

REGIONAL ECONOMIC INTERACTION AND FLOWS OF INFORMATION

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In most developed countries the emphasis of economic growth has shifted from problems pertaining to physical production to problems connected with qualified industry interacting with the service sector. Rapid adjustments to short-run fluctuations in demand as well as to long-run structural changes in the technological, economic, and social environment have become matters of the utmost importance. This implies an increased interdependence between different activities which directly and indirectly interchange resources to form new combinations of input and output. This exchange of resources between activities involves not only ordinary transactions on the market but also the utilization of external economies generated by environmental activities.

The above outlined processes are most heavily pronounced in the largest agglomerations, the expansion of which can be regarded to a growing extent as a self-generating, endogenous process. Their growth is counterbalanced by cost considerations but also by market imperfections like restrictions of housing and traffic along with other diseconomies. Diseconomies due to capacity restrictions are in principle short-run obstacles only, while the generation of smoke and noise as well as the serious imperfections in the land market represent impediments in the long run.

It is the aim of this paper to discuss the role of external economies in the urban growth process. After a brief review of general theoretical and methodological problems, the presentation will concentrate on the role of communication and flows of information between economic activities. Methods and results of completed empirical studies will be reported, as well as methods of planned studies.

THE GENERAL ROLE OF EXTERNALITIES

External economies can be defined as the effects of resources which, from the point of view of the individual firm, appear uncontrollable by means of ordinary economic sanctions, i.e. buying and selling. Technological, legal or

profit considerations can prevent the firm from isolating these often intangible resources from other marketable ones. Therefore, the former resources appear as "side effects" of economic activity.

A pool of economic activity in a certain area can therefore provide its members with technology, trained labor-force, and information not elsewhere accessible. The possible cost savings for a member of such pool are evident. The pool also facilitates a rapid transfer of material, labor, and information of critical importance for the adaptation to a changing technological, economic, and social environment.

Two important characteristics of external economies will be considered here: they are often strictly confined to specific functions of the firm, and they are often unevenly distributed over space.

The individual firm is made up of several different functions like production, research and development, storing and selling. By means of a differentiated location of these functions, the firm can selectively take advantage of certain kinds of positive externalities or avoid negative effects or it can do both. A disproportionate increase or decrease of scale for its different functions, without a change of their location, may have the same effect. This means that the whole organisation can adapt to existing environmental opportunities by a functional change as well as by a spatial change, or a combination of the two *.

THE METHODOLOGICAL CHOICE

A thorough understanding of the interaction between different functions of the firm and functions of its environment can benefit from the use of tools provided by organization theory and systems theory **.

An approach on that level can provide concepts with a more straightforward relationship to the empirical reality than those provided by traditional micro- and macro-theory. In the long run, however, an aggregation of these concepts to the macro-level may be necessary in order to give the analysis a desired higher degree of generality.

Broad categories like mining, pulp industry etc., used in national planning contexts, in certain regional contexts have to be replaced by functional concepts. Regional differences in the rate of growth or decline depend not only upon differences among sectors but also upon functional differences within the various sectors. In most sectors of economy, research and development, marketing, gathering and processing of information etc. are examples of functions employing increasing shares of the labor force.

For the sake of simplicity, the different functions are grouped in two main categories: administrative functions and productive functions. Spatially

* Cf. Florence-Baldamus (1948), Isard-Schooler-Vietorisz (1959), Vernon (1959), Lichtenberg (1960), Meier (1962) and Artle (1963).

** See for example March and Simon (1958), Cyert and March (1963) and Danielsson (1964).

separated units of the firm are called units of administration or units of production. They are operationally defined by their different rates of interaction with the environment, measured as flows of information*.

FRAME OF REFERENCE USED IN THE EMPIRICAL INVESTIGATION

An organization consisting of units of administration and units of production is postulated (Fig. 1). The organization is connected by flows with environmental units of different kinds. The flows of resources and of information can be divided into:

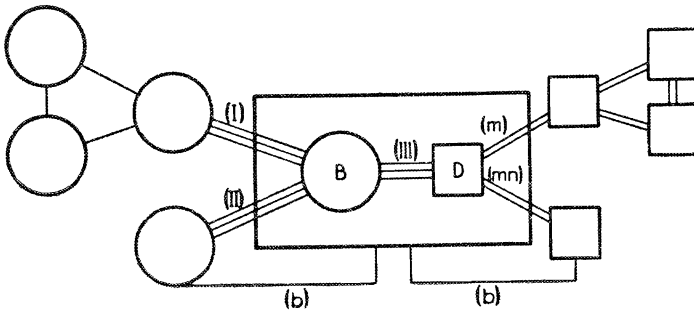


Fig. 1. B — unit of administration in the organization; D — unit of production in the organization; m — flow of resources between D and units of production outside the organization; b — flow of payments between the organization and units belonging to other organizations.

(I) External uncontrollable flows connecting units belonging to different organizations and not controllable by payments to the generator of the flows (“side effects”).

(II) External controllable flows which connect units belonging to different organizations and the direction and volume of which are controlled by payments. Each flow is associated with an actual or anticipated flow of payment in the opposite direction.

(III) Internal flows connecting units of the same organization.

LOCATION TRENDS

The location of units of production is considered to depend upon the properties of the flows of resources, as well as on their connections with units of administration.

* An alternative way of operationally defining the units would be enumerating the functions belonging to the respective unit. This procedure has been rejected because of its inability to reflect structural changes. A unit consisting of functions like data processing today would be perceived as administrative, but will soon rightly be conferred to production. An operational definition of the kind suggested above is therefore more stable.

Units of production with a pattern of production that changes only slowly over time can be considered as routinized and their flows of resources as stable.

An organization with routinized units of production is expected to have less need for face-to-face contacts than other organizations. Consequently the location of routinized units of production is considered to be independent of the different regional possibilities for face-to-face contacts or pooling of resources.

On the contrary, units facing a higher probability of transition require a rapid access to complex face-to-face contacts and pooling of resources.

However, requirements of this kind can be satisfied indirectly as well as directly. To localize units so that they are closely connected with a pool of flows of information is not the only solution. The pools of information can also be reached through the insertion of specialized administrative units from which the processed information can be transmitted by teletechnical devices. Therefore, the concentration of administrative units to a central pool can be accompanied by a more peripheral localization of the connected units of production. Such a concentration of administrative units can be reinforced by the development of the technology of telecommunications.

CONCENTRATIONAL EFFECTS

The development of TV-phones, data terminals and other instruments admits long range transmission of great quantities of information. This affects different types of flows unequally.

Internal flows, connecting units of administration and units of production in the same organization, to a relatively large extent, consist of relatively well structured communication between repetitive combinations of participants. External flows between administrative units are considered to be of a less structured character, e.g. imply a greater element of bargaining and searching for information *. Internal flows may therefore be better suited to tele-transmission than external flows.

The development of telecommunication will primarily facilitate the transmission of internal flows. Units of administration and units of production, then, can be spatially separated from each other to an increasing extent. The internal economies of scale are therefore counterbalanced by the advantages of a splitting up of the organization to utilize regionally varying opportunities.

SPLITTING UP EFFECTS

Empirical observations of a non-systematic kind indicate that many organizations try to keep the various functions together in one location or in a restricted number of locations. This could be explained by an endeavour to utilize

* Cf. Simon (1965).

internal economies of scale, including a large share of face-to-face contacts within the organization. The tendency can be obstructed by a search for external economies of scale, including good opportunities for face-to-face contacts with other organizations. The internal organizational change, in the literature often described as a transition from a hierarchical system to the polarization of administrative and productive functions, will affect this balance.

In a system of hierarchical character (Fig. 2a), the external contacts can be concentrated mainly to the top management which through adjacent strata is connected with the productive process. All strata are closely connected with each other by face-to-face contacts.

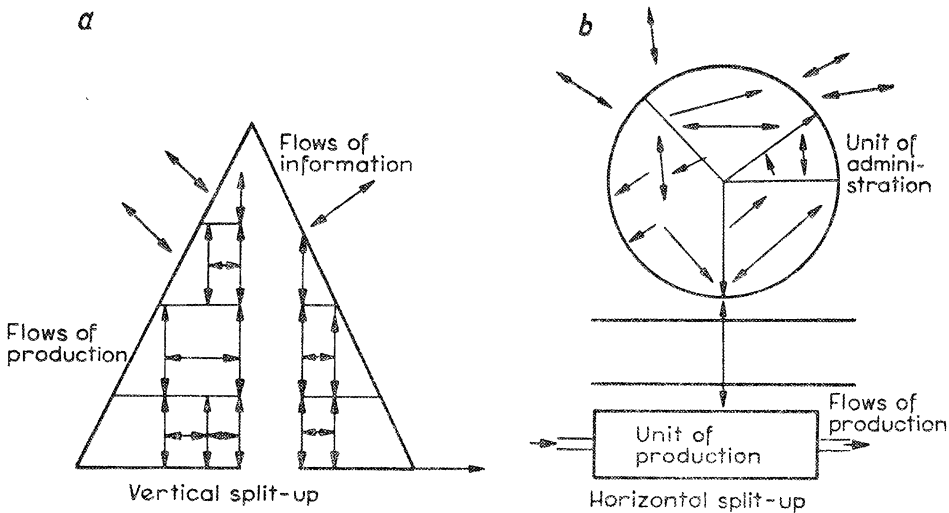


Fig. 2a, b.

In the alternative system (Fig. 2b) the external contacts are divided among a number of functional staff members with heavy internal face-to-face contacts. The results of their gathering and processing of data can be transmitted to the rest of the organization in a structured form by telecommunications.

“Horizontal” separations of organizations will therefore be facilitated and will replace the vertical separations tried earlier. This makes it possible to combine the advantages of internal economies of scale with the utilization of originally dispersed external economies of scale.

The development of teletechnology and the development of organizations are closely connected with each other.

CONCLUSION

The trends mentioned above might lead to an increased regional specialization. Agglomerations will be oriented towards administration or production and connected with telecommunications. Within the different

agglomerations especially the utilization of external factors can be facilitated.

Empirical studies are necessary for the construction of formal models describing and analyzing these new trends in regional development.

THE FIRST PILOT STUDY (MARCH 1965 AND MARCH 1966)

A pilot study, mainly directed towards the development of methods capable of handling large numbers of observations of flows of information, was initiated.

A unit of administration directing several units of production in different parts of Sweden was chosen for study. The office was going to be relocated from Stockholm to a place more than 100 km from Stockholm four months after the first period of observation *. The situation therefore offered an opportunity for a before-and-after study. Eight months after the relocation the observations were repeated.

Forms for reporting all contacts for six randomly chosen days within a period of a month, were distributed to employees having independent contact work (120 out of 200). The reliability was checked by a comparison with a central register of all visitors and 83% of all external face-to-face contacts were found to have been reported on the forms. No such check was possible for telephone contacts. The data were processed in a newly developed program for Latent Profile Analysis ** which permitted a far reaching condensation of data with low loss of information.

The design of the pilot study made it possible to study frequency and time effort for different media, on different levels of decision and for contacted units in different locations. It is not possible, of course, to generalize from the result of the pilot study, but since they are compatible with the theoretical framework some points are worth mentioning.

Both before and after the relocation of the central office most of the information between the central unit and the units of production was effectuated by telecommunications. This flow was affected only slightly by the relocation. The flow of information to other units of administration (authorities, customers, research organizations etc.) consisted to a much higher degree of face-to-face contacts and was also quite stable despite the increased travel effort necessary after the relocation. The increased demand for the time of top management in particular did not lead to increased use of telecommunications but to increased delegation of decision-making power. It looks as if the possibilities for present day telecommunications to be a substitute for face-to-face contacts are very limited.

* This movement of a central office from the capital was unique, initiated by a Parliament decision.

** The method is described briefly in an excursus below.

EXCURSUS: THE USE OF LATENT PROFILE ANALYSIS

The empirical observations are distributed according to their values along the dimensions chosen. The observations are represented by their positions in a conceptual space in which the number of dimensions is identical with the number of observed variables, the interaction between the directly observable, so called manifest, variables will be reflected in clusters of varying form and extension.

Assuming certain basic characteristics of these clusters it is possible to find the latent, i.e. not directly observable combinations of values for the variables characterizing these clusters*.

The latent combinations of values of the variables, here called latent profiles, represent the kind and degree of the existing interaction between the empirically observed manifest variables. These make possible thereby a classification of the data material into groups, within which observations are homogenized with respect to the manifest variables. Such an empirically based classification has many theoretical and practical applications, which will be discussed later.

AN EXEMPLIFICATION

A very simplified illustration with some reference under discussion will be given here. Assume, that the analysis refers to the interaction between some variables describing the flows of information which connect a studied unit A with a number of other units which here are given the general denotation Q . The decision-levels within A , the time-distance between A and Q and the time spent for a contact are assumed to be the manifest variables empirically observed.

The processing has here been assumed to result in three different latent profiles (see Fig. 3). In the graphical representation the latent profiles have been drawn and marked by (1), (2) and (3). Therefore each profile describes one of the interactions which exist between the manifest variables.

The profile here marked by (1) has the p -value of 0.5, which means that 50% of the observations can be assigned to flows connecting low decision-levels between A and Q with each other. These flows are also characterized by contacts of long duration and long time-distances between A and Q .

Analogously, the profiles (2) and (3) show that flows which refer to high decision-levels within A are characterized either by long time-distances to Q , contacts of long duration and high decision-levels within Q or by short time-distances from Q and lower values of contact duration and decision-level within Q . These two types of flows sum up to 35 and 15% respectively of the total number of contacts.

* These basic assumptions include the requirement that the observations within a cluster, constituting a profile, will be locally independent. Hereby is meant that divergence from the profile values for all variables should be mutually independent.

Hence the processing gives an opportunity to assign flows of information to homogenous groups, the composition and frequency of which are computed. As already mentioned the number of manifest variables may be extended* and these variables may refer to directly observable conditions as well as to material gathered by interviews, including assessments of information value.

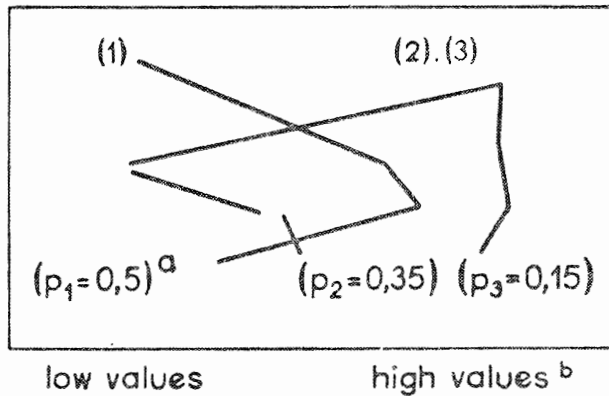


Fig. 3. Manifest variables: (1) Decision-level within A, (2) Time-distance A-Q, (3) Duration of contact, (4) Decision-level within Q. ^a The P-value states the proportion of observations assigned to a given profile. ^b The values of the variables have been given on an ordinal scale only. Had the manifest variables been measured along a quotient scale, however, it would be possible also to refer the latent profiles to such a scale.

After the latent profiles have been computed it is also possible to identify the individual observations included in a given profile. From there on, it is not far to determine from which individuals within A and Q the observations emanate. Similarities and dissimilarities between groups of employees discriminated in this way may be further analyzed within or outside the scope of latent profile analysis.

The most important advantage of using latent profile analysis in connection with large scale measuring of flows information is the opportunity to satisfy the requirement of data condensation while retaining information on level, pattern, and dispersion of the variables.

Especially in explorative studies, the possibility of studying the discriminating power of different variables significantly aids in the construction, evaluation and reconstruction of models.

EXTENSIONS FROM THE FIRST STUDY: THE LINKAGE BETWEEN FLOWS

The results from the first study were encouraging in the sense that the methods for observation, analysis and presentation of data stood the test of application. The empirical results were also compatible with the frame of reference.

* More realistic applications can handle more than 40 variables simultaneously.

However the study was not only limited by its concentration to only one administrative unit, its coverage of the important relationships between flows of information and resources e.g. the effects of flows of information were highly incomplete.

While flows of information are most often directly connected with physical transactions, buying and selling being the most obvious examples, the interaction between the flows of information, resources and payments is often subtle.

The example below gives a simple illustration of some cases of relevance to regional analysis.

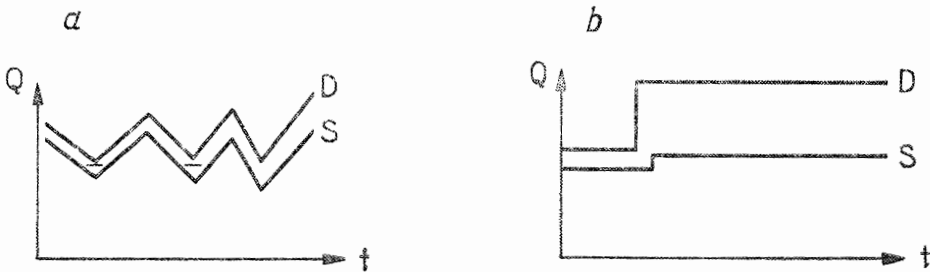


Fig. 4a, b.

Figure 4a illustrates random fluctuations in demand. These fluctuations can be detected and met by cost-incurring storage or by reliance on outside rapid supply. The latter strategy implies lower economies of scale and often higher unit prices for those units taken from outside suppliers. The information needed for an evaluation of different courses of action is here available. An important feature of this case is that the organization is capable of satisfying demand by own and outside sources and therefore can estimate the present magnitude of demand.

Figure 4b illustrates a case where the last conditions do not hold. If a large upward shift in demand occurs and the organization is not able to meet it, it is not able to estimate its real magnitude. This means not only short run consequences from lost revenue, but also loss of the information needed for the choice of action. Important opportunities for the future may therefore be ignored. Access to flows of resources from outside suppliers means not only cost-saving, it has also an information content*.

Even more complex, however, is the information transmitted between organizational units without any direct bearing on present transmission of resources. Knowledge of the moves contemplated by competitors, government agencies and so on belongs to this class. The gathering and analysis of this

* The treatment of the demand forecasting problem given here is of course extremely simplified. It is only meant as an illustration of one aspect of linkages between flows of information and flows of resources.

strategic information takes an increasing but hard to evaluate share of management's time and other scarce resources. Screening of and bargaining with the environment are important features of increased interdependence between organizations.

If elements of change are ubiquitous, the more complex forms of interaction between flows of information and transactions could be expected to play a crucial role for organizational survival and growth.

THE SECOND PILOT STUDY (AUGUST 1967)

A second study, designed to take care of the theoretical extensions was implemented on a larger material. In order to study the time element the administrative unit studied before was included once more together with four units of production belonging to the same organization. For comparisons four administrative units in the core of Stockholm were also included in the sample.

The forms used now included questions designed to differentiate information directly related to transactions from other types of information. Not only were the units of production studied with respect to their information, but measures of the degree of routinization for flows of resource were also studied. This means that value added from different product lines and fluctuations in these for past and present periods were studied. In addition the method for measuring "the rate of technology", described by Woodward, was used to classify the product lines as unit, mass or process production*.

The results from this study are now being processed using factor analysis and latent profile analysis. It is our hope that they will give valuable experiences for a third study now being planned**.

THE THIRD PILOT STUDY (NOVEMBER 1967)

A third study aimed at covering more complex interaction networks is now being planned. More than 100 organizational units located in three different regions in Sweden are to be used as units of observation. Against the background of the earlier studies, this investigation will give some possibilities for the testing of some hypotheses***.

The frame of reference suggests two points as central for empirical investigations:

- (1) The interaction between units belonging to the production sector and

* Woodward, *Industrial organization. Theory and Practice*. London 1965.

** The results will be presented separately by Thorngren and Back. The latter was responsible for the implementation of the study.

*** The analysis is also deepened to cover not only characteristics of the senders and receivers of information and their organizational relationships, but also the content and effects of the information transmitted.

“information amplifying units” belonging to the service, e.g. printing, advertisement and consultants. Flows of information between units in production sectors are expected to be transmitted through amplifying units to a certain extent. This deflexion is expected to show large regional variations.

(2) The interaction between different kinds of amplifying units. The ties between amplifying units can be a common frontier against other economic activities, presumably reinforced by a mutual interdependence in the exchange of information carrying material.

The financial and administrative resources put a definite limit to the number of units studied. More than a hundred units within narrowly selected sectors of production and service have been randomly chosen for study. Electronic and chemical industries are chosen as representatives for sectors with a presumably high deviation between highly routinized physical production and advanced technological and marketing research and development. Printing, advertisement, and consultants are selected within the service sector. The study is also limited to areas around Stockholm, Gothenburg and Sundsvall.

It is hoped that important parts of the interaction between amplifying units and other parts of the economy and the interaction between changes in physical production and the transmission of information are elucidated. The importance of face-to-face contacts as opposed to telecommunications is another question of relevance to the study.

Great attention will also be given to the possibility of replacing the one dimensional sector classification now commonly used with a multidimensional description system. With access to consistent multivariate descriptions of the flows of information, resources and payment generated by units, the latter can meaningfully be aggregated to an organizational, regional or national level. This can have important implications for relevant comparative studies between units, organizations and regions.

A brief and preliminary report from this study is expected to be completed in the beginning of 1969.

IMPLICATIONS FOR RESEARCH

Research directed to the level of the plant can give the opportunity of using concepts of potentially rich empirical content, which often evade analysis on higher level of aggregation. Large scale studies of flows of information and their connection with other phenomena of theoretical and practical interest seem feasible and even necessary. With access to results of this kind a stricter adherence to economic theory can give the analysis the generality needed for broad planning policy decisions. A broader set of variables including the attitudes and behavior of individuals in other roles than the membership of organizations must also be applied for normative statements*.

* See Kristensson [10].

Consideration of the possibilities for the outgrowth of differentiated agglomerations constituting pools in information and physical resources respectively however seems necessary in both research and planning contexts.

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