

E.D.H.P. No. 84.
F.I. Nixon,
22.10.65.

(831)

Makerebe Institute of Social Research

LOCATION THEORY APPLIED TO INDUSTRIAL
DEVELOPMENT IN EAST AFRICA

INSTITUTE
OF
DEVELOPMENT
STUDIES
LIBRARY

It should be noted that this paper does not attempt to present a fully comprehensive survey of location theory. The theories discussed below have been chosen on the basis of two criteria:

- (a) their importance to general locational analysis, and
- (b) their relevance in the context of less-developed countries.

In general, the Classical economists did not consider location as a problem needing special attention, while those lesser writers who did recognise a problem did not have the ability to see its implications.¹

Marshall, in his 'Principles of Economics' emphasised the influence of time in economic analysis rather than space (although he did recognise the existence of a problem and attempt to relate it to other elements in economic analysis) and the majority of Anglo-Saxon economists have followed this path.²

But the German school of thought, in contrast to Anglo-Saxon economics, emphasised the spatial structure of economic processes in the study of economic development, and attempts were made at a fusion of space and general equilibrium analysis.

Towards the end of the 19th century, there emerged specific treatments of location taking two forms, the first realistic and descriptive and the second, deductive and analytical.

Examples of the first approach are found in the work of A.E. Ross (Q.J.E., 1896), cost considerations forming the basis of his analysis, although he created neither a theory of location nor an adequate descriptive study, and F.S. Hall (Twelfth Census of the United States, 1900), who believed that the exact point of location is more or less a matter of chance decision, with the dominance of historical accident being emphasised. The work of Johann von Thunen (1826), is generally considered to be the starting point for the second line of approach.

Walter Isard has been most active in recent years in attempting to incorporate spatial and regional economics into the general body of economic theory through the development of a more adequate theory of location and space-economy. He emphasises the fact that economic processes exist in space, as well as over time, and he conceives of the general theory of location and space-economy as "...embracing the total spatial array of economic activities, with attention paid to the geographic distribution of inputs and outputs and the geographic variations in prices and costs."³

In the work of Johann von Thunen (1826), we find "... the seeds for developing the basic methodology in analysis of specific as well as general location problems .."⁴. The work was an attempt to explain certain problems of agricultural location in the light

1. S.R. Dennison 'Location of Industry and the Depressed Areas', 1939, p.3.
2. W. Isard 'The General Theory of Location and Space Economy', Q. J. E., 1949, p.476.
3. *ibid.*, p.505
4. Isard, *op. cit.* p.479.

of the theory of rent, and the few attempts made to incorporate a theory of location into the general framework of economics, largely German in origin, were probably due to the influence of von Thunen.

In a uniform fertile plain of considerable extent, undifferentiated in physical features and isolated from the rest of the world, containing a single population cluster at some distance from the periphery, the cultivation of different crops and the production of other farm commodities will tend to take place in concentric zones around the cluster as centre. To each zone, there corresponds a particular agricultural product or combination of products, and the factors determining in which zone each product will be produced include the demand for the various products, the transport effort involved in moving a unit of the product to the market, the yield and associated cost at which a unit of area can yield each product or combination of products and resulting prices or barter ratios.

But with the relaxation of the uniformity assumptions and the introduction of realities, for example differences in soil, climate and topography, distortions appear in the concentric pattern and any physical resemblance of zonal arrangement may be absent.

The theory centres on the cost of transport and the rent of land, in an attempt to explain why a given agricultural product is grown on a given plot of land. But by emphasising the importance of the cost of transport, his work is significant because of its influence on later work.

Greenhut¹ contends that although it is an explanation of agricultural locations, it is possible to convert it into an analysis of the site selections of manufacturing plants; rather than inquire into the type of product cultivated at a given site, the inquiry can be directed towards ascertaining the location of a given manufacturing process.

There are two possibilities with regard to the treatment of labour - it could either be considered equal in skill and cost everywhere, or alternately, a disparity in the wage and hence labour cost could be assumed as given. Under the first condition, labour per se is irrelevant to the location decision, and under the second condition, any differential will appear as a land rent.

A major criticism to be levelled at this work is that the conception of competitive equilibrium in land use is partly refutable because of its static nature.²

The next major contributor to location theory was Alfred Weber (1909)³. The purpose of Weber's book was (a) to develop the pure laws of industrial location, and (b) to show what particular form these laws receive in the modern economic order.

His general location theory is essentially an evolutionary approach, "... a theory of the transformation of locational structures".⁴

Weber assumes an empty country with people entering it to build an isolated economic system. 'Layers' or strata of locational distribution now develop.

An agricultural stratum forms to produce the necessary means of subsistence - this is the geographical foundation for all the

-
1. M.L. Greenhut 'Plant Location in Theory and Practice', 1956 p.6.
 2. W. Isard 'Location and Space Economy', 1956, p.3.
 3. English translation by C.J. Friedrich, 'Alfred Weber's Theory of the Location of Industries', 1929.
 4. Isard, op. cit., p.28.

other strata. It first forms the foundation for that part of industrial production (the primary industrial stratum) which works directly for it. The primary industrial stratum serves as the loci of consumption for the third stratum - the secondary industrial stratum. This consists of numerous substrata, each of which is oriented to, and smaller than, the preceding one. These three strata form the core of the economic system.

On top of these groups, we have the "central organising stratum" consisting of those engaged in transportation, officials and businessmen, members of the liberal professions and those living off accumulated wealth. This leads to the "central dependent stratum", living off, and tied to, the central organising stratum.

The locational structures of the five strata are interrelated, with forces playing back and forth among them.

But this technique is inadequate and does not lead to further advances towards a general locational theory. Isard maintains that "...it fails to get at the rule or rules governing structure and provides no common denominator in terms of which all the forces stemming from the various interrelations can be expressed and evaluated and by means of which a net effect could perhaps be deduced."¹

An examination of Weber's locational models may be of greater relevance to the industrialisation study.

The theory is based on three general factors of location:

1. transportation cost
2. labour cost
3. agglomerating forces.

In Weber's pure theory, the location of industry is first determined by costs of transport. Transportation costs are thus the basic factor, but when differences in labour costs are introduced, this alters the basic network. Agglomerating factors are a second force making for a distortion of the transportational network.

The assumptions for his analysis are (a) the geographical basis of materials is given, (b) the geographical nature of the sphere of consumption is given, and (c) there is a given basic distribution of labour, that is, labour is immobile with an unlimited supply at a given wage rates.

Transport costs are fundamentally determined by weight transported and distance covered, all subsidiary factors being incorporated into these two.

Materials may either be "ubiquities" or "localised", and they enter into production either with or without residue - this gives the distinction between "pure" and "gross" material. Gross materials, that is, weight-losing materials, are of two types - fuel which leaves its total weight as a residue outside the product, and secondly, those which leave part of their weight in the product.

Weber further assumes that each product is produced in one stage of production and that there are two raw material deposits and one place of consumption - this gives a locational figure in the shape of a triangle. The entire weight of the raw materials must be moved to the chosen location and the weight of the product must be moved from this location to the place of consumption. The point of location is thus connected to the corners of the locational figure by lines along which the relevant weights move, the weights representing the force which the corners of the locational figure exert on the locations. It follows that the location will be near to, or far from, the individual corners, according to the relative weight of their locational components.

1. Isard, op.cit., p.30.

Thus we obtain a least-cost location in terms of transport costs.

Extending the analysis to take into account the characteristics of the raw materials used, orientation will depend on the material index (the ratio of the weight of used localised materials to the weight of the final product) and the locational weight (the weight of the product plus the weight of localised materials, that is, the total weight to be moved). In any given industrial process, it is the proportion of the weight of the ubiquities used to the weight losses of localised materials which gives the basic answer to the question whether the particular industry settles at the place of consumption or moves to the material deposits.

Labour costs only become a factor in location when they vary from place to place as Weber believed they did. Changes in location from the point of minimum transport costs occur when savings in labour costs are greater than the additional transportation charges.

The decentralising tendencies of the above two factors are counteracted or intensified by Weber's third locational consideration - the agglomerating or degglomerating force. An agglomerative factor is an "advantage" or cheapening of production, which results from the fact that industry, to a certain extent, is carried on in one place, while a degglomerative factor is a cheapening of production which results from the decentralisation of industry. Examples of the former are savings due to the proximity of auxiliary industries, better marketing outlets and economies of size, while the latter consists of higher rents, which offset the tendency to industrial concentration.

It is generally when labour is the vital part of value added that a real force of agglomeration exists. Industry is thus divided into two main categories - some industries are oriented to transportation and some are oriented to labour. A third, less prominent, type of orientation comprises the industries which locate because of agglomerating advantages - these are the governing factors in location when transportation and labour differentials at alternative sites are relatively slight.

Weber excluded institutional factors, for example, interest charges, taxes, management and climate, because he was only interested in the "pure" theory of location. This is a gap that must be closed for a more complete understanding of plant locations in a capitalistic economy.

There are three major criticisms that can be levelled at Weber's analysis¹.

Firstly, the assumptions that Weber makes are such that the theory does not give an adequate explanation of locational factors. Secondly, the analysis is formed in terms of technical co-efficients, abstracting from costs and prices; and thirdly, the assumption of fixed labour locations is unacceptable. Location is a cause of the distribution of population as well as an effect.

The work of three other writers who attempted to formulate general theories of location is now briefly considered.

Andreas Prodohl² attempted to deduce a general location theory as a special case of the existing general economic theory, that is, the theory of interdependent prices. Abandoning Weberian methods for an analysis based on substitution, he deduced a general location theory from the application of the principle of substitution to the employment of the several groups of productive factors.

1. see Dennison, op.cit. p.10-20.

2. 'The Theory of Location in its Relation to General Economics', J.P.E., 1928.

This analysis gives the minimum-cost site as far as the two all-inclusive groups of expenditures are concerned - capital and labour outlays and land use outlays. The problem of production becomes the problem of choosing the right combination of the various types of capital, labour, land and distance inputs (with transport rates as the price of the latter inputs).

Oskar Engländer (1962) maintained that the theory of location is the general theory of "local conditionality" within an Economy. When an entrepreneur chooses a site, he must consider the various prices in different localities of inputs that he might use, and also the various prices he can obtain in different locations for his product or service. When he finally locates at a site, he influences the price of both various inputs and outputs, and thus the pattern of local price differences and the location of economic activities are simultaneously determined by the general theory of "local conditionality".

Tord Palander (1935), in the first major work on location theory to originate outside of Germany, attempted to evolve a solvable system of equations for a space-economy. He emphasized the necessity of depicting the economic development process, analysing the economic starting point, the adaptations of enterprise during a time period, the movement of factors during the same period and changes in technique and institutions. He was in the Weberian tradition as far as Weber's attempts at formulating a general theory of location are concerned.

It is necessary to examine the work of one other author who emphasises the cost approach to industrial location. Although the work of Edgar M. Hoover¹ suggests demand determinants as well as cost factors, the second book in particular (1948) is written largely within the framework of costs, that is, it is a least-cost analysis.

The cost factors of location are divided into two groups - the transportation factors and the production factors. The costs of procuring the raw materials and the costs of distributing the final product are considered as transport costs while the agglomerative forces and institutional cost factors are treated as partial determinants of production.

Greater emphasis is placed on the characteristics of freight rates than is the case with Weber. The cost of transfer does not increase proportionately with distance, and heavy terminal costs are also recognised.

His analysis of agglomerating and degglomerating forces is also more penetrating than that of Weber's and the inter-industry advantage of agglomeration is stressed. The inclusion of institutional factors places his theory within a capitalistic framework, again a major departure from Weber's approach. In the later book, the locational choice is still a problem of substituting among costs, the ultimate objective being the minimisation of these expenses.

The major source of weakness in Hoover's approach is "... the failure to probe deeply into locational interdependence"². He not only emphasises costs but also abstracts from demand, and although an explanation is given of industrial locations in a capitalistic economy, the analysis is mainly confined within a competitive framework.

The theory of industrial location has developed along two lines. Those theories described above of mainly German origin have largely abstracted from demand, that is they are least-cost approaches. Unlimited demand for the output

-
1. 'Location Theory and the Shoe and Leather Industries', 1937.
'The Location of Economic Activity', 1948.
 2. Greenhut, op.cit., p.21.

of a firm at the prevailing market price is assumed, and all sellers have access to the buying centre. The least cost analysis therefore, fits firmly into the framework of perfect competition.

On the other hand, with the market area analysis, buyers are conceived as scattered over an area, with each seller becoming a monopolist with respect to consumers who are located near to the plant. As Losch points out, if buyers are scattered over an area, sellers, by locating accordingly, will control different groups of buyers. The least-cost location becomes not merely the site at which the firm sells greater quantities at the given market price and achieves greater gains per unit sale; it also enables the firm to undersell its rivals at several consuming points and thus places a wider market area under its control.

The Weberian least-cost analysis is thus an oversimplification of the problem because any scattering of buyers over a wide area makes it unrealistic to presume a unique location advantageously situated with respect to all parts of the market area. On this basis a location may be the most profitable despite the fact that it is high in cost relative to other locations, and in the light of this additional consideration, it becomes necessary to investigate the monopolistic effects of plant location.

In earlier theory, the sales price and the freight rate on the final product are the immediate determinants of a firm's market territory, any increase in either of these two narrowing the area. With varying assumptions, market areas of different shapes and sizes may be formed, for example, cost differentials, price policies and freight rate systems all influence the shape and size of the market area.

August Losch¹ presents a simplified static model of the space-economy operating under conditions of monopolistic competition. One of Losch's major contributions to location theory is his concept of the market area. He postulates a broad, homogenous plain with uniform transport features in all directions and with an even scatter of industrial raw materials in sufficient quantity for production; a uniform distribution of agricultural population with a uniform set of tastes and preferences; each homestead is self-sufficient to begin with, technical knowledge is disseminated throughout the plain and production opportunities are available to all.

If in this situation an individual finds it profitable to produce a commodity in greater amounts than is demanded by his homestead, his market area would assume a circular form. But if one farmer finds it profitable to produce more than he needs, others will also, and the force of competition, by eliminating excess profits, will not only contract the market area of the original producer but will also transform the circular shape of the market area into a hexagon. Losch maintains that this is the ideal economic form of market area, (a) because a net of hexagonal market forms will completely cover any area under consideration, and (b) of all the regular polygons which will cover a given area completely, the hexagon deviates least from the circular form, and thus minimises the transport expenditures in supplying a given demand.

The ultimate balance in spatial competition is reached when the hexagon is so reduced in size that profits are completely eliminated.

1. English translation - 'The Economics of Location', 1954.

For each commodity, the plain is dissected into a net of hexagons, that is, market areas. Depending on the nature of the product, the respective sizes vary from very small hexagons to very large ones. The nets are grouped according to the size of their respective market units, and these are then grouped around a common, central production point. This gives him one group of sectors where production units are most frequent and a second group where production units are scarce. The coincidence of many of these centres concentrates population and minimizes freight burdens, thus leading to the agglomeration of industry.

Although Losch did not comprehend to space-economy as a whole, but as consisting of several major sectors, his was the first attempt to encompass general spatial relations in a set of equations, although it would become exceedingly complex if the uniformity assumptions were relaxed.¹

But from Losch, more than any other writer, the theory is advanced that the location of a manufacturing establishment depends upon the firm's cost of production at alternative locations and the market area which it is able to control from each site, that is, the maximisation of profits becomes the criterion for plant location.

The market area approach is based upon assumed locations, with the size and the shape of the firm's market area being derived from this. The locational-interdependence approach on the other hand, seeks to find the reasons for a particular location; it assumes freely movable locations and stresses the attraction or repulsion of a location to a firm by the presence of a rival at a specific location. This school of thought is not concerned to any significant extent with the problem of the size and shape of the market area of the firm, but it is an attempt to explain the location of firms as they endeavor to control the largest market area, abstracting from cost.

The Fetter² and Hotelling³ framework postulated that delivered price varies with location, assuming that buyers are scattered over a given area. Thus each firm (having identical costs and quoting the same net-mill price) is able to sell to its nearest buyers at delivered prices which are lower than those of their rivals. This industrial pattern implies the exclusion of competitors from the market area surrounding a seller's plant, and it makes the location of each seller dependent upon the number of consumers he can monopolise at the different locations.

"The attempt to control the largest number of buyers (market area) at prices yielding greatest returns is the driving force behind orientations to market areas. Under this framework, the size of the market area which belongs to a firm is determined by the locational interdependence of the firms."⁴

The major shortcoming of this analysis is that it abstracts from costs in a similar manner to the abstraction from demand of market-area and locational interdependence approaches differ in analytical patterns, but they are similar in emphasising the monopolistic aspects of space.

The inclusion of cost and demand factors in one model points to the need for a broader statement of the determinants of plant location than one which simply concludes that firms seek the location of least-cost or one which states that firms seek the location with the largest possible market area. The

1. Isard, op.cit., p.48

2. F.A. Fetter, 'The Economic Law of Market Areas' Q.J.E., 1924.

3. H. Hotelling, 'Stability in Competition', E.J., 1929.

4. Greenhut, op.cit., p.258.

5. Greenhut, op.cit., p.267.

concept of the maximum profit location (5) fill this gap, and is defined as that site from which a given number of buyers (whose purchases are required for the greatest possible profits) can be served at the lowest total cost. Average production costs may be higher at the chosen site than at alternative ones, but the monopolistic control gained over a larger number of buyers, makes it the maximum profit location at the optimum output.

A change in demand for a given product implies not only that profits or losses result, but also that there is a direct change in numbers and a direct change in sites. Demand becomes an active determinant of location in every sense.

Variations in cost factors will likewise affect the spatial pattern, not only from the Weberian point of view of cost determination of location, but also from the interdependence standpoint of demand determinants.

Purely personal factors can also be included in this approach, and they also, to some extent, affect the locational pattern.

It has been seen from the above summary of location theory that the optimum location is the one maximising profits. But when we come to relate location theory to the less-developed areas, two questions must be answered before we can proceed any further:

- (a) has modern location theory any meaning in the context of an under-developed country?
- (b) assuming that the theory is significant to some extent in this context, is it of any use, especially in determining the location of future industry?

In the East African context, it would appear that modern location theory, that is, theory derived from the concepts of monopolistic competition, is not particularly useful in explaining the existing locational pattern. Given the system of industrial licensing at present in operation, and the small size of the market which severely limits the number of viable plants, it seems reasonable to assume that many firms occupy a monopolistic position within the East African market. Thus the "first generation" of industry, given this monopolistic position, would probably locate with regard to cost or personal considerations only. We assume that either they chose the least-cost location, or where a higher cost location is chosen, personal considerations outweigh any cost disadvantages. Thus the relatively wide choice of locations was a direct result of the monopolistic position enjoyed by these firms in the East African market.

With the future growth of the market, this position is likely to change. New firms entering those industries already established are likely to locate at those sites where they can successfully exclude the products of the older, established plants. For example, if the entire market had previously been supplied by a firm located in or near Nairobi, a new firm, by locating at Dar es Salaam may be able to establish a monopoly position in that market because of lower transport costs. In theory therefore, the possibilities of monopolistic control should loom large in the mind of a "second generation" entrepreneur when considering the location of a new plant.

The question as to whether or not an entrepreneur is likely to consider this factor in making his locational choice cannot be answered at this stage of the study. But the very fact of it being a significant theoretical consideration illustrates the relevance of modern location theory to the locational problems of future industrialisation in a developing country.

Given the relevance of the theory, we must now attempt to answer our second question - is the theory useful when we come to consider future patterns of industrial activity in East Africa?

A very large part of future industrial development will be the result of State initiative, and we would expect the State, when locating industry, to take into account the social aspects of industrial location and distribution, rather than confine itself merely to considerations of profit. Although profit maximisation is a reasonable criterion for the private entrepreneur to use when selecting a site, it is not comprehensive enough when the entrepreneur is the State and the location of industry must be considered from the viewpoint of the optimum development of the whole economy. It is generally recognised that the human and social aspects of location are of equal, if not greater, importance, in many cases, than the economic considerations alone.

A major problem in planning the location of new industries is the attraction exerted by existing concentrations of industrial activity. Short term benefits are usually to be gained by locating in close proximity to the existing concentrations of industry, but it is often necessary to resist these influences and determine locations on the basis of longer term plans. For example, this was (and is) the pattern of development taken in the U.S.S.R.

Of possibly greater use in planning future locations in a developing country is the criterion formulated by the United Nations¹.

"... a proper location is one which entails the lowest possible direct investments per production capacity unit and, in particular, minimum additional investments for infrastructure such as electric and water mains, housing, etc., and which enables the new industry, once established, to make the largest possible contribution to national capital accumulation."

The first condition would appear to fit in well with potential industrial development in East Africa. Michael Safier² has isolated four areas which are likely to dominate the industrial scene for at least the period of the proposed study:

1. the Nairobi-Thika axis.
2. the Jinja-Kampala area.
3. Mombasa and hinterland.
4. Dar es Salaam and hinterland.

(Other centres of potential development being Tororo, Mbale, Kisumu, Mwanza and the Arushi-Moshi area).

The location of new industry in these centres will probably entail a lower level of infrastructure investment than elsewhere which is obviously beneficial in an economy where capital is scarce.

The second condition seems to imply that given the limited number of centres where the lowest investment in infrastructure is required, the least cost, most efficient

1. Science and Technology for Development: Report on the U.N. Conference on the Application of Science and Technology for the benefit of the Less Developed Areas. U.N. New York, 1963. Vol.7. Science and Planning, p.11.
2. 'Industrial Location and Economic Integration in East Africa' paper delivered before the University of East Africa 'Conference on Public Policy', Nairobi, Nov., 1963.

location must be chosen from among these centres, to enable the largest possible proportion of profits to be reinvested, either directly in the firm, or in other spheres of Government activity. It is quite possible that this criterion will be modified in the light of social considerations.

The theoretical criterion attributed by economists to private enterprise in the determination of location is the maximisation of profits. Government locational decisions are expected to lay greater stress on the social, as opposed to the economic, benefits of a particular location. It is quite possible that we shall see a narrowing in the gap between these two approaches, with Government, either directly or indirectly, exerting pressure on private industry to locate in a certain area or at a certain site. "The Kampala Agreement" would appear to be a step in this direction, and with the mixed economies planned for the future, one would expect such compromises between Government and private industry to appear at the national level, regardless of interterritorial developments.

This work is licensed under a
Creative Commons
Attribution – NonCommercial - NoDerivs 3.0 Licence.

To view a copy of the licence please see:
<http://creativecommons.org/licenses/by-nc-nd/3.0/>