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A Method of Regional Planning

By

Jan Tinbergen



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A METHOD OF REGIONAL PLANNING

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## A METHOD OF REGIONAL PLANNING

At the Netherlands Economics Institute (Division of Balanced International Growth) we are preparing, with the financial support of "Resources for the Future", a publication dealing with "The Element of Space in Development Planning". Provisional texts, not yet edited or revised, will be made available to P.I.D.E. In the subsequent text a sketch is given of the problems considered and the solutions offered. The study is based on the assumption that many developing countries do not have the computer facilities needed to use highly sophisticated methods and that also for lack of staff and for reasons of communication with policy-makers relatively simple methods may have their value. The outcome of such methods may represent a first approximation to the ultimate solutions.

A complete introduction of the element of space or location into economic planning is virtually impossible. We propose to introduce a qualitative classification of commodities with regard to their mobility. World products are those which can move without much cost all over the world; national goods are those which cannot be traded between nations; among these are regional and even local goods which cannot easily leave a region or even a locality. We introduce "heavy goods" as a category of world products with non-negligible transportation costs. One of the features of our study is that we introduce geographical sub-divisions at different levels. Thus we consider four cases to be described hereafter.

### Case I "World Planning" for continent

We consider the main planning problem to be the estimation of the optimal income increases for each cell in a two-entry table, where continents are the columns and sectors are the rows. From the income increases we can derive the necessary investments by multiplying by capital-output ratios. Alternatively we can determine the costs of producing the

goods in all cells, taking into account all costs of scarce factors.

We consider as targets the income increases in the various continents and hence in the world at large. From demand relations the income increases of the various sectors can be found. Thus the horizontal as well as the vertical totals of our two-entry table are known. The problem is to fill out all the cells in such a way that total costs or total **investments are** a minimum under **the target constraints**. This appears to be the Hitchcock (transport) problem, a sub-species of linear programming. The solution can be found with the aid of the so-called  $u - v$  - method, starting from a first basic feasible solution and applying iterations. The number of iterations can be greatly reduced by an appropriate ordering of the rows and columns. There will also be <sup>a</sup>number of pre-determined zeros, for instance no coffee production in Europe.

#### Case II. Regional Planning for One Nation

At the national level we introduce regions as the first subdivision. We make a distinction between regional other national and international sectors. The regional sector income increases are assumed to have a pre-given ratio to the total regional income targets. As soon as the regional income targets are given, the income increases for the regional sectors are also given therefore and we deal with the remainder of the table only. Here we have other national and international sectors only. Again, the row **totals** of each of the other national sectors are given from demand relations. But this is not true for the international sector rows. Here only the sum total of all of them is known. The problem can be solved nevertheless with the aid of the  $u-v$  method, now with more degrees of freedom.

Sensitivity analysis with regard to the regional income target will yield information on the costs of regional target changes in terms of national income.

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Assuming that transportation costs are low in comparison to the differences between regions of production costs for the same commodity, we can assume that the locations found for the various industries will not be influenced by these transportation costs. The flows of transportation can be determined in such a way as to minimize transportation costs. It appears that this problem can again be given the shape of a Hitchcock problem, now using as rows and columns the regions of destination and of origin.

Case III. "Heavy Goods" Introduced .

In this case transportation costs are assumed to be large enough for these goods to interfere with the optimal location. The problem to minimize the sum total of production plus transportation costs (or investments) now becomes quite a bit more complicated; but it may be solved by iterations, starting from the solution of the two problems implied in Case II, namely minimizing production costs first and transportation costs afterwards. Heavy goods, if defined as fuel, building materials, fertilizer, minerals and bulky agricultural products make up for at least 70 percent of transportation in most countries.

Case IV. Hierarchy Models

Upon passing on to ever finer geographical subdivisions we finally arrive at space units such as cities and villages (together to be called "centres") and now we can no longer neglect the existence of indivisibilities, leading to the concept of the minimum size of enterprises in order to be lowest-cost units. A problem we are now facing may be formulated as follows. Given a country (say square) with a uniform density of agriculture; to begin with, no foreign trade and a number of industries. Given also, for each industry, the necessary number of minimum - size plants in order to satisfy demand; how do we have to duster these plants into

centres of different size in order to minimize transportation costs? We proposed a hypothetical solution which we called the hierarchy model. In some cases we can prove that it does minimize transportation costs. In other cases amendments are necessary; some of them are offered. The simplest version of the hierarchy model can be described as follows. Arranging the industries in the order of diminishing number of enterprises, we call "industry of rank 1" the industry with the largest number of plants; "industry of rank 2" the industry with the next lower number of plants, ending up with the highest rank H, showing one "plant" only (central government, mostly). In this model there are only H types of centre; they also can be given a rank. In any type of centre of rank h' all industries with rank 1, 2, up to h' appear and only one enterprise of the latter rank. In each type of centre only industry h' exports to other centres (and agriculture); all other industries 1, 2 ....., h'- 1 only serve the local market. With these assumptions it is possible to find the frequency distribution of centres of all types and hence of all sizes.

We have amended the model for the following features. In one alternative we introduce an activity bound to a certain spot (mining or a big harbour) next to the centre of rank H. In another alternative we introduce exports of agricultural goods through a big harbour. In a third alternative we introduce some industries with heavy agricultural inputs (dairying, sugar), which appear in one type of centre only and not in bigger centres.

Finally we are now working on models which combine the features of Cases II and IV.



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