CHAPTER 9

INCREMENTAL SPATIAL PLANNING

9.1. Differences in Variability of the Elements Involved

In the economic process and more particularly in its locational aspects a number of elements play a role, such as factors of production and products of various types. Some of these can change their location easily and quickly, others only with considerable difficulty or slowly. It is not only a question of mobility as discussed in the previous chapters. One may also think of indirect mobility. A building is immobile; but on being worn out it can be replaced by a building on another spot and this will be an example of indirect mobility. We may use the word variability if we want to speak of both types of mobility together. Obviously there are considerable differences in the degree of variability among the elements occurring in our economic process. This gives rise to a number of problems where only part of the elements can be changed and hence only partial optima can be reached. Generally in the short run most problems of location can only be solved in such a partial way. In practical decisions short-run considerations will always play an important part. This is why in this chapter a number of these partial problems will be indicated. As a rule they are simpler than the long-run problems and much more concrete work has been done in this field. The chapter is meant to be a bridge between the main subject matter of this book – long-term planning of location problems – and the partial problems tackled for practical purposes.

In this section we will remind the reader of the differences in variability among the elements of our problems. In the next few sections we will indicate some of the most common practical problems in location planning. In the last section (Section 9.5) one of the bridges between short-term and longer-term problems of this kind will be described.

Among the factors of production, land and natural resources are the least

variable category. Land, mineral deposits and geographical positions cannot be moved. Yet small elements of variability do exist: new land may be reclaimed from the sea, mineral deposits may be exhausted or discovered and regions may be "opened up" by roads or irrigation.

The next category of factors of production, capital, is easily mobile when available in liquid form, but shows considerable immobility once it has been invested. In particular, buildings can hardly be moved. The location of buildings can be varied mainly by replacing them by a new building elsewhere but this will be done only after a considerable proportion of their economic life time has elapsed. This life time is often several decades. New investment in new buildings can also contribute to changing the location of some activity; but, as a rule, new investment is only a small proportion of the existing volume of structures. Equipment shows similar characteristics, but here the economic life time is as a rule shorter. In the past, railway equipment (rolling stock), had an actual life of 45 years, but trucks have one of at the most 7 years and most machinery has an economic life of at the most 10 years. The variability of the stock of machinery in any location is larger therefore than that of buildings.

A difference of variability exists between single plants and complete centres in the sense of Chapter 8. This is due to the difficulties in changing the infrastructure – material as well as organizational – of centres. To change the number of centres is more difficult than to expand existing centres.

The third factor of production, labour, is not highly mobile; migration figures are moderate in comparison to the total stock of population (cf. Section 10.1). But there is the other form of mobility represented by commuting, constituting considerable variability over shorter distances.

Products have very different degrees of mobility and of variability, as we discussed previously. The variability of the volume of production is larger than that of production capacity as determined by equipment, since part of that capacity may be left idle, depending on the costs.

Adaptation of the location of activities to a new pattern of data therefore, can only take place through new gross investments, migration or commuting and partial utilization of existing production capacity, that is typically through incremental variables, which, for the economy as a whole are small and can be relatively large only for single industries, products or centres. As stated above, we will remind the reader of some of these problems of

"incremental spatial planning" as they may be called, in the next few sections.

9.2. *Optimal Location of a New Plant*

One of the most common problems of locational planning of an incremental character is the one of finding the optimal location of a new plant (cf. e.g. ISARD, 1960, Chapter 7). In this problem the location of all other plants and human beings – with the exception of a few of the employees of the plant – are assumed given and the problem of finding this partial optimum is very much simpler than any of the problems dealt with in the preceding chapter. It is possible therefore to go into considerably more detail for this than for these wider problems. Price differences of supplies between alternative locations, and transportation costs, can be taken into account explicitly for all items concerned and profit figures or other criteria for optimality can be calculated in order to find the best location. The problem can be combined, if so desired, with the problem of finding the optimal size of the plant. Account can also be taken of possible special rates which may be negotiated for railway transportation if use can be made of idle capacity of rolling stock in a particular direction.

A somewhat more sophisticated approach is conceivable in which future changes in the variables relevant to the problem are taken into account (cf. MANNE, 1967). Thus, demand may rise; prices of some supplies, including labour, may rise and changes in the volume of production of other industries, which possibly change transportation demand and hence rates may be taken into consideration.

Also, the problem of finding the optimum location of all new plants of a certain industry needed over some future period may be tackled. Thus, the question may be asked where to erect a number of cement plants which will be needed in the future in a developing country. The question of the optimum size of each plant will then be almost built into the problem.

9.3. *Growth of Existing Centres*

The next type of incremental spatial planning which we will describe briefly consists of the planning of the growth of centres which already exist,

especially the bigger cities. This has become an established discipline and a large volume of applied research has been done and, often, published[1]). To begin with, population forecasts are made, based on a demographic analysis for the natural growth of population and on research about the factors determining migration, for the net immigration into the centre considered (Cf. also Section 10.1). Next a choice is made with regard to the most probable development of the primary industries. Sometimes this development will be interrelated with immigration and then it will have to be studied simultaneously. For single centres in a free-market economy there is necessarily an important chance element in the development of primary industries. What happens to a middle-sized city may depend on the decisions of a single person. It will also depend on the attractiveness of the municipal policies with regard to new industries; and, of course, it depends on the city's geographical position. If the primary industries which already exist in the city have a high rate of growth, this may turn out to be the decisive element.

The remainder of the planning process is susceptible to a more accurate treatment. The growth of the secondary or servicing activities can be estimated on the basis of demand studies for the centre itself. Here some of the elements of Chapter 8 may be useful.

For practical purposes a subdivision of the city into quarters will be necessary and similar problems arise for these quarters as for the city as a whole with regard to the desirable growth of servicing activities such as schools, retail trade and so on. But there is a difference to the extent that some quarters may "specialize" in primary industries, others in some of the main servicing activities (shopping centre) and a number will be residential, having dwellings, primary schools and shops for daily needs.

Finally the question of transportation flows enters the picture, either separately or simultaneously with the subdivision into quarters. Part of the intercity transportation will have to be included in this question.

[1]) Also the Netherlands Economic Institute has been active for some twenty years in this field, not only for a number of Dutch cities (of which Amersfoort was the first, followed by a series of others) but also for foreign cities.

9.4. The Development of a New Region

As already observed, sometimes, empty regions may be opened up or areas may be reclaimed from the sea. Thus, in Venezuela, the region of Guyana was almost empty some ten or fifteen years ago. The new polders attached to the territory of the Netherlands are another example. The discovery of mineral deposits of any kind or soil analyses may give rise to the idea that an empty region may offer good prospects for development. Deposits of bauxite in Surinam are an example of such discoveries.

The number of variables in the problem is already larger now. Not only the new production first envisaged, but also a number of dependent activities must be considered, including, often, the construction and operation of roads, railways or irrigation works. If the planned activities create a considerable increase in income the repercussion of it on the older parts of the country, for instance on the demand for food from these parts, may have to be added to the list of variables. In principle, a new equilibrium for the production, consumption and trade of the new region as well as of the rest of the country and the rest of the world must be estimated in order to appraise the project. A theoretical treatment was given by one of the authors in 1957 (cf. TINBERGEN, 1957) and a more concrete illustration of the method was given by KOYCK and BOS (1961). Numerous studies of practical examples for individual regions have been made, from the works by the Tennessee Valley Authority onwards, especially on river valley projects, such as the Indus, the Mekong and the Euphratis valleys, to quote only a few. Since in practical planning work models of a mathematical type have often only played a subordinate role, an integrated check on consistency is often absent or taken more intuitively. The authors of the present study feel that some of the techniques developed in this publication may be usefully applied in studies of this type, if only to serve as a framework for the more refined studies which have already been incorporated in most appraisals of the type indicated[2]).

[2]) For a broad survey of techniques in use and proposed some five years ago cf. ISARD *et al.*, 1961. More recently, cf. KLAASSEN (1967).

9.5. Small Additions to an Existing System of Centres

Again a somewhat different type of incremental planning can be seen in partial planning studies of the type covered by this title. One example is the creation of one satellite city next to a city which already exists whose growth it is desired to limit, for instance, because of recreational facilities or because there is only a limited area available surrounded by mountains or the sea. Another example is the abandonment of a number of smaller centres which are considered to be no longer viable. This abandonment may be a spontaneous process as it was in several French villages in the Jura, or it may be a more deliberately guided process. A third example may be the creation of a new city because of the discovery of new natural resources (oil), the setting up of a new industry (electronics) or changes in optimal location (the steel industry in Europe, moving to the coast).

Again various methods have been applied, from purely intuitive to more systematic ones. The intuitive ones use quite a few of the coefficients also used in a more systematic setup, such as empirical figures about the numbers of shops, schools and other facilities present in centres of comparable size. The choice of the primary industries in a satellite city will be determined by incidental research or somewhat arbitrary decisions. One example is the choice of a quickly developing industry which already happens to be present in the old city. Another is the deliberate movement of a part of the central administration which does not need too many daily contacts with the remainder of the government complex. There are also a few well-known cases of the deliberate construction of a completely new capital (Brasilia, Islamabad) to which the whole administration moves. The primary industries are known beforehand if the new centre is based upon new discoveries of minerals, upon the creation of a new industry, or on the changes in optimal location.

A somewhat more systematic approach may be based on one of the versions of the hierarchy model of Chapter 8 or on future improved versions of it; in fact this model has been launched with the hope that it may be useful for the solution of such practical problems as now discussed.

Such a partial change in the system of centres will not as a rule be optimal, if a higher degree of variability of the rest of the country or even the rest of the world is taken into account. For changes which may be considered small in comparison to the economy as a whole this may not be serious; moreover,

it can only be cured in the longer run, after more variables have become adaptable. It is part of the objective of the models presented to test this optimality in the longer run. The models should be more reliable and realistic however, before any such test can be made more convincing. At the present stage of research only suggestions can be formulated on the basis of the models, possibly leading to more precise research.

Some of the problems that come up if we want to consider bigger changes and longer-run developments will be taken up in the next section of this chapter, Section 9.6.

9.6. Bigger Changes in a System of Centres

We are now going to discuss some general aspects of the development over time of any geographical dispersion of economic activities. Assuming for a while that the models presented in Chapters 3-8 together contain the main features of a theory of optimal location, then the theoretical aspects of development over time of the locational optimum and its implications for the relevant decisions can be stated in the following way. Most of the data of the models will change over time. Incomes and income targets will increase; the structure of demand will shift and the technological coefficients such as costs of production and transportation and the optimal size of enterprises will change. Accordingly, the optimum pattern of regional distribution of production and of the size distribution of centres will also change. Industries will have to shift or to disappear; others will come into existence. The numbers and the optimal location of centres of different size will have to be changed. These changes can only be slow, however, because of the limited variability of a number of elements, especially of the buildings (productive as well as dwellings). Some decisions taken on to-day's evidence will prevent a quicker adaptation which will become desirable later. The variability of a quickly developing economy is higher than that of a slowly developing one, since the proportion of gross investment in national product is higher and this proportion constitutes the easily adaptable part.

A few examples of the deviations from the optimum which may occur will clarify the nature of the problem. An increase in total income will cause an increase in demand for a given commodity. Instead of two production units, three production units may become the best number. As a consequence

the best location also changes; in general, as even a distribution as possible of the units over the country's territory is desirable. At the moment that three units become optimal, the location of the two old units becomes suboptimal.

Can we avoid this sort of thing from happening? Never completely. The main method of minimizing this type of suboptimality probably consists of planning over long periods. Possibly the first two units should not have been located so as to minimize transportation costs at the moment of their creation, but so as to minimize transportation costs over a prolonged period, during part of which the third plant is also in existence.

But while the growth of demand can be predicted to some extent, this will be less so for the changes in the supply of fuel which have caused the change in the optimal location of the steel industry. Long-term planning might not have been of much help in this case in preventing steel plants from being established in the neighbourhood of coal mines. These are the risks of any type of planning; and they do not justify the opposite conclusion, namely that short-term planning is better.

The main characteristic of a long-term plan will be that all variables considered are dated and that the optimality criterion is applied over a period of one or more decades. This requires the formulation of assumptions with regard to the changes of all the target variables and all the data over the planning period. If the function to be minimized is taken to be production plus transportation costs then these will now have to be estimated over the planning period. An important role is played by the discount rate to be applied to future values of all variables entering into the objective function. Some of the instruments of development policy, such as the location of a number of new enterprises or the creation of new centres can be introduced into such a dynamic model at various time points, taking into account the limitations in variability of each element. Needless to say, however, such models will be considerably more difficult than the models dealt with in this book. The number of degrees of freedom being considerably larger because of the number of time periods implied.

9.7. Instruments for Spatial Planning

Finally we want to emphasize the importance of using policy instruments properly to bring about the derived spatial distribution of economic activi-

ties. Firstly, if the government(s) want to change the geographical distribution of total income, or want to vary the current development of that distribution, it is clear that certain policy instruments must be actively used, since "spontaneous" forces apparently do not lead to the desired result. Secondly, however, if policies affecting geographical income distribution are not carried out, but some measure of total cost for the whole area considered is minimized, it is by no means certain that an optimum solution with regard to the spatial distribution of economic activity is attained by so-called spontaneous forces, and the active use of policy instruments by the authorities may be called for. This may be because decision makers who influence this spatial distribution by their decisions have, by their limited responsibility, interests contradictory to the interests of the whole area, or do not have enough information about the relevant factors in the given situation or about their development. For example artificial trade barriers may prevent an optimal division of labour between countries, or the location of enterprises on the basis of short term profitability calculations may cause unnecessary congestions in the area in the longer run. Thirdly, authorities may have to handle certain instruments with certain aims in mind, and these instruments, however, also influence the spatial distribution of economic activity. Then they also need to consider the implications of their decisions for this spatial distribution. An example is in the Netherlands where the decision the authorities had to take was where to locate centres in an area regained from the sea, in order to provide the people going to work there with the first daily necessities. Also, the decision of national governments on where to locate new government laboratories or military establishments might have considerable impact on the income of the region concerned.

Little systematic research seems to have been done on the effectiveness of possible instruments for the spatial distribution of economic activities, and we cannot do more here than mention some further examples and draw attention to the point. A distinction can be made between direct and indirect instruments. Direct instruments are e.g. economic activities undertaken by the authorities themselves, the location of which they can exert influences. Less direct are subsidies or infra-structural projects like roads, undertaken by governments, which are hoped to attract other economic activities. Such attraction may only happen with a considerable time lag. The promise of subsidies or favourable financial conditions for projects located in certain

areas or for people moving into or out of certain areas may also need careful screening with regard to their effectiveness. Simply providing adequate information about opportunities or future developments may be useful. Obviously, unemployment payments may have a favourable influence on the spatial distribution of income if unemployment is unevenly distributed. Finally, the spatial distribution of educational facilities, may have lasting effects.