development. Secondly, the investors who have access to savings in backward regions will under market institutions generally desire to diversify their portfolios as as a protection against risk, by transferring a substantial portion of their investment resources to the more advanced regions. There have been many discussions of the fact that for a backward region it can be a serious disadvantage to be tied to an economically prosperous one:

this has been cited for the case of Southern Italy and Northern Brazil, and in many ways it can be asserted to hold for the underdeveloped world as a whole in relation to the industrialized countries as long as primarily commercial-type relationships prevail between them.

In the face of the observed tendency for the polarization of development rather than its dispersal under conditions of free capital movements and the consequent drain of resources from the backward areas, it makes good sense to suggest self-financing as a suitable policy goal for increasing the net investible resources of the latter. In other words, since free capital movements tend to strip the backward regions of resources, these movements should be stopped as a matter of policy, in spite of the fact that net capital inflows to the same regions, if such net inflows could be achieved, would be beneficial to the regions in question. While self-financing appears to be a more modest policy goal than the goal of net capital transfers to the backward regions, in the face of the very real practical obstacles and contrary forces that have to be reckoned with it is in fact a highly ambitious goal that may not be at all easy to realise in practice.

The suggestion of self-financing may be attacked on the ground that neoclassical economic theory predicts a net capital inflow to backward regions if capital movements are free. The available facts tend to support the opposite conclusion. In spite of the great difficulties of measuring capital flight from backward regions, evidence is building up that this transfer from the less developed countries of the world to the more advanced countries amounts to several billion dollars annually,[11/] offsetting direct investments and economic aid flowing in the opposite direction. There is ample reason to expect

---

11/ See Göran Ohlin, Foreign Aid Policies Reconsidered, OECD, 1966, Table IV-3 and accompanying text. In spite of administrative and military expenditures, foreign aid, private investments and credit running to over 10 billion dollars annually, the import surplus of developing countries (including transport and similar services) does not reach 2 billion dollars annually, and is very unevenly distributed.

that the same pattern is repeated between the regions of individual countries.

The suggestion of self-financing might, however, also be attacked from another angle, namely by asserting that polarized development might be favourable to a country as a whole. Some regions, this argument goes, are inherently inefficient, high-cost regions, and such scarce investible resources as the country as a whole might be able to generate, should go preferentially to the more efficient regions, otherwise overall development will be slowed down. It is not difficult to construct illustrative models in support of this view, and it has adherents in countries both with market economies and with centrally planned economies.

This argument has indisputable merit for small regions, since the logic of dispersing development uniformly over geographical space must break down at some point; evidently there cannot be an integrated steel mill in every square mile of space; thus economies of scale inescapably lead to a polarization of investments at some level of regional subdivision. While for a system of larger regions this argument loses some of its force, there are still many activities, particularly the ones that are associated with social overhead investments such as transport arteries and terminals, housing, and urban facilities, that continue to raise the same kind of problem. These investments are not only subject to major indivisibilities but, distinct from steel mills, their product cannot be transferred or utilized over a distance; thus a single large investment cannot serve the needs of many geographically distinct points, and therefore each region requires its own investment to function at a favourable cost level. This creates a force tending to favour the inter-regional polarization of investments even at the level of major regions. Economies of agglomeration and urbanization reinforce this tendency.

These tendencies however, are not the only influence at work. The effectiveness of polarizing capital transfers is restricted both by unfavourable feedback effects on productivity and the supply of savings and skills in the regions that are losing resources, and by

the limits on the absorption of large doses of capital in the advanced regions. If the development of these regions is already rapid enough to strain the capacity of these regions for structural change, the polarizing capital transfers will merely deprive the backward regions of the resources needed for growth, without contributing significantly to the development of the more advanced regions.

If the notion of self-financing (at least for regions of reasonable size) is provisionally accepted, the question will inevitably occur: in what way can different regions offer each other mutual support, given that capital transfers are ruled out by assumption? The main avenue of mutual support under these conditions is jointly planned industrialization. The more advanced regions can offer a decisive aid to the lagging regions by assisting the latter in converting their savings into the physical investment resources required for industrialization. This can be done by a planned sharing of industrial markets: in other words, by providing the backward regions with an outlet for their industrial exports from which needed capital-goods imports can be financed. The more advanced regions gain by this policy due to the widening of their own markets. To the extent that development does not remain restricted to the most advanced regions and income rises rapidly in the inter-regional system as a whole, all regions will benefit from the economies of scale that can be achieved in the wider joint markets.

The key to this policy is regional self-financing. It is emphasised that the viability of a policy of regional self-financing does not require a demonstration that the system of regions as a whole is necessarily better off with self-financing than if capital transfers were permitted. While strong arguments can be advanced to prove false the conventional view which holds that any interference with spontaneous polarization tendencies will exact a severe sacrifice in terms of the growth of the system as a whole,[12/] the case for regional self-financing

---

12/ See the models presented below in Section C-3. See also T. Vietorisz, op.cit.

does not hinge on these arguments. It only needs to be reiterated that each region is to a considerable extent an autonomous goal-setting and decisionmaking unit. This unit may not be able to impose its preferences on the other regions, but it has a variety of devices by means of which it can exercise veto power over many aspects of joint or central decisions. Thus a demonstration by means of simple programming models that certain resource transfers that are damaging to a region are beneficial to the system as a whole fall far short of proving the case for such transfers, since the putative benefits may not be attainable under any set of realistic circumstances. When making a planning choice, each presumed alternative must de facto exist. The burden of the present argument is that a serious infraction of regional equities will in all probability result in an illusory estimate of overall growth possibilities. The case for reasonable standards of equity in inter-regional planning decisions is merely strengthened by a demonstration that, even when abstracting from considerations of regional autonomy, the additional global benefits that might be available as a result of polarised growth are modest or non-existent.

5. Regional autonomy and the formulation of programming models

Given the above considerations about regions as partly autonomous goal-setting and decisionmaking units, is it possible to use mathematical programming models as aids to the inter-regional planning process?

The answer is in the affirmative, provided that the limitations of such models are recognised. In the usual formulation, a global goal is maximised (such as the global product for all regions) while so-called welfare constraints are introduced for the individual regions, for example in the form of prescribed minimum shares in the increase of global product. The foregoing argument does not imply that such formulations are necessarily beside the point; but it does imply that the models possessing the given formal characteristics have to be interpreted and used with a different point of view from the customary one.

It is usual to consider the regional welfare constraints as being in some sense an afterthought, introduced into the model once the essential, technical parts of the model are assembled. It is also customary to talk about the cost of such welfare constraints, in the following sense. If an additional constraint is imposed on a maximising model, this will generally restrict the number of alternatives available for choice, and will reduce (or at best leave unchanged) the objective being maximized. Thus the cost of introducing a regional welfare constraint is a reduction in the global product (assuming that the latter is the maximand). What is not sufficiently appreciated, however, is that any constraint in the model can play exactly the same role. If we remove any one of the technical constraints (for example, the constraint on iron and steel inputs) then the formal solution to the model will yield a higher maximum. This maximum would of course never be interpreted on the same footing as the normal maximum since it is readily apparent that the suppression of the constraining role of iron and steel inputs will result in an illusory improvement that cannot be de facto attained under any set of circumstances. The economic significance of the estimate is that it measures the effective scarcity of iron and steel supply.

Given the fact that individual regions are partly autonomous goal-setting and decisionmaking units, the exercise of this autonomy on their part can be described in terms of certain political constraints that are imposed on global maximising decisions. These political constraints, however, are by no means gratuitous: their removal would lead to an entirely illusory improvement of global product, exactly as in the case of the iron-and-steel constraint discussed above. Therefore, such constraints are by no means to be interpreted as a gruding concession to a moral sense of equity on the part of the central planner. If the latter interpretation were allowed to stand, then it would become a matter of the central planner's exercising his own preferences in ascertaining how much of a global cost (decrease in global product) he would be willing to accept for a given improvement in regional equity.

In this case, indeed, welfare constraints could well be regarded as an afterthought; and there is good reason to suppose that in customary formulations of programming models they are generally so regarded. The very name welfare constraint suggests this; in representing the veto power of partly autonomous regional units, the name political constraint is a good deal more descriptive of actual conditions.

The consequences of the two differing attitudes to programming models, however, go beyond a mere change of names. Rigid constraints are a very elementary way of representing the political autonomy of regional sub-units in programming models. A more sophisticated approach is an attempt to quantify the economic repercussions of inequitable inter-regional development policies, as reflected by productivity decreases, lagging supplies of savings and skills, diminished innovative activity, and other indicators. This permits a more realistic appraisal of the consequences of different patterns of inter-regional development. Yet even this fails to come to grips with some aspects of regional autonomy, since it still leaves out of account the possibilities of direct political action that can have a fundamental influence on the shape of the inter-regional development plan as a whole and that elude any attempt at simple quantification via maximising models.

The attempt at quantifying some of the socio-political factors is, none the less, highly significant in spite of all imperfections and attendant difficulties. The more the repercussions of different patterns of inter-regional development are traced out concretely, the more will it be possible to define inter-regional development policies that emphasize the common interests of the individual regions, thereby reducing the sphere of conflicting interests that have to be resolved by primarily political means.

The following chapter offers a few tentative first steps in this direction.

C. CAPITAL ACCUMULATION, CULTURAL TRANSFORMATION, AND INTER-REGIONAL DEVELOPMENT

We have so far explored the shortcomings of a maximizing approach to inter-regional development, and urged the introduction of social and political considerations into the formulation of resource-allocation models that are used to study inter-regional development. In this chapter some further shortcomings of these models will be analysed, focusing on the inadequacy of the concept of capital accumulation for explaining the phenomena of economic development, even if the former concept is extended to comprise the accumulation of human capital. This suggests a systematic modification of the parameters of such models in order to represent some key aspects of the cultural transformation process that have a bearing on inter-regional resource allocation. These principles will be illustrated by three rudimentary, aggregate-level models of inter-regional development. The models lend support to a policy of regional self-financing and show the effects of such a policy on the growth of advanced regions, backward regions, and the inter-regional system as a whole.

1. Human capital

The concept of human capital is firmly grounded in the view of economic development as an accumulation process, and is in fact a powerful attempt to salvage the dominant position of the resource-allocation framework in explaining the phenomenon of economic development. The device used to this end is the extension of the concept of capital from the accumulation of physical stocks to labour skills, and as such it follows the tradition of treating human labour as a commodity, on a par with other commodities traded in the market. In a programming-type resource allocation model each grade of skill, like each physical commodity, appears in two balances: a stock balance with an associated stock-rental price that depends on the scarcity of the stock accumulated up to the given time; and a flow balance with an associated flow price

that represents the capitalised value of rentals in buying or selling a unit of the commodity. The stock-rental price of a unit of skill is its wage rate, while the flow price is the capitalised value of wages. The latter can be interpreted as the value of a man's skills to himself, or the purchase or sales price of a skilled slave in a slave society; it also represents the social value of a skilled emigrant or immigrant. Skills are generated by educational or training activities that are defined as the exact counterpart of ordinary production activities; i.e., they have inputs of physical and skill-commodity flows and stocks, and outputs of the desired skill-commodity flows. There are, in addition, special activities that carry over physical and skill-commodities from one time period to the next. These activities inter-link flow and stock prices and jointly determine the structure of discounted prices which underlies the concept of the rate of interest. A simple programming model of this kind is shown in Figure 1. (A detailed interpretation will be found in the Appendix.)

Such a model represents the qualitative cultural changes that take place in the course of economic development in terms of a gradual build-up over time of stocks of skills of ever higher order. Each higher skill implicitly embodies the requirements of physical stocks and flows as well as the requirements of crude labour and skills of different grades that enter into its generation by means of educational or training activities.

In order for this model to have analytical value, education and training must be represented as taking place within the economic sphere, i.e., as a part of the productive process. From the point of view of production, skilled labour of various distinct grades is no more than an intermediate commodity that can be produced directly or indirectly from crude labour and other primary inputs. In the simple model of Figure 1 the only primary (non-produced) inputs are crude labour and the initial stocks of physical goods. If optimisation over time is represented by maximising the value of terminal stocks, the growth of the system in any time period is limited only by crude labour,

FIGURE 1. A simple programming model for human capital

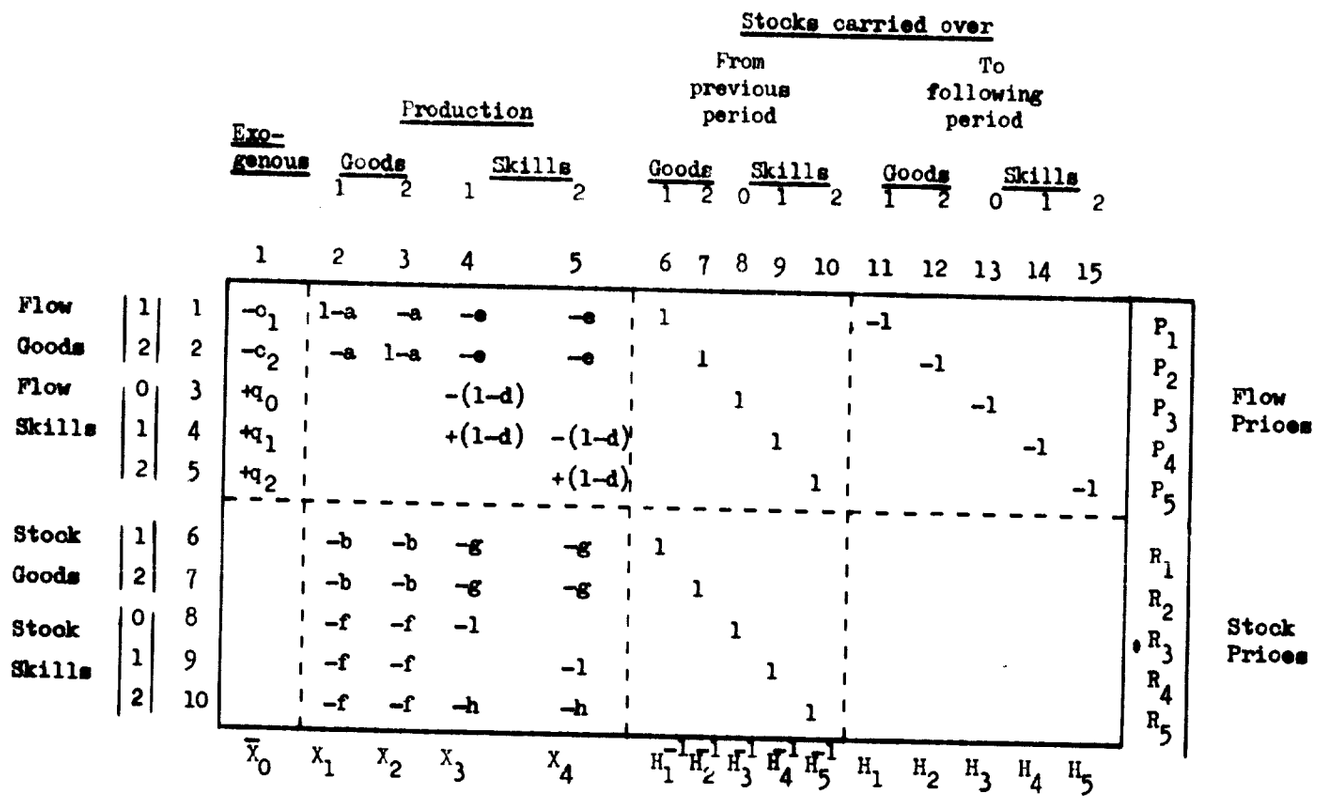


Figure 1-A. Detail for a single period

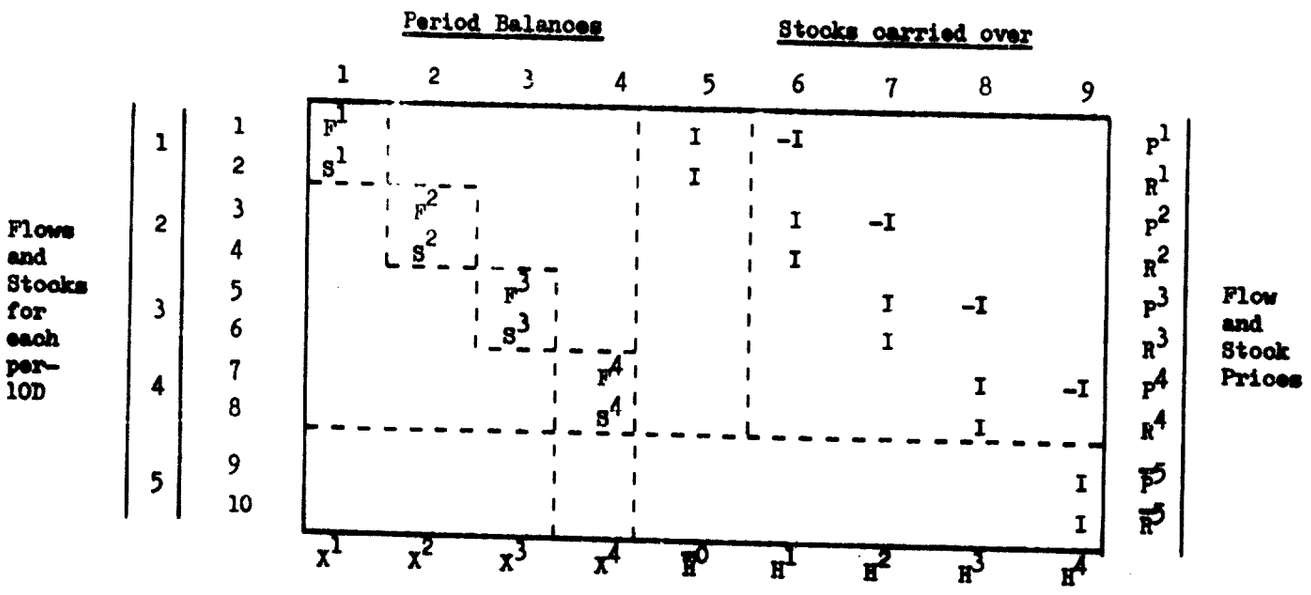


Figure 1-B. Interconnection between periods

and by the stocks of physical commodities and stocks of labour skills that have been accumulated up to that period of time. The essential choices within the model pertain to the extent and time-phasing of educational and training activities, so that the balance between the disadvantages of tying down labour in training activities as against the benefits of the higher productivity of the resulting upgraded labour force may be struck in the most favourable manner that can be achieved. While in Figure 1 only two production activities are shown, the model in general assumes that a wide range of choices exist between production activities using skills in a more or less intensive manner, and that increasing amounts and higher degrees of skills are compensated in the overall technological structure by reductions in crude labour and/or physical stock or flow requirements. While substitution possibilities between activities are at the core of the technical/economic description provided by the model, crude labour and skill input-requirements within a productive activity are assumed to be rigidly determined and precisely given.

In Figure 1 the growth of the labour force is represented by net exogenous additions to labour of various grades in each time period. These net additions for crude labour comprise new entries into the labour force, minus deaths and retirements, plus immigration net of emigration. For higher-grade skills there should be no new exogenous entries (other than possible immigration) if the model proposes to handle education and training as taking place within the productive sphere.

As formulated in Figure 1, educational and training activities always result in a direct debit against production, since they withdraw some labour from productive uses; there is of course an indirect credit, in that the newly generated skills will make possible a higher productivity in a future period. The only possible exception to this rule is the training of crude labour under conditions where crude labour itself is in surplus; then the shadow price of crude labour is zero and the training activity is not debited with a cost item on this account. There will, of course, still exist debit items due to

tying down high-skill teachers, as well as costs due to physical stock and flow requirements. The wage structure resulting from the training activities is such that the capitalized difference between wage levels just compensates for the training costs incurred, including the opportunity cost of wages foregone while in training.

The tour-de-force of representing the cultural transformation incident to economic development as an extension of the process of stock accumulation is worthy of admiration as an intellectual feat, and in fact it yields an excellent description of the purely technical aspects of the labour training and educational process. Moreover, when technical inputs into labour training other than labour inputs can either be safely ignored or can be reduced to further indirect labour inputs, the model also yields an acceptable description of the differentiation of the labour force as corresponding to different amounts of congealed unskilled labour that is implied by the emergence of each skill category. None the less when the phenomena of cultural transformation are forced into the procrustean categories of resource allocation, some of the key features are left outside.

Three of these key features that have to be allowed for at this point are: (a) the direct interaction between education/training and consumption; (b) the direct interaction between education/training and production; and (c) the instability of the technical coefficients related to labour inputs, under conditions of social and institutional change.

(a) Direct interaction between education/training and consumption. The resource allocation framework presupposes a neat division between the production and consumption spheres in society, whereby any activity can be classified either as work, contributing to production, or as consumption (e.g., utility generation). Given this classification, the amount of work that can be performed is limited by the available labour supply. Yet the most fundamental determinants of productivity are impossible to classify in this manner. Basic language, literacy, and social skills whose lack totally undercuts labour productivity are acquired as a matter of course by all members of a given society, completely

regardless of their needs as individuals to do productive work for a living. Higher education, the leading edge of productivity advances, is sought after by many of the socially most productive individuals as an end in itself. Thus educational and training activities cannot be neatly assigned to the sphere of production, and conversely their lack or relative backwardness cannot be simply reduced to deficient stocks of teachers and deficient training activities within the sphere of production. By the same token, a rapid upsurge of these activities can at times take place with great spontaneity, in spite of the phantastic imputed costs (and consequent additions to gross national product) that would be implied if all of these activities were accounted for at conventional (i.e., commercial or administered) resource prices. To appreciate the margin of uncertainty in this regard, suffice it to say that with an institutional work year of 2200 hours (50 weeks at 44 hours/week) and a labour-force participation rate of 40%, barely 10% of total population-hours are spent in work. This is the maximum that we can assume to be subject to resource allocation either by the market or by some planning mechanism that acts as a surrogate for the functions of the market, such as programming. Given this 10% and regarding the 67% of waking time as the fund of vital hours available to the culture, we can see that only 15% of the vital time-fund is allotted to the economic sphere, while the disposition of 85% is culturally rather than strictly economically determined. The education and training of children, decisive for later labour productivity, draws on these hours; so do the unaccounted-for productive activities of housewives that, as experience indicates, can be considerably contracted, e.g., during wartime; and so do the culturally patterned recreational and other spare-time activities of workers. With this tremendous slack at the disposal of society, it is hard to argue that the speed of cultural transformation is primarily determined by economically scarce stocks of skills, except under highly formalized and rigid institutional conditions It is of course true that there may be severe bottlenecks in some critical skills, and also that there is in general a well-defined time lag associated with all educational undertakings that in some ways mirrors the time lag incident upon the accumulation of stocks; yet the existence

of this vast slack more than adequately explains the cultural breakthroughs that can be achieved at times spontaneously, or under proper conditions in a purposeful and controlled manner with literacy campaigns, adult-education programmes, and other institutional means of accelerated cultural transformation.

In a purely formal manner, these phenomena can be subsumed under the resource-allocation model in at least two ways.

First, all educational and training activities can be assigned to the productive sphere. This implies a vast increase in the hours of activities classified as work, which have to be accounted for in terms of a corresponding increase in the hours of available labour supply per unit of stock of each skill grade. In the model of Figure 1, for example, the increase in yearly work hours available from a stock of 1 worker and the reclassification of non-productive individuals as workers is reflected in the expansion of all skills (including crude labour) inherited from the base period (increase in the $\bar{H}^o$ parameter vector in Figure 1-B) and corresponding increases ir the exogenous labour supply in each time period (parameters q_o, q_1, and q_2 in Figure 1-A). Accordingly, the physical and/or skill outputs that can be attained with a given population can be increased. In formulating such a model, of course, care has to be taken to sub-classify the newly expanded labour resources properly, since otherwise the educational activities involving, e.g., the time of small children (that are now accounted within the productive sphere) might show up as a sudden expansion of crude labour available for industrial tasks, etc. It is also essential to specify that the expansion of the labour supply incident upon this redefinition of the productive sphere of the economy be matched by a corresponding increase in savings, since the redefinition must not be allowed to expand consumption; thus whatever additional income is generated must be formally shown as being saved and reinvested in additional stocks of skills.

Secondly, educational and training activities taking place outside the conventional economic sphere can be represented as exogenously

determined supply and demand parameters: in particular, this applies to supplies of specified flows of new higher-grade skills matched by withdrawals of corresponding amounts of lower-grade skills, and demands of physical and skill resources associated with the unspecified educational and training phenomena.

It is clear that these purely formal solutions to the problem achieve very little, since all of the really difficult questions remain outside the analytical framework. In the first case, there is no way of analysing the amount by which the redefined labour supply will expand in each time period and by each skill class; the formal expansion of savings required for mopping up extra factor income cannot be properly specified except ex post; and the usual optimizing criterion, i.e., the maximization of the value of terminal stocks, has to be modified, again in a manner that cannot be determined except ex post, in order to allow for the apparent overscheduling of certain educational/training activities that are known to be valued for their own sake. In the second case it is even more evident that the key questions are hidden behind exogenously determined parameters.

(b) Direct interaction between education/training and production. The evolution of skills, in the resource-allocation framework, proceeds independently of the technological evolution of the productive process. A complete set of technological alternatives can in theory be embodied in the set of physical production activites, and the adoption of the most advanced technological alternatives is limited only by the availabilities of the corresponding skills, as reflected in their shadow prices. Thus, as long as certain advanced skills are very scarce while crude labour or low-grade skills are abundant, the available stocks of these advanced skills will be allocated only to selected critical activities that have an exceptionally high productivity in terms of these skills, matched by low inputs of other grades of labour and physical commodities. These critical activities will then set the shadow prices of the advanced skills, and will do so at a level sufficiently high to rule out the profitable use of these skills in any but

the corresponding activities themselves. As development proceeds, additional stocks of the higher skills can be generated by education/training activities, and this will in fact be done in so far as the resultant productivity increase justifies the training costs.

One socio-cultural aspect of this process that has typically not been built into programming models, but has received detailed attention at the aggregate level is the impact of upgraded skills on the total wage bill and thus on the balance between consumption and savings. Another aspect which is critical to the present evaluation is the inseparable, organic relationship between the evolution of work skills, organizational skills, advanced technical/scientific skills, and the evolution of technology as represented by the collection of de facto available alternative production activities. There is an interpenetration of the process of production and the process of innovation that results in joint activities having a triple character: by means of physical and skill inputs they produce, first, physical commodities; second, a net surplus of higher-grade skills, and third, information pertaining to new production activities that may be added to the set of available alternatives in future time periods. Thus a resource-allocation framework that treats education/training as independent of production and innovation is forced to postulate, in a patently unrealistic fashion, that workers can be trained, in complete isolation from the production activities, for predetermined slots in the production process; while the latter process itself is viewed as consisting, besides currently utilized activities, of costless alternative blueprints using higher-grade skills, that are waiting to be embodied at the right moment within the accumulation sequence.

There has been much recent work on one aspect of these problems, namely the costs involved in generating new technical alternatives and the inclusion of decisions pertaining to the allocation of resources to cover these costs within the overall framework of resource allocation. This however still leaves open the question of how such costs depend on the interaction between the productive process and innovation; and how

both interact with the simultaneous upgrading of the labour force. While it is easy formally to define activities that produce physical outputs, upgraded labour skills, and new technical alternatives for future use as joint products, this device begs the question, since it throws no light on how the technical coefficients of such activities are to be determined. Thus the key phenomena of cultural transformation remain hidden behind arbitrarily defined parameters.

(c) The instability of technical coefficients related to labour inputs. Those technical coefficients within resource allocation models that depend directly or indirectly on labour productivity are notoriously unstable as compared to technical coefficients that depend primarily on physical phenomena. Thus for example in the production of caustic soda and chlorine by electrolysis, the proportions of these joint products as well as their ratios to the required input of electric current are determined primarily by Faraday's law, and are accordingly highly stable. Contrariwise, the output of a mechanical workshop depends heavily on labour productivity even if its machine park, product assortment, and outside operating conditions are standardized. The technical coefficients of such a workshop are strongly affected by at least two kinds of cultural conditions: first, by conditions pertaining to learning, both at the level of the individual and at the level of the social organization; and secondly, by conditions pertaining to motivation, affected both by material and social/political incentives.

Learning phenomena have been studied in some detail and can be described by a gradual improvement of performance that tends to level off asymptotically towards an empirically determined limit.[13/] It is theoretically possible to build such learning behavior into resource allocation models by means of integer-type sequencing constraints that prohibit the employment of more efficient technical variants within a learning sequence until the less efficient variants have

---

13/ H. Asher, Cost-Quantity Relationships in the Airframe Industry, RAND Corporation, Santa Monica, California, Report R-291, 1956.

already been undertaken.[14] The rate of improvement can be adequately described by period-to-period coefficient changes, while the ultimate level of improvement is given within error limits, by the last activity in the sequence. The key un-answered questions implied by this formal description refer, of course, to the rate and the limit of improvement under different socio-cultural settings.

The phenomena pertaining to motivation are even harder to assess. There is no question that material conditions of living feed back on the productivity of the workers, and so long as a given socio-cultural setting can be assumed to be essentially invariant, it is possible to relate material incentives to effort put forward. This relationship is covered by numerous investigations of incentive systems. The broader aspects of the effects of the social, cultural, and political setting on productivity are, on the other hand, inherently much harder to quantify. Some of these effects may be summarized under the heading of morale which, as indicated for example by the celebrated Hawthorne experiments,[15] is a highly elusive concept. While it is plausible that a high rate of economic growth and a general atmosphere of purposefulness and optimism create a favourable feedback on productivity, a similarly favourable feedback may on occasion also be obtained from an atmosphere of challenge and crisis. It has been asserted that under one set of particularly dramatic circumstances increases of productivity in a country paralleled the sharp rise of international tensions in which this country as a whole had a vital stake.[16] If technical coefficients can on occasion exhibit this degree of instability over the very short run, it becomes obvious that their longer-term trend

---

14/ For the logic of sequencing constraints see H. M. Markowitz and A. S. Manne, "On the Solution of Discrete Programming Problems," Econometrica, January 1957, pp.86-87.

15/ For a comparative discussion of these and related experiments, see H. F. White, "Human Relations in Industry," The Delphian Quarterly, Spring, 1956; relevant portions reprinted in M. L. Barron, ed., Contemporary Sociology, New York, 1964, pp.318-320.

16/ A. Gilly, "Inside the Cuban Revolution," Monthly Review, New York, October 1964, p.84.

must be subject in cardinal ways to socio-cultural determination that is entirely outside the analytical scope of the proposed resource-allocation models.

In sum, the concept of human capital represents the most far-reaching attempt, within the resource-allocation framework of thought, to come to grips with the phenomena of economic development including the qualitative cultural transformation incident on the acquisition of higher skills and broader education. We have reviewed some shortcomings of this approach and have concluded that while the key objections can be met in the purely formal sense, the resulting models conceal the analytical difficulties behind ad hoc definitions of parameters. Resource allocation of stock accumulation models, whatever their purely aesthetic appeal, are useful analytical and planning tools only to the extent that their parameters can be operationally derived and are reasonably stable. The foregoing discussion has focused attention on the non-operational character and instability of the parameters that are introduced into these models when an attempt is made to extend them to cover some critical questions of qualitative cultural transformation incident on economic development.

2. The modification of resource-allocation models

What can be done to introduce an alternative point of view into the discussion of the development process? As remarked before, it is premature to attempt the construction of an entirely sui generis framework for dealing with these problems. Possible leads in this direction are provided by attempts to construct computer-simulation models of social change; but these are far from being standard working tools. We opt, instead, for a systematic modification of resource allocation models. Where these models assume stable parameters, we introduce systematic parameter shifts illustrative of forces of cultural transformation that, while not adequately quantifiable at the present stage, can be shown to exert a characteristic influence.

We shall specifically study three kinds of systematic parameter shifts that can be regarded as rudimentary illustrations of qualitative

cultural transformation phenomena. These illustrative parameter shifts are chosen because they directly modify the conclusions to be drawn from the mechanics of interregional capital accumulation. These are:

(a) A steady progressive advance of the savings ratio over time that cannot be speeded up abruptly and that is subject to sharp limitation when there is an interference with the development process, for example by draining away resources from the area or region in question.

(b) A steady progressive advance in the absorption capacity for capital over time, with a sharp increase in the capital/output ratio when this capacity is exceeded.

(c) A steady progressive advance in capital and labour productivity over time that cannot be speeded up abruptly and that is subject to the same limitation as that presented in (a) above.

The progressive advance of the savings ratio, the absorption capacity, and the capital and labour productivity of a geographical area illustrate the process of what is here termed as <u>normal</u> development. This is taken to be characterized by an orientation to growth; a systematic transformation of the attitudes, thoughts, and habits of individuals; and a remoulding of the institutional setting within which the development process takes place.

Under the conditions prevailing in many developing countries such a progressive growth process is thwarted by a variety of social and political rigidities. In order to limit the scope of the discussion, this paper will deliberately bypass the crucial issues connected with breaking through these rigidities and introducing a social and political setting within which an orientation to growth and the consequent progressive advance characteristic of economic development has a chance to assert itself. Since it is the purpose

of this paper to study the policy choices concerning the planned inter-regional location of industries, it will be assumed instead that a general orientation to growth is already present at least in the key parts of the social-political unit, for example, in the advanced regions or at some geographical growth poles. What will be studied in some detail is the effect of potential resource transfers between regions upon the process of growth itself, taking into account the effects of these resource transfers upon the normal course of development as defined above. In traditional formulations of resource allocation models that do not have systematic parameter changes of the above three kinds built into them, the focus is on stock accumulation, and conclusions tend to favour the geographical polarization of investments. In models with these systematic parameter changes introduced to reflect the underlying cultural transformation process, such conclusions are modified in the direction of considerably greater geographical decentralization of the growth process, based on regional self-financing.

3. Three aggregate-level interregional growth models

Tables 1 through 3 contain the three illustrative, aggregate-level inter-regional growth models referred to in the previous Section. Each of these tables isolates for study systematic shifts in one set of parameters. The models refer to a simple, closed, two-region economy, with an advanced region A and a backward region B.

Table 1 illustrates the behavior of the savings ratio.[17] In most of the conventional growth models savings are treated either as a constant fraction of national (regional) product, or as a constant fraction of the share of profits. We wish to argue here that these mathematically simple and elegant assumptions prejudge completely the conclusions that are to be drawn from such models in regard to

---

17/ This table has been taken (except for an interchange of the symbols A and B) from T. Vietorisz, "Locational Choices in Planning," op.cit., Table 6, pp.96-97.

Table 1

An aggregate level interregional growth model with systematic shifts in the savings ratios of the regions

(a) No capital transfers

Year	Regional Product			Capital			Savings Ratio		Savings		Investments		Investment Ratio	
	Y_A (1)	Y_B (2)	Σ_Y (3)	K_A (4)	K_B (5)	ΣK (6)	σ_A (7)	σ_B (8)	S_A (9)	S_B (10)	I_A (11)	I_B (12)	ρ_A (13)	ρ_B (14)
0	100,000	100,000	200,000	650,000	350,000	1000,000	20	20	20,000	20,000	20,000	20,000	20	20
1	106,667	105,000	211,667	670,000	370,000	1040,000	22	22	23,467	23,100	23,467	23,100	22	22
2	114,482	110,775	225,257	693,467	393,100	1086,567	24	24	27,476	26,586	27,476	25,586	24	24
3	123,632	117,422	241,054	720,943	419,686	1340,629	26	26	32,144	30,530	32,144	30,530	26	26
4	134,336	125,055	259,391	753,087	450,216	1203,303	28	28	37,614	35,015	37,614	35,015	28	28
5	146,861	133,809	280,670	790,701	485,231	1275,932	30	30						

(b) One-half of region B's savings transferred to Region A

0	100,000	100,000	200,000	650,000	350,000	1000,000	20	20	20,000	20,000	30,000	10,000	30,000	10,000
1	109,990	102,500	212,490	680,000	360,000	1040,000	22	12	24,198	12,300	30,348	6,150	27,592	6,000
2	120,096	104,038	224,134	710,348	366,150	1076,498	24	8	28,823	8,323	32,985	4,162	27,466	4,000
3	131,080	105,079	236,159	743,333	370,312	1113,645	26	6	34,081	6,305	37,234	3,153	28,406	3,000
4	143,479	105,867	249,346	780,567	373,465	1154,032	28	5	40,174	5,293	42,821	2,647	29,845	2,500
5	157,738	106,529	264,267	823,388	376,112	1199,500	30	4.5						

inter-regional investment policy. Instead of assuming such constant ratios we stipulate that the behavior of the savings ratio in the course of a normal development process characterized by cultural and political orientation to growth is a steady progressive advance up to some reasonable upper limit. This limit is determined in practice not by considerations of foregone consumption but rather by technical and organizational considerations pertaining to the effective utilization of additional investment funds, i.e., by the absorption capacity of the economy for additional doses of investment. For the purposes of the model of Table 1 this upper limit has been set at 30% of regional product and the annual advance has been specified as 2%, a figure that is in all probability excessive but that serves to bring out the features of the model in a more pronounced fashion than a lesser increase. In other words, it is assumed that in the course of economic development there is a progressive recognition of the benefits of setting aside an increasing portion of net output for accumulation purposes, and this recognition is translated into an advancing savings ratio via the decisions of individual households and business firms (in predominantly private-enterprise economies) or the political decisions embodied in investment targets (in centrally planned economies). Growth models that incorporate such systematically advancing savings ratios have been investigated by Branko Horvat.[18/] The most salient feature of such models is the fact that after an initial lag in consumption (as compared with alternative models that maintain the savings ratio at its starting value) the models with advancing savings ratios yield a consumption profile that not only catches up with the consumption profiles of the alternative models, but outdistances them spectacularly within a short span of time. On reasonable assumptions pertaining to the parameters of the model, the lag in consumption amounts to somewhere from one-half to one full year at its greatest; i.e., a given consumption level is reached this

---

18/ See references cited in an earlier footnote.

much later in calendar time as compared with the alternative model that has a static savings ratio. The time required for catching up is of the order of ten years. It should be noted that neither the consumption lag nor the time required for catching up depend on the upper limit set on the savings ratio, but exclusively on the pace of the year-to-year advance of the latter; in other words, as far as consumption levels are concerned, there is no impediment for the rise of the savings ratio to 50, 70, or even 90% of total product! What limits the rise of the savings ratio to these stratospheric heights is the impossibility of effectively utilizing the resulting phenomenal doses of capital, i.e., the built-in inertia of the cultural transformation process.

While we stipulate a steady autonomous advance of the savings ratio as the normal behavior incorporated into our model, we assume that draining off capital from a given region for the purpose of transferring it for investment to another region will choke off the flow of savings. This assumption is incorporated in the model by means of a rule that re-sets the base-line for the autonomous increase of savings to the actual investment ratio of the preceding period whenever savings are drained off.[19/] While this rule is

---

19/ The formula for the savings ratio is the following:

$$\sigma_i^t = \text{Max} \left(\sigma_i^{t-1} + \alpha, \rho_i^{t-1} + \alpha, L \right),$$

where:

σ_i^t savings ratio in region i at time t

ρ_i^t investment ratio in region i at time t

α period-to-period autonomous advance of savings ratio (a fraction per time period)

L upper limit to advance of savings ratio.

It is noted that in Table 1 the advance of the savings ratio in Region A remains below 0.30; thus the limit on the autonomous advance of the savings ratio does not come into play up to the fifth time period. Apart from the systematic shifts in the savings ratio explained in the text that critically alter the growth path over time, the growth of each region from period to period follows the simplest type of Harrod-Domar postulate; i.e., the increase in regional product is obtained by dividing investment in the region by its capital-output ratio.

analytically convenient, it represents merely a drastically over-simplified illustration of the disincentive effects that are exercised upon autonomous development of a region by draining off the resources of that region. Such a curtailment of savings might result in practice from the reduced profitability of private investments when the funds needed for complementary private or social-overhead type investments are drained off (in a private-enterprise economy); from the collapse of the political support for a high-savings policy (in a centrally planned economy); or possibly from a mixture of the two. In addition there will be adverse effects on the morale of workers and managers alike that are translated into reduced labour productivity and a retardation of the process of technical advance and the generation of higher skills, which are superimposed upon the effects due to a reduction of the savings ratio. It should of course be recognized that the device of reducing the base-line for the autonomous advance of savings to the investment ratio of the preceding year is no more than a very broad-brush attempt to represent the nature of such disincentive effects; in practice the effects might well be delayed or distributed over several periods of time and might have an unequal incidence in different sectors of the regional economy. None the less, the model is put forth as an essentially valid illustration of the kind of effects that are to be expected from inter-regional capital transfers.

In Part (a) of Table 1 there are no inter-regional capital transfers; the growth of regional product in the advanced (A) and backward (B) regions can thus serve as a benchmark for studying the effects of capital transfers. The total base-period capital investment is assumed to be higher in the advanced than in the backward region (650 vs. 350 units); while the marginal capital/output ratio is set to favour the advanced region (3 vs. 4). Assuming initial incomes of 100 units in each of the two regions, these grow to 146.861 and 133.809, respectively, by the fifth period, while the initial joint capital stock of 1000 units rises to 1275.932 units.

In Part (b) of Table 1, it is assumed that one half of the savings of the backward region are at all times drained off and transferred to the advanced region for reinvestment. The usual expectation in such a case would be that the joint inter-regional product would now rise faster than before, since a given dose of investment yields a higher return in the advanced region whose capital/output ratio is more favourable. This conclusion, however, rests on the implicit assumption of fixed regional savings parameters.[20] Our assumptions concerning the normal advance of the savings ratio together with the disincentive effects due to the withdrawal of regional resources, however, profoundly alter such a conclusion. While the autonomous year-to-year increase of the savings ratio in the advanced region is unaffected by the resource transfer, savings in the backward region are cut back drastically. Thus the system as a whole loses more by virtue of being deprived of part of the potential savings in the backward region than it gains by virtue of reinvesting the actual savings of this region at an improved capital/output ratio. By reference to Table 1 it can be seen that growth in the advanced region is stimulated by considerably less than the growth lost in the backward region; accordingly, the levels of national product and capital stock, jointly for the two regions, rise slower when capital is drained off from the backward region than when each region grows on the basis of its own capital resources. In the fifth year, combined regional product for the two regions is only 264.267 with capital transfers, as against 280.370 in the case of regional self-financing; while the corresponding combined levels of capital accumulation are 1199.500 and 1275.932, respectively.

It requires emphasis that this result is due to a fundamental asymmetry in the assumptions concerning incentive effects. While we assume a strong disincentive effect in the losing region, we deny a

---

20/ Alternately, symmetrical incentive and disincentive effects between the two regions will lead to the same result. See T. Vietoriss, op.cit.

corresponding positive incentive effect in the region that gains resources, since we stipulate that the rate of autonomous cultural transformation cannot be effectively speeded up by additional doses of capital investment. These assumptions are perhaps vulnerable to the charge of being too strong. The disincentive effects in the losing region might not cut into the flow of savings quite as strongly as we have postulated, while the receiving region might in fact succeed in speeding up slightly its cultural transformation process under the influence of the extra abundance of capital resources. Yet there is no question that the considerations here adduced have a powerful modifying effect on the usual conclusions that tend to support geographically concentrated growth. These considerations must therefore be incorporated into the usual industrial location criteria in order to escape from the biases to which the latter now give rise. This will be pursued further in the final Section.

Table 2 illustrates the second of the three inter-regional growth models selected for study. This model concentrates on the growth of the absorption capacity of a region. Part (a) of the table again serves to create a benchmark for comparison. The assumption here is that in the absence of inter-regional capital transfers each region will experience a growth corresponding to the natural expansion of its absorption capacity. In order to simplify the model and concentrate attention on the absorption capacity, the autonomous advance of the savings ratio in each region has been omitted; in any realistic model its inclusion would of course be crucial. Thus it is postulated for the purposes of defining the model that in each region the savings ratio is a stable 20% and that the absorption capacity of the region grows in step with the capital growth that corresponds to the reinvestment of the resulting quantity of savings. In the table this absorption capacity is designated by the symbol Ψ and is seen to coincide, in Part (a) of the table, with the total amount of capital. Once the absorption capacity is exceeded, as in Part (b) of the table when half the savings of region B are transferred to

Table 2

An aggregate-level interregional growth model with a systematic shift in the capital absorption capacity

(a) No capital transfer

Year	Regional Product			Savings		Investment		Capital	Absorption Capacity		Changes in Regional Product				Capital	
									ABS.	CHG.						
	Y_A	Y_B	ΣY	S_A	S_B	I_A	I_B	K_A	Ψ_A	$\Delta\Psi_A$	$\Delta Y'_A$	$\Delta Y''_A$	ΔY_A	ΔY_B	K_B	ΣK
0	100,000	100,000	200,000	20,000	20,000	20,000	20,000	200,000	200,000	20,000			6,666	5,000	200,000	400,000
1	106,666	105,000	211,666	21,333	21,000	21,333	21,000	220,000	220,000	21,333			7,104	5,250	220,000	440,000
2	113,770	110,250	224,020	22,754	22,050	22,754	22,050	241,333	241,333	22,754			7,577	5,513	241,000	482,333
3	121,347	115,763	237,110	24,269	23,153	24,269	23,153	264,087	264,087	24,269			8,082	5,788	263,050	527,137
4	129,428	121,551	250,979	25,886	24,310	25,886	24,310	288,356	288,356	25,886			8,620	6,078	286,203	574,559
5	138,048	127,628	265,676	27,610	25,526	27,610	25,526	314,242	314,242	27,610			9,194	6,382	310,513	674,755

(b) One-half of region B's savings transferred to region A

0	100,000	100,000	200,000	20,000	20,000	30,000	10,000	200,000	200,000	20,000	6,666	2,000	8,666	2,500	200,000	400,000
1	108,666	102,500	211,166	21,733	20,500	31,983	10,250	230,000	220,000	21,333	7,104	2,130	9,234	2,563	210,000	440,000
2	117,900	105,063	222,963	23,580	21,013	34,087	10,507	261,983	241,333	22,754	7,577	2,267	9,844	2,627	220,750	482,233
3	127,744	107,690	235,434	25,549	21,538	36,318	10,769	296,070	264,087	24,269	8,082	2,410	10,492	2,692	230,757	526,827
4	138,236	110,382	248,618	27,647	22,076	38,685	11,038	337,388	288,356	25,886	8,670	2,560	11,180	2,760	241,526	573,914
5	149,416	113,142	262,558	29,883	22,628	41,197	11,314	371,073	314,242	27,610	9,194	2,717	11,911	2,829	252,564	623,637

region A, the capital/output ratio becomes more unfavourable. In the present case the capital/output ratio has been assumed to rise from 3 to 5 in region A as the absorption capacity of the region is exceeded; in region B it has the value of 4.

In Part (b) of the table the value of Ψ for each region is the same as in Part (a) but the value of K, total capital, can now exceed Ψ. When this is the case the addition to the product of the respective region (region A in the illustrative model) is assumed to consist of two parts. The first part is calculated from that portion of total investment in region A which corresponds to the increase in absorptive capacity: this portion is divided by the capital/output ratio of 3. To get the second part of region A's product increase, the rest of total investment in region A is divided by the capital/output ratio of 5, reflecting the deterioration of the effectiveness of extra investment as the region's absorption capacity is exceeded. All other computations are straightforward. An inspection of the growth profiles in the table discloses that region A's gain is more than offset by region B's loss and that correspondingly both total inter-regional product and total capital accumulation is reduced as a result of the capital transfer from region B to region A.

Thus a limit imposed on the amount of capital that can be absorbed at favourable capital/output ratios counteracts differences in the effectiveness of investment between regions. It might again be objected that our assumed model overstates the strength of these effects. In particular, it might be adduced that in many cases the economy of the receiving region (advanced region A) operates well below its own limit of capital absorption capacity, and that in such cases the effect of a capital transfer from region B to A will be favourable. As far as capital absorption capacity alone goes, this might well be the case, in particular if the inter-regional system as a whole including its advanced regions operates under conditions of semi-stagnation due to social and political

rigidities. It is noteworthy, however, that our argument gains in persuasiveness precisely to the extent that the development process as a whole is proceeding in a satisfactory manner, i.e., that the generation of capital as a byproduct of growth pushes strongly against the absorptive capacity of both advanced and backward regions. This also underlines the need for considering the limit on absorption capacity not independently of the autonomous advance of the savings ratio, as was done here for purely expositional purposes, but in conjunction with the latter, since an autonomous advance in the savings ratio is sure to raise savings eventually to such a high level[21] that the absorption capacity becomes the binding constraint. Thus the draining of capital resources from the backward to the advanced region becomes a rational policy, as far as absorption capacity is concerned, only under conditions of semi-stagnation: an ironical result, since stagnation, from the social point of view, is the height of irrationality.

Table 3 illustrates a systematic shift in labour productivity. Technology is here assumed to be described by a Cobb-Douglas function of the form

$$Y = Y_o K^{0.5} L^{0.5} ,$$

with a Harrod-neutral technological improvement of 2.5% per year that can be represented as an equivalent expansion of the labour force alone.[22] Assuming a simultaneous biological expansion of the labour force by another 2.5% per year, Part (a) of Table 3 shows a cumulative 5% annual increase of the effective labour force in each region. Part (a) is again used to establish a benchmark for

---

21/ As emphasized earlier, there is no constraint based on considerations of foregone consumption that would exclude a rise of the savings ratio to levels near unity.

22/ For a summary of relevant technical concepts, see Hahn and Matthews, "The Theory of Economic Growth, a Survey," Economic Journal, December 1964. In the formula given in the text, Y is regional product, K capital, and L the effective labour force. The constant Y_o is set to yield a base product of 100 units in each region with a capital/output ratio of 3 and 4,

Table 3

An aggregate-level interregional growth model with systematic shifts in labour productivity

(a) No capital transfers

Year	Effective Labour Force		Equivalent Capital		Regional Product			Savings		Investments	
	L_A	L_B	K_A^*	K_B^*	Y_A	Y_B	ΣY	S_A	S_B	I_A	I_B
0	100,000	100,000	300,000	400,000	100,000	100,000	200,000	20,000	20,000	20,000	20,000
1	105,000	105,000	320,000	420,000	105,830	105,000	210,830	21,166	21,000	21,166	21,000
2	110,250	110,250	341,166	441,000	111,973	110,250	221,223	22,395	22,050	22,395	22,050
3	115,763	115,763	363,561	463,050	118,444	115,763	234,207	23,689	23,153	23,689	23,153
4	121,551	121,551	387,250	486,203	125,261	121,551	246,812	25,052	24,311	25,052	27,311
5	127,629	127,629	412,302	510,513	132,441	127,629					

(b) One-half of region B's savings transferred to region A.

0	100,000	100,000	300,000	400,000	100,000	100,000	200,000	20,000	20,000	30,000	10,000
1	105,000	102,500	330,000	410,000	107,471	102,500	209,971	21,494	20,500	31,744	10,250
2	110,250	105,063	361,744	420,250	115,300	105,063	220,363	23,060	21,013	33,566	10,506
3	115,763	107,690	395,310	430,756	123,507	107,690	231,197	24,701	21,538	35,470	10,769
4	121,551	110,382	430,780	441,525	132,113	110,382	242,495	26,423	22,076	37,461	11,038
5	127,629	113,142	468,241	452,563	141,140	113,142	254,282				

growth under conditions of no capital transfer between regions. When capital is drained away from the backward region, however, it is assumed that this will create disincentive effects of sufficient impact to choke back technological improvement: accordingly, the growth of the effective labour force will be reduced to the biological growth rate of 2.5% per year. Part (b) of the table indicates that under these conditions both the increase of the joint income of the two regions and the total accumulation of capital is reduced, indicating that the benefits accruing to region A are more than offset by the damage done in region B. As before, the issue might be raised whether the model does not overstate the impact of capital withdrawal on regional productivity. Since the institutional conditions surrounding a policy of such capital transfer are likely to be highly unfavourable to the backward region, it can be argued that under such conditions the entire cultural transformation process is likely to be slowed down critically, if not stopped; thus the postulate of a strong impact is reasonable, even though its exact quantification can be the subject of debate.

In sum, each of the three parameter shifts that have been individually embodied in illustrative aggregate-level models have the effect of modifying in the same direction the conclusions

---

(footnote continued)

respectively, in region A and B; its value is thus $1/\sqrt{3}$ and 1/2, respectively, if capital endowments are assumed to be 300 and 400. It will be noted, however, that the endowment of region A is less than that of region B which is contrary to the assumptions of the models in Tables 1 and 2, in which the advanced region was assumed to be endowed with more capital. This inconsistency can be resolved if it is assumed that the Cobb-Douglas function used in the computations is merely an approximation to the true production function in the range relevant for computations. The true production function, specifically, must be assumed to have an initial range of increasing returns to capital. Thus the amount of capital actually employed in each region can be considerably higher than the amount that is assumed to be operative in the approximating Cobb-Douglas function. Table 3 contains only the latter amounts which are designated by the symbol K*.

drawn from the neoclassical versions of these models. In each case, the effect is one of discouraging the transfer of resources from the backward region to the advanced region.

Some of the possible objections to the assumptions embodied in the models have already been mentioned. These objections centre on the overstatement of the adverse effects of resource transfers. Yet the force of these objections is considerable diminished when it is taken into account that the three effects that have been isolated for purposes of presentation in fact work together and reinforce each other; besides, there are additional effects (some of which have been mentioned in the discursive part of the paper) that have not been quantified in separate models. Taken together, the joint impact of these effects has a decisive influence on inter-regional industrial location criteria.

Before passing on to the definition of such criteria two further objections will be taken up.

First, it may be asserted that the resource transfers embodied in the models are excessive and that their impacts are largely discontinuous; thus if consideration were given to smaller transfers with graduated impacts, it might well turn out that some resource transfers are at times advantageous for the system as a whole. Thus in considering the absorptive capacity for capital, instead of postulating a discontinuous deterioration of the capital-output ratio from 3 to 5 as the absorption capacity of region A is exceeded, it might be postulated that the deterioration is gradual and related to the extent of the excess. Thus a modest overstepping of the nominal absorptive capacity would raise the capital/output ratio only slightly in region A, while leaving it still below that of region B. Under these assumptions the degree of resource transfer would be optimal when it lowers

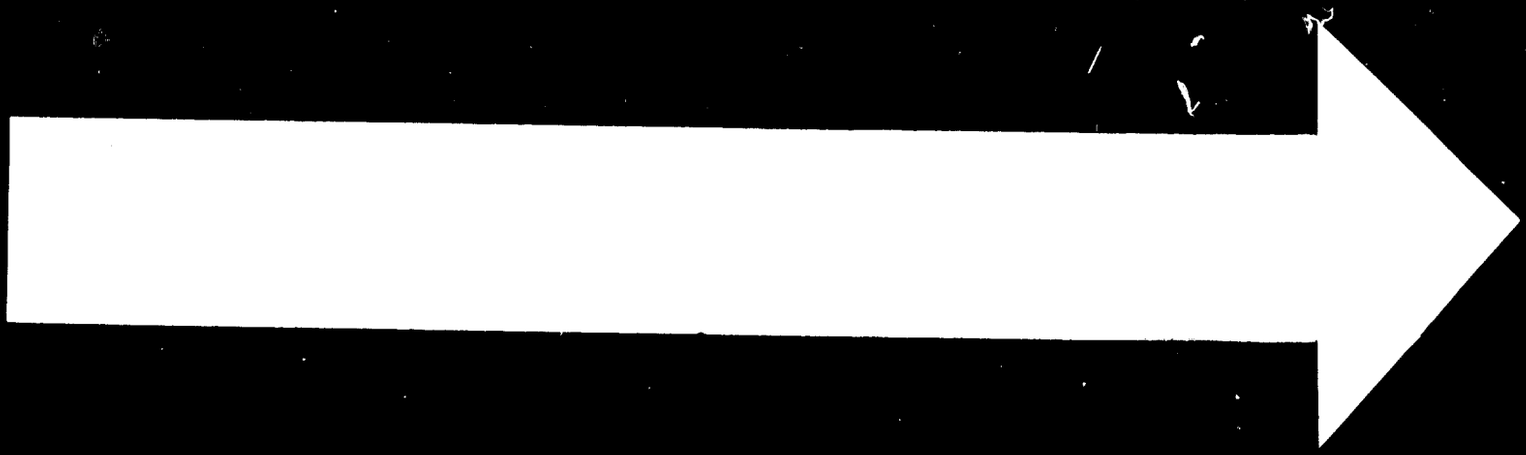
the capital/output ratio of region A to that of region B. In a similar vein, the reduction in the technological improvement in the third model might be made gradual in response to an increase in the ratio of transferred savings rather than being treated as an all-or-nothing proposition: here again the more favourable capital productivity of region A might offset the adverse effects on region B as long as the degree of transfer is maintained small.

There is merit to these objections, but only in so far as the assumption of gradual impacts can be complemented in practice by the assumption of carefully graduated policies that adjust the system to an optimal balance of opposing forces. This is hardly likely to be the case. Policies in this area are much more likely to be embodied in broad directives or operational principles that in many cases have an all-or-nothing character. If it is decided to channel resources into favoured areas, or to permit market forces to do so,[23/] this policy is likely to be carried beyond the point of balance - which is in any case almost impossible to measure - and is moreover likely to go hand in hand with a *de facto* neglect of the backward areas, flowing from an exclusive concentration of technological factors, to the disregard of the social, cultural, and political issues of broad-based development.

Second, it may be objected that the analysis leaves aside all economies of scale, of agglomeration, and of urbanization; that these are nevertheless the controlling considerations in decisions of spatial resource allocation, overriding such allegedly secondary issues as the ones on which this paper has concentrated.

23/ The publicly announced development policy of a government may at times pay lip service to the opposite strategy of channelling resources into the backward regions, but the modest amounts of aid that flow to these regions are on the whole heavily outweighed by large capital flows of various kinds that typically move from the backward to the advanced regions.

The methodological problem connected with these economies is the fact that they cannot be explicitly included in aggregate-level models, since they operate at the level of individual productive activities. Yet allowance can be and in fact has been made for them, precisely in the form of the more favourable capital/output ratios that have invariably been used to characterize the more advanced region in each model, in spite of the fact that the backward regions have many investment opportunities that can be exploited under conditions that avoid the diminishing returns associated with the high-intensity operations of advanced regions (e.g., extractive activities). This argument therefore hinges on the exact value of the capital/output ratio that can be legitimately postulated for regions of varying size and level of development. The values inserted in the models can be taken to characterize sizable regions, having at least one major metropolitan concentration. As the size of regions decreases, the qualitative arguments concerning the need to bring out the full human and productive potentials of the inhabitants still hold in full force; however, it is obvious that an attempt to reproduce the economic structure of the major regions in the microcosm of regions based on individual villages or hamlets would run counter to fundamental technological realities involving economies of scale, of agglomeration, and of urganisation, and would be futile. Exactly where the line has to be drawn between major regions and micro-regions cannot be precisely stated; but the three aggregate models discussed above lose their validity in analyzing the problems of the latter. It is beyond the scope of the present paper to explore alternative approaches to inter-regional development at this level. The key issues that arise include at least the following: the choice of strategies for technical progress in agriculture; the issue of a hierarchical organization of economic activities, with the larger-scale and technically more sophisticated activities concentrated into the larger centres; the issue of the development of local

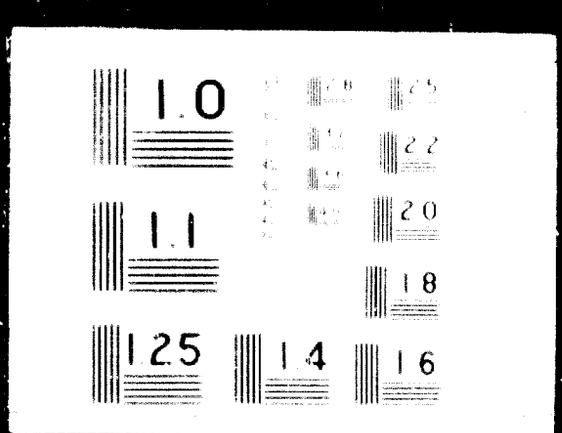


8.8.73

2 OF 2

DO

3002



industries aimed at satisfying local demand; the reliance on secondary and local resources for local development; the integration of the seasonal labour requirements of agriculture with industrialization objectives; and many more.

D. CONCLUSION: CRITERIA FOR THE PLANNED INTER-REGIONAL LOCATION OF INDUSTRY

The previous argument lends strong support to the policy conclusion of regional self-financing, at least at the level of major regions. Thus the development of each region is to proceed on the basis of capital resources that are generated within the region as a byproduct of the growth process itself. Net transfers of resources from the advanced to the backward regions are ruled out as next to impossible to achieve in predominantly private-enterprise and mixed economies; even in centrally planned economies the probability of achieving major net transfers of this kind is rated as low. The policy objective then becomes twofold: (1) attempt to restrict or to eliminate net resource transfers from the backward to the advanced regions; (2) define an industrial location strategy that will significantly support the autonomous development efforts of the backward regions, without creating a drag on the development of the advanced regions.

The present section will concentrate on the second policy objective. The instrument of choice is an inter-regional counterpart of the "trade-not-aid" policy that has been extensively discussed in the international context but that is equally applicable, in fact considerably easier to apply, at the level of regions within a single country.

Our discussion will again be based on the simple illustrative conceptual model consisting of two regions, an advanced region A and a backward region B. The system of two regions is closed. Inter-regional capital transfers are now ruled out by assumption; thus for

each region imports of goods and services from the other region are equal to exports of goods and services to the other region. It is assumed, as in the first model (Table 1) of the previous section, that there is a progressive autonomous increase in the savings ratio up to a limiting ratio L that takes place in the course of development of each region unless choked off by constraining influences. Since capital transfers are ruled out, the principal constraining influence in the backward region is assumed to be its inability to convert its potential savings into investment. The savings ratio in region B is thus prevented from taking its normal, autonomously rising course.

Region B is assumed to have only traditional exports to region A. The demand for such exports in region A has an income elasticity lower than unity; thus the growth rate of these exports is lower than the growth rate of region A.

Imports to region B equal exports from region B. In order to make our point in the strongest possible form, we will assume that these imports consist entirely of investment goods, which region B is incapable of producing at a reasonable capital/output ratio due to scale limitations. Under these conditions, the growth rate of investments in region B is limited to the rate of growth of its exports, which will always be below the growth rate of region A's income.

All of these assumptions, while extreme, represent in a simplified way concrete aspects of economic reality. While inter-regional capital movements can actually differ from zero, it is not an unreasonable assumption that the overwhelming portion of the capital required for economic growth has to come out of the internal resources of each region. This question has been dealt with at length in the previous section. The nature of traditional exports and the income elasticities characteristic of these can be accepted without further justification; likewise, the great

limitations on the ability of the backward region to produce capital goods are not open to serious doubt, provided that exception is made for such items as construction. The most questionable assumption of the above set is that imports to region B will consist entirely of capital goods; however, if this assumption is weakened, the lag of the backward region is made that much more pronounced, thereby strengthening the conclusions to follow.

What can the advanced region do within the context of planning, to promote the growth of the lagging region, given the above assumptions? First, to the extent that it breaks any constraints upon its own growth, it will follow the autonomous upward path of the savings ratio discussed earlier, with a corresponding self-accelerating growth pattern up to a given limit. The effect of this accelerated growth in region A will be translated into a higher demand for traditional exports from region B to region A, and a correspondingly higher growth of investments in region B, leading finally to a higher rate of growth in region B. This will benefit region B, but it will still tend to widen the relative gap between the two regions.

Secondly, while capital transfers are ruled out by assumption, region A can break the constraints upon the conversion of potential savings into investment in region B. Region A can do this by planning to import certain commodities it requires, from new productive sources located in region B which are financed out of the savings of region B itself. By thus assuring a market for this new investment, region A helps region B to create new exports in lines other than the traditional ones and thereby raises the supply of investment goods to B. Total exports of region B increase above the amount corresponding to traditional exports alone, and the constraint on the procurement of investment goods in region B is relaxed. Savings can now rise to the level permitted by the availability of investment goods. Thus the way is opened to the

progressive autonomous expansion of the savings ratio in B, until it eventually reaches the limiting saving ratio, at which point region B is in the process of full-fledged rapid development.

Some care is needed in specifying the mechanism of the expansion of total exports in region B under the condition of zero capital transfers when new non-traditional export markets are opened up. In order to create these additional exports, region B has to channel its limited supply of investment goods into newly built capacity for non-traditional exports. This can be done either at the expense of investment in traditional export lines (needed for the routine expansion of these traditional exports) or else, it can be done at the expense of investment in consumer-goods production for the domestic market. For maximal growth, the former investment has to be left untouched, in order to be able to add the new exports on top of the normal growth of the traditional ones. This course of action, however, may imply (depending upon the parameters of the problem) a faster increase in the savings ratio than the autonomous year-to-year increase will permit. In this case, the situation may arise that savings in region B temporarily fall short of the amoung that would be required to take full advantage of the new export markets. Such a situation can be avoided if the planning of new lines of supply for region A, based on productive investments in region B, is coordinated with the available increase of savings in region B. The same coordination will also ensure that the new markets that are created for region B are sufficiently extensive to permit the eventual raising of the savings ratio in region B all the way up to the final limiting ratio, and not only part of the way.

The investments in region B aimed at serving new, non-traditional export markets will typically take place at considerably more favourable capital/output ratios than could be achieved in

the same lines of production if they were intended solely for the internal market of region B. This is due to the economies of scale that can be achieved when serving the combined markets of both regions. Therefore, whenever there is an internal market in region B for a new line of production that becomes a non-traditional export line, the export-oriented investments produce an additional benefit in that they reduce the unit capital requirements for producing the same commodity for the internal market. Thus the channelling of investments into export industries does not cut into domestic consumption possibilities as deeply as might otherwise be the case. This is readily apparent in the case of consumer goods or their intermediates. When the new exports happen to be in a capital-goods or intermediate producers' goods line, there is a similar extra benefit over and above the value of exports generated, to the extent that an internal market exists that can be supplied at a reduced capital/output ratio.

What are the overall benefits of planned "trade-not-aid"? The benefits to the backward region have been indicated above; those to the system as a whole are almost equally transparent. When the planned trade-not-aid policy is pursued, capital accumulation in the advanced region is unaffected, while capital accumulation in the lagging region is sharply increased; consequently, the growth of the system as a whole must increase unless the additional capital accumulation within the system is more than compensated by an increase in the average capital/output ratio for the system as a whole. To this issue we now turn.

Under a rational development policy, the industries or branches selected for the trade-not-aid approach will be the ones which either have an absolute cost advantage in the backward region or are at least reasonably footloose, i.e., whose cost structure is not critically influenced by geographical location. In the combined market of the two regions, such footloose industries will typically achieve economies of scale not available in either market alone.

If in the absence of a trade-not-aid policy such industries were located in A, their products would be excluded from region B except for the modest shipments (under our assumptions consisting entirely of capital goods) that could be financed out of region B's traditional exports to region A; thus the economies of scale of serving the combined markets would be foregone in these industries. The disadvantages would, however, not stop here. Those indus. which under a trade-not-aid policy would continue being located in region A could also achieve economies of scale in the combined regional markets; moreover, there are traditional gains from trade that could be achieved even in the absence of economies of scale by regional specialization. Without a trade-not-aid policy most of these benefits would also be foregone, except for the minor ones that would still be captured by the modest amount of trade permitted by the market for region B's traditional exports.

Under a trade-not-aid policy all of the foregoing benefits will accrue to the system as a whole, reducing the average capital/output ratio. Conversely, industrial location in B for serving the combined markets will typically also have disadvantages: extra transport costs, lower productivity and quality, or unfavourable net differentials in agglomeration and urbanization-type economies and diseconomies. These extra costs have to be charged off against the benefits enumerated above.

When such a cost comparison is attempted on an industry-by-industry basis it has to be clearly understood that no more than an approximation can ever be achieved. For exact results it would be necessary to compare the entire development profile in the presence as well as in the absence of a trade-not-aid policy; moreover, within the overall policy of trade-not-aid and jointly planned regional development it would still remain to be determined what was the best possible division of productive activities between the two regions. Since economies of scale are significant the resulting problem is non-convex and cannot be exactly solved by a method of systematic revisions of trial programmes. Approxima-

tions, none the less, are of great value.[24/]

The industry-by-industry locational comparison is one such approximation. This approximation can be undertaken at a crude aggregate level, concentrating on the capital/output ratio, or it can be undertaken at a more sophisticated level, relying on detailed programming models (linear or convex nonlinear) that yield appropriate shadow prices for all resources, permitting a more exact definition of costs and benefits. In either case what requires quantification is the interplay of the factors mentioned before: economies of scale in the combined market, economies of specialization, and increased capital formation on the one side, as against extra costs, productivity and quality losses, and lost economies of agglomeration and urganisation on the other side.

Three cases may arise in the course of such a comparison.

(1) If the comparison of <u>costs</u> alone, not allowing for increased capital formation in the backward region, comes out in favour of the latter, the planned trade-not-aid policy will benefit not only the backward region, but also the advanced region.

(2) If the cost comparison favours region A, relocating the industry in region B will increase costs, i.e., in terms of crude aggregate models, it will raise the capital/output ratio. Such an increase may nevertheless still be more than compensated, as far as the system as a whole is concerned, by the additional capital generated in region B. In such a case the planned trade-not-aid policy will favour the backward region and the system as a whole, but not the advanced region.

24/ For a detailed discussion of the problems raised by nonconvexity, see T. Vietorisz, "Decentralisation in non-convex Systems", Conference paper, Econometric Society Meetings, New York, 1965; forthcoming in United Nations, <u>Industrialisation and Productivity</u>, Bulletin 12 (in press). An earlier version is available under the title <u>Project Evaluation in the presence of economies of scale and indivisibilities</u>, United Nations Interregional Symposium on Industrial Project Evaluation, Prague, 1965, Discussion Paper CID/IPE/B.28.

In dealing with this case, we have to be particularly careful about the exact definition we wish to give to the postulate of no capital transfers between regions. If an industry has a locational disadvantage in region B but is nevertheless located there in order to give region B an export outlet, then notwithstanding the resulting overall benefit for the system as a whole, region A will experience a rise in the price of the respective commodity, provided that factor prices in the two regions are held constant. Such a price rise, however, would amount to a de facto capital transfer from region A to region B which, under our initial postulate, must be excluded. This can be achieved by subsidizing the transfer price of the commodity from region B to region A, the subsidy being taken out of region B's factor incomes. In this way region A can always be left no worse off than before, just so long as there remains any net benefit to region B after the transfer-price adjustment.[25/]

(3) The cost comparison can come out so much to the disadvantage of a location in region B that any additional savings generated in the latter region are more than compensated by deterioration of the overall capital/output ratio. In this case, insistence on selecting this particular industry within the framework of the trade-not-aid policy will result in an actual reduction of the income of the system as a whole. If this case should prevail for all industries, the development of the lagging region cannot be stimulated within the framework of this model without a reduction of the income of the two-region system as a whole. Political constraints, discussed in Section B above, may of course still dictate location in the backward region.

25/ A similar adjustment might also be required in some marginal situations falling within the domain of case 1, above; e.g., when an industry has a slight locational advantage in B, yet the delivered price in A rises somewhat due to a longer transport haul.

In sum, the planned trade-not-aid policy produces benefits because, first, it raises capital formation in the lagging region by means of removing the constraints on the conversion of savings into investment; second, because it creates economies of large-scale production in the combined market of the two regions; and third, because it yields the conventional gains from trade incident upon inter-regional specialization. The combined effect of these benefits will raise the joint product of the two regions except in the unlikely event that it is impossible to find any industries that can supply the combined markets of the two regions from a location in region B without incurring overwhelming cost disadvantages. To outweigh the benefits accruing to the system as a whole, these cost disadvantages have to be heavy enough to offset not only the potential economies of scale and specialization, but also the additional savings and the resultant investment and growth that are created in region B. In addition, the advanced region generally shares in these benefits to a considerable extent due to the broadening of the markets for its industries, not only as a result of the combination of the separate regional markets, but also following region B's induced, accelerated income growth. These benefits to the advanced region can be negated only by strong cost disadvantages of locating new export industries in the backward region, when overall system benefits depend exclusively on the additional savings induced in the latter region. Political constraints arising out of the cohesion of the inter-regional system may even so dictate a trade-not-aid policy in favour of the backward region.

These conclusions acquire particular force to the extent that the social and political conditions for rapid development, with autonomously rising savings ratios, productivities, and skill levels, are already present. Under conditions of stagnation or semi-stagnation all secondary questions of social rationality, such as the precise criteria for the inter-regional location of industry, become irrelevant in comparison with the key question of a strategy for establishing the pre-conditions for a social orientation to growth.

APPENDIX

NOTES TO FIGURE 1

Figure 1 presents a linear programming model in Tucker's combinatorial format. Activity scales (X and H variables) appear in the bottom margin; prices (P and R variables) appear in the right margin. Slack variables are omitted.

Sign convention. Outputs or supplies are positive; inputs, requirements, or demands are negative.

Figure 1-A

Interpretation of table. Rows represent resources: either physical goods or labour skills, each accounted for separately as a flow and as a stock. Columns represent activities: the production of goods or of skills; the carry-over of stocks of goods or skills from one time period to the other; or exogenously determined combinations of supplies or demands that are entered in the model as given data. A given coefficient in the table represents an output (supply) or an input (requirement, demand) of a given resource per unit of activity scale.

Row balances. Multiply each coefficient in the table by the activity scale of its column (the X or H variable appearing at the foot of the column in which the coefficient is located). This yields total output (supply) or input (requirement, demand) of a resource at the activity scale designated by the X or H variable. Add algebraically all products in a given row. The sum is a surplus (if positive) or overdraft (if negative) of the resource at the specified activity scales.

Column balances. Multiply each coefficient in the table by the resource price of its row (the P or R variable appearing at the right

margin of the row in which the coefficient is located). This yields the total revenue (for positive coefficients) or total cost (for negative coefficients) associated with the sale or purchase of the resource in question, at the prices designated by the P or R variables. Add algebraically all products in a given column. The sum is the profit (if positive) or loss (if negative) of running the given activity at unit level, calculated at the specified resource prices.

Figure 1-B

Figure 1-B represents in condensed form the interconnections between sub-models providing resource balances for single time periods. The X, H, P, and R variables in Figure 1-B are vectors, and the coefficients in the table are matrices. All rules given for Table 1-A are valid for Table 1-B if the operations are undertaken following matrix algebra. In particular, the intersection of Rows 1-5 and Columns 1-5 in Table 1-A is designated by the symbol $\underline{F}^t$ in Table 1-B, where the superscript $\underline{t}$ refers to the time period in question. Likewise, the intersection of Rows 6-10 and Columns 1-5 in Table 1-A is designated by the symbol $\underline{S}^t$ in Table 1-B; and the diagonals made up of (+1) or (-1) elements are designated by $\underline{+I}$ and $\underline{-I}$ respectively.

Optimization. The table as given is a simple accounting device. In order to use it for optimization, certain variables have to be pre-set to constant values. These include the exogenous vector for each time period, usually pre-set to unit scale; the stock carry-over vector $\bar{H}^o$ for the zero time period, which fixes the pre-existing stock levels; and the stock and flow price vectors $\bar{P}^5$ and $\bar{R}^5$ for the fifth time period that establish the valuation of terminal stocks. The optimization can then be expressed in two closely related ways:

(1) Choose a programme of activity scales by setting the remaining X and H variables to any desired non-negative values.

Among all possible programmes of this kind, identify as optimal a programme which maximizes the value of terminal stocks while leaving a positive or zero surplus (row balance) for each resource.

(2) Choose a pattern of resource stock and flow prices by setting the remaining P and R variables to any desired non-negative values. Among all possible patterns of this kind, identify as optimal a pattern which minimizes the joint profit on all exogenous activities, while leaving a negative or zero profit on all activities.

Interpretation of optimization. The maximand of the first way of optimizing will coincide with the minimand of the second way of optimizing after the respective optima are identified, provided that both problems do have finite optima. In the optimal solution, activities having losses will occur at zero scales, and resources having positive surpluses will have zero valuations (free resources). The avoidance of negative surpluses in the first way of optimizing is an obvious device for preventing resource bottlenecks in the optimal programme; the avoidance of positive profits in the second way of optimizing corresponds to the well-known efficiency condition of perfect competition which requires the elimination of all profits under perfectly competitive equilibrium. The maximization of terminal stock valuations is a device for putting the system in the best possible position for growth following the terminal period. The minimization of profits on the exogenous activities is a device for reducing the scarcities of exogenously supplied resources while enhancing the values of exogenously demanded resources.

The exogenous activities. The growth of the labour force is handled as an exogenous supply q_i for skill of grade i, in each time period. The parameter q_i comprises the effects of entries into the labour force (for skill-grade zero); immigration net of emigration in each skill grade; and deaths or retirements from the labour force (a negative item). If any amounts of skills of grade i are generated outside the economic sphere covered by the model, e.g., by a socio-cultural process not subject to resource allocation considerations, these amounts have to be included in the exogenous supply.

Education and training activities. The $\underline{g}$ and $\underline{f}$ coefficients refer to ordinary flow and stock inputs of physical goods into the educational and training activities, i.e., electricity (a flow) or inventories of desks and benches (stocks). The -(1-d) and +(1-d) entries refer to the removal of lower-grade skills and the addition to higher-grade skills resulting from the educational and training activities; the $\underline{d}$ coefficients in particular designate the fraction of dropouts at each level. The entries of (-1) and (-h) in the education and training activities represent the stocks of trainees and teachers tied down, respectively, by these activities, while the process of training is under way. It is assumed for convenience that only the third level of skill acts in the capacity of teacher. It is further assumed for convenience that each activity is self-contained within a single time period; this assumption can of course be easily relaxed and longer-term training activities as well as various time lags can be introduced into the model in any manner desired.

Stock carry-over activities. It is assumed for convenience that all stocks are liquidated at the end of each time period; thus stock carry-over activities interconnect just two consecutive time periods. No depreciation on physical stocks is assumed; all withdrawals from stocks of skills, as already indicated in the previous section, are handled exogenously.

Rate of interest. The optimal pattern of prices can be interpreted as a pattern of discounted prices. In order to determine a rate of interest connecting any two time periods, current prices are defined by reference to a common rate of interest, using the conventional discounting formula to connect current and discounted prices. Since each stock-carry-over activity actually used has a zero return in terms of discounted prices, this translates into a formula connecting the ratio of stock rents and flow prices for a commodity (physical good or labour skills) with a percentage capital gain or loss in terms of current prices. Choosing a

value-standard stock for which current prices are equal in the two periods yields a rate of interest defined as the ratio of rental price to flow price for the value-standard stock. The rate of interest is not a fundamental property of the model, since it varies with the choice of the value-standard stock; but the pattern of discounted prices, emerging directly from the optimisation, is fundamental.

8.8.73