招待論文

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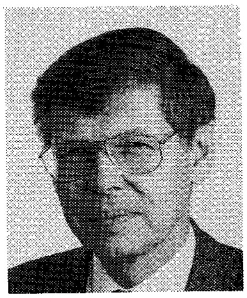
LOCATION ATTRIBUTES AND DYNAMICS OF JOB LOCATION



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1. LOCATION ADVANTAGES

In agricultural societies the population tends to concentrate on sites in response to the fertility of land. In post-agricultural societies we find new forms of "fertility" differentiation over space. Both within and across urban regions of various sizes one can observe how the competitive advantages differ between locations. We relate such distributions of advantages to variation of location attributes or location characteristics across regions and places within a region.

This paper examines how specific combinations of regional attributes offer location advantages for specific categories of economic activities and land use in general. Variations in location attributes of regions give them individual opportunities to specialise in accordance with comparative advantages, as stated by the Heckscher-Ohlin model which refers back to Ricardo. It was later refined and developed by Ohlin (1933). This model defines an equilibrium in which every region has a relative advantage, given the located (trapped) resources which constitute the invariant (slowly changing) economic milieu of each particular region. In Beckmann and Puu (1985) any spatial variation in interaction opportunities may bring about a specialisation in the land use structure.

In this study location attributes of a municipality and urban region constitute an economic milieu of the region. A theoretical framework is outlined to explain why such a milieu can be advantageous for sets of economic activities. For different sets of private services a location advantage index is estimated, revealing which milieu provides most benefits to a given group and service activities. Moreover, by means of an econometric model it is shown that regions with a high location advantage index (for private services) also are attractors for dynamic processes of overall job location changes.

(1) Regional Density and Knowledge Intensity

The milieu advantages in urban regions are described by Hägerstrand (1970) by emphasising that it facilitates considerably the contacts between decision makers, between experts, between sellers and buyers. Results presented in this paper are consistent with the view that costs associated with contacts between persons are a main efficiency factor for business service and development activities.

The argument by Hägerstrand is accentuated if it is combined with observations in recent decades of an emerging knowledge economy (Malecki, 1980; Noyelle, 1983; Andersson, 1985). This development implies that the average firm gradually uses an increasing share of knowledge intensive labour inputs. Another and related characteristic of the change is that a growing share of value added is allocated to R & D investments (Andersson, Batten and Karlsson, 1989; Anderstig and Hårsman, 1986). In this type of economy nearby personal interaction becomes an inherent element of development, production and transaction processes. It can then be argued that under these conditions industries will benefit from urban density with proximity and multiple contact possibilities.

Contact intensity is further facilitated by networks for interaction which augment the accessibility between potential interactors. According to the analyses and studies presented subsequently, such networks and the associated accessibility constitute location attributes which are important for knowledge-handling and development activities of different types of firms, in service sectors and manufacturing industries. All this should imply that knowledge intensive and non-standardised activities have and are developing a high location intensity in dense regions. It remains to make precise which other location attributes, besides density, that provide appropriate conditions for knowledge-based and knowledge-handling activities (Batten, Kobayashi and Andersson, 1989 ; Kobayashi, Batten and Andersson, 1991).

Although one can identify a general change process moving towards increasing knowledge intensity across sectors and regions, it is still possible to observe differentiation between two basic types of production, dichotomised into (i) routinised and standardised in contrast to (ii) knowledge-based and non-standardised activities. This pattern can be assumed to be the result of spatial relocation processes which resemble the estbalished model of spatial product cycles (Hirsch, 1967 ; Norton and Rees, 1979 ; Andersson and Johansson, 1984). In the subsequent analysis we refer to a weaker assumption which means that type (ii) activities may remain in dense and contact-friendly environments over extended periods during which firms continuously renew and customise their supply. In such cases there may be very little of direct relocation from knowledge-intensive C-regions to other categories of regions. However, in general we assume that when certain forms of customisation become well known, it also becomes more easy to imitate the behaviour of already established firms in leading regions, and the activities can diffuse to other regions.

In general, the model outlined in the paper does not assume that location and relocation follows any strict scheme such that all new activities start in regions with favourable location attributes, e.g. C-regions. The basic ambition here is to describe how the expansion possibilities and profitability of economic activities depend on location attributes. Given such a specification, the model can be applied to predict location and relocation patterns in frequency or probability terms.

(2) Functional Urban Regions and Location Advantages

The studies presented in this paper has municipalities as observation units. In certain cases an individual municipality can be characterised as a functional region. For Sweden with more than 280 muncipalities, the generic case is that groups of adjacent muncipalities constitute integrated functional urban regions. A functional urban region is defined as an area with frequent interaction within the region, comprising labour market participation as well as public and private service deliveries to households, firms and other organisations. In textbook definitions

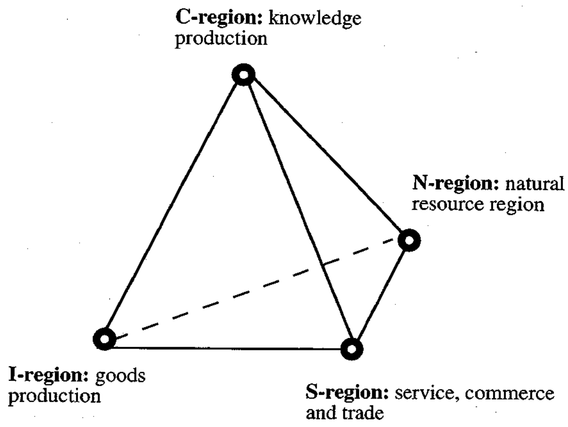

Fig 1.1 Four types of regional specialisation

this corresponds to the concept of a daily commuting region. A functional urban region usually has a multinodal structure, although one of its nodes has a definite role as a centre in almost all cases.

One may distinguish between regions specialised on (i) knowledge-handling and development activities (C-regions), (ii) service, commerce and trade activities (S-regions), (iii) goods production and industrial activities (I-regions), and (iv) natural-resource handling (N-regions). In **Fig. 1.1** these four extremal cases are represented by the vertices of a tetrahedron. Any particular region may be thought of as placed somewhere inside the four-corner body, with a possible orientation towards one of the vertices, indicating the region's specialisation. Every region's specialisation is identified by measuring its location intensity as regards C-, S-, I- and N-sectors. One may interpret the four vertices of the figure as extremal or ideal cases. In general an actual region will be located somewhere inside the frames of the figure.

According to the theory presented and the associated emprical assumptions in the paper, the competitive advantages of C-regions are based on favourable conditions for knowledge production and creative innovative activities, in particular those development processes which require intense communication and multi-agent face-to-face contacts. I-regions are recognised by their specialisation on industrial production and associated producers' services. Service production, trade, distribution and other commercial activities constitute the characteristics of S-regions. N-regions are specialised on natural resource handling which refers to harvesting and extraction of natural resources and basic processing of the resources. When these activities grow in scale and agglomerate, the individual N-region is transformed to an I-region.

Location intensity can be represented by the ratio between (i) a certain set of activities and (ii) all economic activities in a region. Hence, in general a high location intensity of a sector implies a strong sectoral specialisation. The major aim of the paper is to show that such sectoral location intensities are influenced by the location attributes of individual regions. Moreover, it is demonstrated that the density of regions is systematically correlated with their location intensities.

(3) Outline of the Paper

Section 2 presents the theoretical framework of the paper. The first task is to classify different speeds of adjustment for spatially located variables and to identify regional characteristics which adjust on slow time scales. In the analysis, location attributes are selected from the set of variables which adjust at a slow pace. In a second step a general profit function of individual firms is introduced. This function is used to identify various forms of scale phenomena as discussed by Krugman (1991) and agglomeration properties as introduced by Marshall (1920). With this specification of the model, it is shown how location attributes are prerequisites without which agglomeration effects and economies of scale (and scope) may be prevented to develop.

Section 3 classifies regions with respect to population density. It is shown by means of cross-classification tables that density is a property that reflects important location attributes as regards the location of manufacturing industries, basic service production, and knowledge intensive service activities.

Section 4 focusses on two aggregates of service production: interaction services and knowledge intensive business and financial services. A set of location attributes are presented and used in regression equations to show how the location intensity of each category of service activities depends on these attributes. Moreover, these regressions generate for each sector a location advantage index, with a specific value for each municipality.

In section 5 the location advantage indexes are used in a quasi-dynamic econometric model which is applied to the aggregate growth and decline of jobs in Swedish municipalities. This exercise shows that the overall change of job location during a decade is strongly influenced by location advantage indexes referring to our two categories of service activities. This indicates that location attributes which influence the location of our selected service sectors, they also influence the overall growth of private sector jobs. In particular they differntiate the growt rates among municipalities. Section 5 ends by some concluding remarks.

2. LOCATION INTENSITIES OF MUNICIPALITIES

This section starts by specifying location attributes as the most slowly changing part of a region's economic milieu. As a next step the economic performance of firms is related to the location attributes of the host region of each firm. Thirdly, firm activities are classified with regard to the degree of routinisation of production and distribution and the degree of standardisation of products (goods and services). This classification is then applied to systematise different firm's sensitivity to variations in location attributes (Wigren, 1984, 1985)

(1) Economic Milieu and Slowly Adjusting Regional Characteristics

Let us formulate a dynamic extension of the theory of comparative advantages. Differences between regions as regards their economic milieu provide opportunities for specialisation in accordance with the advantages of each region. In equilibrium a specialisation pattern obtains such that each region makes use of its relative advantages-as given by those fixed resources which constitute the region's location attributes and its entire economic milieu. One may associate two fundamental questions with this formulation: (i) how fast does an economy adjust towards the described form of spatial equilibrium, and (ii) to which extent do location attributes adjust themselves.

The economic milieu of a region comprises those location attributes which are regionally trapped and which influence the transaction, production and innovation possibilities. In addition, the milieu represents agglomeration economies which implies that it evolves in a self-organising and self-reinforcing way. Some of the regional attributes are given by nature. Other attributes are created by accumulation and investment processes-including experiences, knowledge and competence of the labour force in the region, assuming that households display a low mobility. Infrastructure and the entire built environment constitute another set of investment-based regional attributes (Biehl, 1986; Blum, 1982).

The time scale assumptions made can be organised as follows. First, production factors of firms such as installed capital and employed labour adjust to market signals in a delayed way, i.e., they adjust slowly compared to the speed of change of market signals themselves, such as prices, current input flows, sales volumes and profits. Second, the economic milieu adjusts on a slower time scale than capital equipment of goods and service producing firms. As a consequence it can affect production possibilities in a fundamental way and influence location dynamics as well. Third, labour supply is assumed to adjust on a time scale which is slow enough to make labour supply a component of the economic milieu. This implies that location attributes will include the production knowledge and experiences of the labour force. Earlier studies inform us that accessibility characteristics of a region represent a basic component of the region's location attributes (Wigren, 1984, 1985 ; Andersson, Anderstig and Hårsman, 1990 ; Forslund and Johansson, 1995). In summary : due to its slow pace of adjustment the economic milieu functions as the structure on which the fast game of competition and interaction is played. Because of this time scale difference, one can also assume that the economic milieu of a municipality can attract and repell specific sets of transaction and production activtities.

The slowly changing location attributes may be classified as location specific infrastructure. Other attributes like agglomeration diversity may be somewhat less time invariant but can be assumed to be strongly correlated with slowly changing attributes. In this context we observe that Marshall (1920) identified three specific conditions which explained why firms in a certain sector tended to be localised, i. e., why they could function more efficiently when located nearby each other. First, an industrial centre and, in particular a diversified urban region with several industrial centres allows a pooled (and robust) market for workers with specialised skills such that the robust market benefits both workers and firms. Second, the same urban region can provide nontraded inputs specific to each of its localised industries at lower costs. Third, new and subtle information can spread more easily and accurately in a local environment than in distant networks, and this generates market and technology spillovers. The same three conditions can also be applied to explain why the multiplicity and richness of a specific economic milieu (agglomeration diversity) simultaneously brings benefits to firms in many sectors.

The Marshall inspired arguments above means that a specialised industrial centre can self-reinforce its location advantages for a specific industry. It also means that a vital and multifaceted urban region can do even better. It can provide (i) a creative milieu (Andersson, 1985), (ii) a diversified supply of various producer services, (iii) an intraregional network for information flows about new production techniques, products, suppliers and customers (Johansson, 1991), and (iv) a differentiated supply of labour categories. Our enumeration of location attributes tend to emphasise intraregional accessibility and the associated infrastructure. It also implies that firms mutually may constitute each others production milieu characteristics. One may simply add the importance of interregional interaction links and pertinent accessibility properties.

(2) Basic Elements of a Theoretical Model

Firms select and retain their location on the basis of many factors which have a specific composition in each individual case. The ambition here is to identify and sort out economic aspects which are generic in the sense that they on a frequency basis can be said to predict the probability of a firm's survival and growth. Moreover, the main concern is about the importance of the location attributes.

Following Wigren (1984) we may distinguish four basic decision spheres of a firm : (i) control of current inputs, (ii) production activities, (iii) distribution and sales activities, and (iv) management and formation of a development strategy. The performance of all these activities are assumed to be influenced by location attributes as outlined in (i)-(iv) below :

(i) The control of input flows comprises purchase of current inputs, equipment and production services, and hiring of personnel. The production milieu should by definition influence the various transaction costs associated with these input markets. In particular, input efficiency increases with increasing accessibility to the supply of labour and production services.

(ii) Standardised production activities of a manufacturing firm is often considered to be invariant with respect to variations in the economic milieu. However, service production and customised production in general require customer contacts as an integral part of the production activity as such. In cases like these, milieu differentials are assumed to influence the production efficiency.

(iii) The economic milieu comprises the accessibility to customers and market potentials. As such it influences the efficiency of the distribution and sales activities. This impact is accentuated with regard to customised production and deliveries which tend to be contact intensive.

(iv) The management and administration function comprises all activities not included in the three categories described above. It controls and develops the technical, organisational and commercial knowledge associated with the firm. Hence, it includes innovation activities which generally are stimulated by accessibility to deliverers, customers, competitors and R & D -resources.

Each of the four types of activities described above relate to both activities and interaction within the firm, and external interaction. As regards the internal activities the production milieu may allow positive scale effects to be realised. In addition, the size of the economic environment will in general bring about non-linear scale effects on the transaction costs. When these scale phenomena are positive, they all correspond to the economies of scale argument put forward by Krugman (1991).

The assumptions presented above may be clarified further by means of a partial model which describes aggregate price, cost and delivery conditions of firms in a sector. First, let $a_r=(a_{r1}, \cdots, a_{rn})$ be a vector of location attributes, representing in particular region r's internal and external network and accessibility features, and assume that all attributes are measured so that they have a positive influence on economic performance. Among location attributes we recognise interaction networks for face-to-face contacts, mediated communication and transportation flows. As activities expand while networks and other location attributes remain unchanged, the region will experience capacity tensions in the form of congestion, friction, delays and increasing interaction cost levels. These phenomena are labelled attribute tensions and are assumed to influence economic performance negatively as they become large.

Assume that attribute tensions are negligible and consider the following profit function referring to a given sector in a region r:

$$\pi_r x_r=[p_r-c_r(x_r)]x_r-\sum_s c_{rs}(x_{rs})x_{rs}$$
$$\partial c_r(x_r)/\partial x_r<0,\ x_r \in X_r \qquad (3.1)$$
$$\partial c_{rs}(x_{rs})/\partial x_{rs}<0,$$

where π_r denotes profit per unit output, p_r price in region r per unit output, x_r total output, x_{rs} sales deliveries from region r to s, and where $c_r(x_r)$ denotes the unit cost of production which in general depends on the scale of production, such that $\partial c_r(x_r)/\partial x_r<0$, as x_r does not excede the upper limit of the interval, X_r, in which average costs continue to fall.

Moreover, $c_{rs}(x_{rs})$ represents the unit cost of delivery and other interaction costs associated with distributing and selling x_{rs} in region s. In this case the natural assumption is that $\partial c_{rs}(x_{rs})/\partial x_{rs}<0$, as long as the capacity tension of relevant interaction networks remain negligible or limited. This condition reflects an assumption about positive scale effects in the interregional interaction activities. These effects can be constrained by quality and capacity limitations of location attributes. Such limitations may give rise to capacity tensions in the form of congestion and other forms of interaction delays and frictions. Hence, improvements of location attributes may release potential scale effects as sepcified above.

Assume that all attributes are measured in such a way that they have a positive influence on profit opportunities, in particular by removing capacity tensions. The earlier assumptions (i)-(iv) are then reflected by the following conditions:

$$\partial c_r(a_r, x_r)/\partial a_r \leq 0, \text{ referring to (i)-(ii)}$$
$$\partial c_{rs}(a_r, x_{rs})/\partial a_r \leq 0, \text{ referring to (iii)} \qquad (3.2)$$
$$\partial p_r(a_r)/\partial a_r \geq 0, \text{ referring to (ii)-(iv)}$$

where strict inequalities apply when attribute tensions are large. The first condition in (3.2) restates that (i) input costs for all types of production, and (ii) production costs as regards service production can benefit from improvements of the location attributes. The second condition implies that improved systems for interregional interaction will reduce the costs of interaction. The third relation between the output price and location attributes reflects how the efforts to improve the product quality (or attributes) by means of R & D may be more efficient or successful (on the average) when location attributes are improved. In summary, formula (3.2) describes how improvements of the a_r-attributes may remove capacity tensions and in addition release potential scale effects as specified in (3.1) above (cf Seitz, 1995).

It is rewarding to carry this model exercise one step further by making the input deliveries and thereby assumption (i) above explicit in the following way, while assuming that attribute tensions are negligible:

$$c_r(x_r)=\sum_s \sum_i p_{sri} b_{sri} x_r + \hat{c}_r(x_r)$$
$$\partial p_{sri}(a_r, b_{sri}x_r)/\partial x_r<0 \qquad (3.3)$$
$$\partial b_{sri}(a_r, b_{sri}x_r)/\partial x_r<0$$

where b_{sri} is the coefficient describing the input of product i from region s per unit output of x_r, p_{sri} denotes the unit price of the delivery $b_{sri}x_r$ from region s to region r of input i, and $\hat{c}_r(x_r)$ represents other production costs not specified as input flows. In (3.3) two assumptions about positive scale effects are specified. First, increased output is assumed to influence the prices of input flows, p_{sri}, to decline. Second, as the economic scale grows, the input coefficients, b_{sri}, are assumed to diminish.

Formula (3.4) assumes that improvements of location attributes may reduce both the price of inputs and the associated input requirements. Also in this case, effects of a_r-improvement can be related to an assumption that scale phenomena exist. Increasing the level of a_r-attributes may have a direct influence by reducing attribute tensions and an indirect effect by releasing scale effects specified in (3.3). When attribute tensions are large strict inequalities apply in formula (3.4):

$$\partial p_{sri}(a_r, x_r)/\partial a_r \leq 0$$
$$\partial b_{sri}(a_r, x_r)/\partial a_r \leq 0 \qquad (3.4)$$

The scale effects in (3.1) and (3.3) can be counteracted by large attribute tensions, caused by attribute limitations. We may summarise these observations as follows:

> Conditions (i)-(iv) above assume that reduction of attribute tensions reduce production and interaction costs, while increasing profits as specified in (3.2) and (3.4). The conditions also assume that removal of attribute tensions (or improving location attributes) provide options for firms in the relevant region to utilise scale and scope (diversity) effects as specified in (3.1) and (3.3).

(3) Standardisation and Routinisation

During the 1960s a dynamic theory of spatial product cycles was introduced by Vernon (1966) and Hirsch (1967), followed by intense empirical research in subsequent decades. In this theory a basic distinction is made between the development of new (young) products and the production of mature, standardised products by means of routinised production methods. Moreover, it is recognised that the early phase of a product cycle benefits from one type of location attributes, while the later phase has other requirements (Johansson 1993b).

The von Thünen class of location models describe variations in the milieu within an urban region as the consequence of accessibility patterns. An equilibrium solution in this framework is such that contact-intensive and non-standardised activities locate in zones or subnodes with high accessibility values, while goods-handling and standardised activities are forced to select less accessible locations. This class of model has also been related to spatial product cycle models (Andersson & Johansson, 1984b).

Non-standardised products (goods and services) comprise customised deliveries as well as young products. According to the theoretical framework referred to here, firms find it advantageous to locate this type of production in urban regions which are characterised by accessibility to a broad set of various customer categories, as well as to R & D resources and suppliers of knowledge services. Other desirable location features are relatively high purchasing power and rich contact opportunities.

When a product gradually matures and a growing market develops it becomes possible to standardise its design and automate and routinise its production process. The comparative advantages are in this case found in regions which have lower land values and costs of premises, lower costs of routinised labour inputs. In these environments the supply of knowledge intesive and R & D oriented labour force comparatively small. (Andersson and Johansson, 1984a, 1984b).

Table 2.1 summarises some basic aspects of the

Table 2.1 Degree of production routinisation and product standardisation

	Non-routinised production	Routinised production
Non-standardised products	(1) Development oriented, knowledge handling activities; both customer relations and production is contact intensive	(2) Contact intensive relations with customer markets, but limited development inputs
Standardised products	(3) Limited development activities, but skill-requiring inputs; price competitive customer relations	(4) Both transaction and production activities require limited contact intensity; price competitive market relations

product cycle model by cross-classifying the degree of routinisation of the production and the degree of product standardisation. In schematic versions of product cycle paths, a young product starts in position (1) and moves gradually to position (4). It may jump directly to position (4) or it may follow either of the sequences (1)—(2)—(4) or (1)—(3)—(4). Which way will a particular product follow? When products mature price competition and cost reductions are survival requirements. Hence, we may assume that such changes follows paths along which cost savings are largest. In position (2) the firms try to save input and production costs by routinising. In position (3) the standardisation of products provides the measure to reduce costs.

One basic message from **Table 2.1** is that in position (1) economic activities are knowledge and contact intensive, while in position (4) these elements are reduced with the intention to cut down on costs and compete with low prices. The subsequent analysis will focus on these two extremal cases. As a general assumption we expect activties of type (1) to have a high location intensity in C-regions and a low in I- and N-regions. The inverse relation is assumed to hold for activties of type (4) which should have a high location intensity in I-regions and N-regions.

3. CORRELATION BETWEEN REGIONAL DENSITIES AND LOCATION INTENSITIES

The population density of a region is not perfectly correlated with the capacity and quality of the region's infrastructure and location attributes in general. However, there is still a strong relation as will be demonstrated. Given this conclusion we illustrate two phenomena. First, the production of non-standardised, customised and R & D-dependent products are

Table 3.1 Population density of Swedish municipalities, 1985

Population density	Share of Sweden's total area, %	Share of Sweden's total employment, %	Number of inhabitants per km²
(I) 0−6.4 inhabitants per km²	65	9	2
(II) 6.4−13.5 inhabitants per km²	15	13	9
(III) 13.5−32.6 inhabitants per km²	13	24	20
(IV) More than 32.6 inhabitants per km²	6	54	85
The whole country	100	100	21

Source: Statistics Sweden

Table 3.2 Regional infrastructure indexes of Swedish municipalities, 1985

	I	II	III	IV
Value of the building capital per inhabitant	100	108	112	121
Proportion of the labour force with university education	100	120	138	200
Number of air flight departures per day	100	86	162	281

Source: Johansson and Karlsson (1991)

located in dense regions. Second, the production of standardised, routinised, and often natural-resource based products are located in less densely populated, peripheral regions.

(1) Density Classification of Muncipalities

Four groups of regions are described in **Table 3.1** and have the following label: (I) Very sparsely populated municipalities; (II) Sparsely populated municipalities; (III) Densely populated municipalities; (IV) Very densely populated municipalities, forming metropolitan regions. In the low-density minicipalities (I)-(II), one finds 22 percent of all jobs in Sweden 1985. The corresponding figure for muncipalities of category (IV) is 54 percent.

Table 3.2 illustrates the average difference between the four categories as regards building capital, knowledge intensity of the labour force, and air transportation conditions. As regards building capital, one should in particular observe that in a dense region the amount of public or collective facilities is much larger than elsewhere which accentuates the differences in the table. In regions of type IV (metropolitan) we observe high building capital and education density,

Table 3.3 Share of total employment distributed across regional types for three categories of manufacturing industry, 1987

	Total manufacturing	Low value products*	Price-competing firms with declining employment
(IV) Very dense	31	9	20
(III) Dense	35	18	36
(I)-(II) Not dense	34	72	44
Total	100	100	100

Source: Johansson and Karlsson (1991); price competition is defined and specified for sectors in Johansson and Westin (1994)

as well as an indication of air transport accessibility.

Table 3.1 and **3.2** describe regional differences as regards location attributes for 1985. To which extent are these differences reflected in location characteristics of the manufacturing industry. First, one can observe that the sparsely populated regions (I) and (II) host 34 percent of all manufacturing employment, while only 22 percent of all Swedish citizens dwell in the same region. This makes them the manufacturing regions of Sweden. In particular, 72 percent of all low value products are produced in region (I) and (II) (less than 5 kronor per kilogram). In the same regions we also find a high location intensity of persons employed in firms which operate on price-competition markets, i.e., markets in which products tend to be standardised and then price is the remaining competition instrument.

One reason for the high location intensity of firms producing low value products in the non-dense regions (I)-(II) is that a lot of this production benefits from the accessibility to input resources in these regions, e.g forestry inputs. Moreover, we conclude that the location pattern in **Table 3.3** is completely congruent with the pattern predicted by product cycle theory. We note especially that the metropolitan regions has a lower than average location intensity as regards manufacturing in general and a much lower intensity as regards price-competing manufacturing industries. The location intensity in regions of type (IV) is 31 percent which should be compared with the figure 54 percent which is the total employment intensity in this type of region. On the other hand, municipalities of type (I) and (II) have an unproportionally high location intensity of manufacturing industries.

(2) Distribution of Basic Service Production

Interaction services are performed by sectors as a means to facilitate the transmission and displacement

Table 3.4 Location intensity of interaction services across regional types, 1987

	(IV)	(III)	(I)-(II)
Share of expanding interaction services	0.7	0.5	0.2-0.4
Share of slowly growing interaction services	7.0	4.0	4.0-5.0
Share of interaction services with stagnating or declining employment	14.0	12.0	10.0-11.0
Share of all other sectors of the economy	78.3	83.5	83.8-85.6

Source : Johansson and Karlsson (1991)

of persons, messages and goods. They enable supply sources to interact with demand sinks in such a way that markets can clear. One can use the employment change between 1977 and 1987 as a way to distinguish stagnating, slow and fast growth. In the 1980s expanding interaction services (with fast growth) included (i) property trade brokerage, and (ii) travel agent services. From **Table 3.4** one finds that these sectors were all small. During the 1980s, the slowly growing interaction services comprised (i) air transportation, (ii) hotel and restaurant, (iii) machinery rental services, (iv) mail and telecommunication services.

The largest set of interaction service sectors are those with stagnating or falling employment numbers. They include various forms of trade and transportation sectors as described below :

- Retail trade
- Standard wholesale trade (excluding technology trade with equipment)
- Road transportation by lorries and trucks
- Railway transportation
- Water system transportation

Table 3.4 informs us that the interaction services are evenly distributed over space, in the sense that location intensity is about the same in all three density categories of municipalities. The declining interaction services are slightly overrepresented in the peripheral and sparsely populated municipalities. The implicit hypothesis behind the classification in **Table 3.4** is that the expanding interaction services refer to knowledge oriented, differentiated and customised services, while the slowly growing services are more standardised and less knowledge dependent, while the third group of declining sectors is significantly more standardised and on the average involved in clear price competition. Among the sectors in this group one finds activities for which both employment and production diminishes, while others survive by simultaneously expanding production and reducing the size of the labour force—typical features of price competition in standardised markets Comparisons of the knowledge intensity of the three groups of sectors strengthens this conclusion (Forslund, 1995).

Table 3.5 Relative location intensity of knowledge-handling (KH) service activities 1987 Index in percent*

	KH-sectors with fast growth	KH-sectors with slow growth
Stockholm region	100	100
(IV) Metropolitan, very densely populated	78	90
(III) Densely populated	32	54
(II) Sparsely populated	23	51
(I) Very sparsely populated	14	27

Source : Johansson and Karlsson (1991). *Relative location intensity describes for each sector its location intensity in the region divided by the same sector's intensity of the country. The index in table 3.5 uses the Stockholm region as a norm.

(3) Concentration of Knowledge-Intensive Service Activities

Besides the interaction services described in the previous subsection, one may distinguish two other groups of business and knowledge-handling services as specified below. On should also observe that for the 1980s there does not exist any observations of decline for business and knowledge-handling sectors.

- Business and capital services : property management ; credit and financial services ; computer-processing services ; juridical, accounting and word-processing services ; guard-duty services ; efficiency-improvement services ; ordinary bank services ; insurance services ; cleaning services.
- Knowledge-handling services with fast growth : R & D services ; special consulting ; marketing and media services ; technology trade (=sales of technical equipment and production methods).
- Knowledge-handling services with slow growth : technical/engineering consulting ; organisation consulting ; architectural and building services.

The major part of all subsectors among the business and capital services have a high knoeldge intensity with long education (Forslund, 1995). However, in this section we shall emphasise knowledge-handling and development services (KH-services). It will be demonstrated that these services are strongly concentrated on municipalities with high population density. Moreover, this tendency is strongest for the service sectors with fast growth. In **Table 3.5** the Stockholm region is also included, and in that region the concentration of knowledge-handling services is particularly marked.

4. LOCATION ADVANTAGE INDEXES FOR SERVICE SECTORS

Section 4 presents a set of variables which reflect a municipality's location attributes and its economic milieu in general. Two aggregate service sectors are selected to be included in a regression analysis. The location intensity of each group is regressed against location attributes in municipalities. Finally, from the estimated prarameters a location advantage index is constructed. It indicates for each sector how strong a municipality's location advantage is with respect to this sector.

(1) Selection of Service Sectors

The objective of section 4 is to assess location intensities of two aggregate service sectors in municipalities by relating the respective intensities to location attributes of every municipality. One of the sectors is wholesale and transportation (WT), representing the interaction service sectors which experienced stagnation or slow growth 1980-1990. The second sector is the aggregate of all business services (consulting) and banking activities. In **Table 4.1** these sectors are described in terms of their subsectors and their national growth 1980-1990.

One should observe that the shift from the period 1977-1987 to the period 1980-1990 also implies a shift in growth figures. In the first of these periods (referred to in section 3) transportation was declining, and with the three years shift there is a considerable expansion of the subsectors "transport agencies" and "urban transport". When analysed econometrically the sectors are organised into the following aggregates:

- *WT* = Wholesale and trade
- *BC* = Bank and business services (C for consultancy)

Knowledge intensity may be measured as the share of the labour force in a sector having college or university education. With such measures the WT-sector has a considerably lower knowledge intensity than the BC-sector. However, within the WT-sector one finds that technology trade has a high knowledge intensity. On the other hand, ordinary bank services have a fairly moderate knowledge intensity and they represent a considerable share of all jobs in sector BC (Forslund, 1995; Johansson and Karlsson, 1991) However, compared with other sectors of the economy, both WT and BC are expected to have a strong willingness to pay high land rents in order to stay in urban regions with rich contact opportunities, high purchasing power, accessibility to a broad set of customer categories, to R & D resources, and to suppliers of knowledge services.

Table 4.1 Four aggregate sectors selected for further analysis of their dependency on location attributes. Size and growth in Sweden as a whole.

	Change in percent 1980-1990		Change in percent 1980-1990
Wholesale of production inputs	−19.6	Financial services	+123.2
Technology trade	+68.0	Other financial institutions	+ 57.5
Other wholesale trade	+ 5.9	Bank services	+ 29.8
Total wholesale	+16.5	Total banking	+ 30.4
Railroad transport	−10.0	Computer services	+195.8
Waterway transport	−43.9	Advertisment and marketing	+ 94.7
Road freight transport	+20.3	Accounting services	+ 56.1
Urban transport	+22.3	Special consulting	+ 54.6
Transport agencies	+23.5	Legal services	+ 35.8
Total transportation	+ 6.7	Engineering consulting	+ 31.8
		Total business services	+ 37.8
Number of jobs in the WT-sector	379,000	Number of jobs in the BC-sector	238,000

Source: Statistics Sweden

(2) Selection of Location Attributes

According to the theoretical framework introduced in this paper, loctation attributes should reflect properties of the economic milieu. Moreover, the variables are required to adjust at a slow pace compared with the adjustment speed of normal market transactions and flows of economic resources. In brief, to contitute an economic milieu the variable must show a certain degree of permanence. Moreover, firms should not be charged specifically for the provision of the attributes of the economic milieu.

Table 4.2 describes the set of variables (describing location attributes) available to the study presented here. Many of these variables satisfy in an obvious way the criteria discussed above and specified earlier in the paper. However, variables (L1) and (L3), referring to education-specified labour supply, may need some comments. In North America one can observe a much higher labour mobility than in Europe, and economist from US are often excluding labour supply and accessibility to such supply from the time invariant characteristics of the economic milieu. Without any further discussion of the labour market mobility in North America, one may conclude that in Europe the adjustment of each region's labour supply is a

Table 4.2 Set of variables reflecting location attributes available in the study

LOCAL AND INTRAREGIONAL ATTRIBUTES	INTERREGIONAL ATTRIBUTES
(L1) Labour supply in each municipality specified by education composition	(I1) Frequency of interregional trains
(L2) Number of jobs in each municipality specified by education composition	(I2) Interregional accessibility in the road system
(L3) Accessibility to labour supply of each employment category and to the set of job opportunities for each category of job	(I3) Accessibility to airport capacity (number of airplane seats departures per day)
(L4) Flow capacity of the road system	(I4) Travel time to the main air traffic hub, nearby Stockholm
(L5) Regional accessibility to population concentrations in the road system	(I5) Accessibility to international harbour terminals for freight flows
(L6) Regional accessibility to population concentration in the railroad system	(I6) Accessibility to universities and research centres
(L7) Frequency of local trains	(I7) Value of all premises in the municipality divided by the total labour supply
(L8) The capacity of intraregional public transport (supply of person kilometers)	
(L9) Capacity, size and value density of built environment (building capital)	

slow process. The accessibility to labour supply from a given municipality (urban node) is a composite variable, and it depends on the location of labour supply and the characteristics of the pertinent commuting networks.

Let us consider the accessibility of firms to the labor supply in the municipality of each firm and in the neighbouring municipalities. Such an accessibility measure has the form

$$T_r = \sum_s H_s \exp\{-\lambda t_{rs}\} \qquad (4.1)$$

where H_s denotes the supply of labor in node s, t_{rs} is the distance between municipality r and s measured by commuting time, and λ is a time sensitivity parameter. T_r describes the accessibility to labor supply that a firm in municipality r has. By labor supply is meant the potential supply, defined by persons belonging to occupationally active age groups.

Other accessibility measures are defined in the same way as in formula (4.1), observing that the nodal or regional attraction variable. H_s, has to be redefined in each particular case. For example, with attribute variable (L5) H_s refers to the number of inhabitatnts in region s.

Many of the variables in **Table 4.2** has a self-evident interpretation. However, attribute variable (L4) needs a detailed specification, especially since it has a central role in the econometric study. It represents the flow capacity of a region's road system. According to our previous discussion one may expect that the flow capacity of the road system, (L4), is a key factor for maintaining a cohesive and robust labor market. The variable is measured in the following way:

$$(L4) = aV/A \qquad (4.2)$$

a = width times length of the main road system in a municipality in square meters

V = driving speed in meter per second on each segment of the main roads in the municipality

A = total area of the municipality in square meters

The dimension of (L4) is thus meter per second, i. e., a flow characteristic. It describes the relative availability of road capital and its throughput capacity. From the statistical analysis, L4 is classified as the basic factor as regards keeping a compound and robust labour market together.

The variables in **Table 4.2** have been used in combinations as variables explaining the location intensity for the two sectoral aggregates WT and BC. Only certain combinations are possible, since certain pairs of attribute variables are strongly correlated (see appendix). The following set of variables are included in regression equations which will be presented and discussed in the subsequent analysis: (L3), (L4), (L5), (I1), (I4) and (I7). The remaining variables do not appear as statistically significant in any accepted regression equations. However, variable category (L1) will be used in the analysis of job dynamics in section 5.

Among the variables included in the econometric exercises we may comment also on variable (I7). Since it reflects the value of premises, it refers to a production factor for which each firm pays a rent, directly or indirectly. However, (I7) does not refer to rental costs payed by individual firms or even by the firms in each sector. Instead (I7) reflects the general or overall attractiveness of the region's supply of premises. Hence, it reflects a location attribute.

(3) Location Intensity as Function of Location Attributes

In the econometric study the location intensity is regressed against variables representing location attributes. The dependent variable which is called location intensity is based on two observations for each municipality r. The first observable is the wage sum, W_r, of each analysed sector. The second is the potential labour supply in node r. It is based on all persons across all occupational groups. In this way the location intensity of service sector j in node r is defined as

$$V_{rj}=W_{rj}/H_r \qquad (4.3)$$

where H_r represents the labour supply in municipality r. For wholesale trade and transportation, the WT sector, the measure in (4.3) ranges between 15 to 1. With regard to the BC sector business and banking services, the variation between regions is even larger. We may finally observe that the wage sum constitutes a large share of the value added in both the WT and BC sector. One may also describe the location intensity measure used in the regressions as the reatio between the number of persons employed in sector j divided by total labour supply and weighted by the wage level of sector j. This means that the intensity between two municipalities differs as a consequence of both the relative size of employment and the relative wage level.

V_{rj} is the dependent variable in the regression equation, and location attributes $a_{rj1}, \cdots, a_{rjn}$, referring to region r are the independent variables. The following form of the regression equation was used:

$$V_{rj}(t)=V_j a_{rj1}^{\gamma_{j1}} a_{rj2}^{\gamma_{j2}} \cdots a_{rjn}^{\gamma_{jn}} \qquad (4.4)$$

where V_j denotes the intercept with respect to sector j. This functional form has several advantages in the type of explorative econometrics carried out in this study. For example, it is easy to add and remove variables while examining the robustness of parameter estimates. Moreover, the multiplicative structure of (4.4) has capacity to detect synergies, since it is sensitive to small values of any of the a_{rji}-variables. Hence, the composition of the loction attributes affects their impact. In **Table 4.3** the parameters of four regression equations are presented. One should observe that an additional explanatory variable has been introduced:

P_r = the total wage sum in the public sector in municipality r, divided by the total labour supply, named public sector intensity.

One may interpret P_r in two different, perhaps complementary, ways. As a first option P_r represents the level of public services in municipality r. One may also consider the public sector intensity as a reflection of the normed size of the public sector's demand for private services from the WT sector.

From **Table 4.3** one may first observe that variable (I7) has a robust parameter value across the four alternative equations. The variable value is influenced by two aggregate processes in a muncipality. It increases as the attractiveness and usefulness (producticity) of the stock of premises grows on the average. It decreases as the number of jobs grows when the capacity and quality of premises remain unchanged.

Table 4.3 Location intensity of the WT sector regressed against location attributes

	Equation (1) 1988	Equation (2) 1988	Equation (3) 1985	Equation (4) 1985
(I7) Value of premises per labour supply	0.40	0.36	0.39	0.35
(L3) Accessibility to labour supply with college eduction	0.20	0.10	0.18	0.09
(I1) Frequency of interregional trains	0.05	0.06	0.06	0.06
(I4) Travel time to main air hub	—	−0.05*	—	−0.06*
(L4) Flow capacity of the road system	—	0.15	—	0.15
(P) The public sector intensity	0.16*	0.20	0.29	0.33
R^2	41	42	43	44

Source: Johansson et al (1991). All parameters have t-values above 2, except those marked by "*".

Table 4.4 Location intensity of the BC sector regressed against location attributes

	Equation (1) 1988	Equation (2) 1985	Equation (3) 1985	Equation (4) 1988
(I7) Value of premises per labour supply	0.53	0.49	0.49	0.50
(L3) Accessibility to labour supply with college eduction	0.14	0.18	0.13	0.06
(I1) Frequency of interregional trains	0.02*	0.01*	—	0.02*
(L5) Accessibiulity to population concentrations by car	—	—	0.09	—
(L4) Flow capacity of the road system	—	—	—	0.09°
(P) The public sector intensity	0.34	0.29	0.37	0.36
R-square	41	42	43	44

Source: Johansson et al (1991). All paramters have t-values above 2, except those marked by "*" and the paramter marked by "°" which has a t-value just sligthly below 2.

Accessibility to labour supply with college education, i.e. (L3), has a lower parameter value in equation (2) and (4), and both these equations include the variable (L4) measuring the flow capacity of the road system within the municipality. When this road sys-

Table 4.5 Simple correlation between accessibility to labour supply and transportation systems characteristics

ACCESSIBILITY TO LABOUR SUPPLY WITH	(L4)=flow capacity of the road system	(L8)=capacity of public transport	(L3) Accessibility to supply of labour with university education
University preparatory education (college)	0.68	0.27	0.99
University education	0.67	0.30	1.00
Post graduate (research) education	0.68	0.31	0.99

Source: Johansson et al (1991).

Table 4.6 Selected regression equations from **Tables 3.2** and **3.3**

Variable	WT sector	BC sector	C sector
(L4) Flow capacity of the road system	0.15 (0.05)	0.09 (0.05)	—
(I7) Value of premises per work-place	0.36 (0.06)	0.50 (0.06)	0.64 (0.06)
(L3) Accessibility to labour force with college education	0.10 (0.05)	0.060 (0.05)	0.19 (0.02)
(I1) Frequency of inter-regional trains	0.06 (0.02)	0.02 (0.01)	0.03 (0.02)
(I4) Travel time to Arlanda	−0.05 (0.09)	−0.10 (0.09)	— —
(P) Size of the public sector divided by total labour supply	0.20 (0.10)	0.36 (0.10)	0.45 (0.10)
R-square	0.42	0.49	0.46

Remark: Standard errors are reported within parentheses.

tem variable is removed the effect is clear. Both in equation (1) and (3), the parameter value of (L3) is doubled. As is shown in **Table 4.5**, the correlation between (L3) and (L4) is fairly high. Moreover, the correlation is also high between various versions of variable category (L3), where the attraction variable, H_r, may alternate between labour supply with pre-college, college, university and doctoral education, as well as total labour supply. As shown in **Table 4.5**, associated pairwise correlations can be very high.

The structure of the observed relation between location intensity and location attributes is very similar when we compare the WT and BC sectors. One may note that the BC sector has higher parameter values both for the value of premises and the public sector intensity. Perhaps one may guess that the public sector may be equally important as a provider of services for both sectors, while its role as a customer is more pronounced for the BC sector. Typically one finds universities, university hospitals and similar large public organsiations in municiplities with a high public sector intensity, and these generate demand for BC and WT activities.

The correlation between the labour supply accessibility variables is recorded in **Table 4.5**. The same table also shows that in the 1980s the flow capacity of the local road system covaries with the relevant accessibilities.

(4) Location Advantage Index

The location intensity of the WT and BC sectors is regressed against location attribute variables, in **Table 4.3** and **4.4**. In **Table 4.6** one regression equation is selected for each of the two sectors, with regard to the estimation year 1988. Moreover, **Table 4.6** presents one regression equation for the C sector alone (business services) which has been separated out from the BC sector. The latter is included for the sake of completeness.

Given the estimates in **Table 4.6** one can calculate an aggregate value of the location attributes for each municipality with regard to both the WT and BC sector. The aggregate location attribute value is represented by the a-index in formula (3.8) In each case the a-index is a function of the location attributes so that

$$a_{rj}=a_{rj1}^{\gamma j1}a_{rj2}^{\gamma j2}\cdots a_{rjn}^{\gamma jn} \tag{4.5}$$

where $j=WT$, BC and C. Hence, we may write

$$a_{WT}=a(\text{L4, L3, I1, I4, I7, P})$$
$$a_{BC}=a(\text{L3, I1, I7, P}). \tag{4.6}$$

Consider now the fact that the a-index associated with one of our service sectors is a good predictor of the location intensity of this sector in a static, cross-section perspective. Should we expect the a-index to be an important variable in a dynamic model in which the number of jobs A_r, in a muncipality r adjusts in response to the location attributes in muncipality r as well as other municicpalities?

The von Thünen class of models describes variations within and urban region as a consequence of accessibility patterns, and it can be generalised to cover a system of urban regions as well. An equilibrium solution in this framework is such that contact-intensive and non-standardised activities locate in zones or subnodes with high accessibility values, and where as a consequence land values and the rental price of floorspace is high. This is reflected in the three selected indexes by the variable (I7) measuring the overall value of premises per job in private sectors, The influence from this variable is high for WT, higher for BC and highest for C. The remaining variables reflect intraregional and interregional accessibility of various kind. As disussed earlier, public sector intensity may be given several different interpretations (cf Hansen, 1965).

5. SPATIAL DYNAMICS OF JOBS IN PRIVATE SECTORS

Earlier in this paper reference has been given to a dynamic theory of spatial product cycles (Hirsch, 1967; Andersson and Johansson, 1984a). In this theory a basic distinction is made between the development of new (young) products and the production of mature, standardised products. It is recognised that the early phase of a product cycle benefits from one type of location attributes, while the later phase has other requirements. As a consequence we should expect adjustments towards a location equilibrium to be disturbed when new products are being introduced into the economy from specific regions. Such perturbations may be evenly distributed or may occur in pulses, following temporal cycles of low and high innovation intensity. Theses observations imply that we should not be satisfied with analyses of static descriptions of equilibrium patterns based on cross-section information. Instead we have to investigate the adjustment process itself and examine the associated speed of change (Wigren, 1995).

(1) An Adjustment Model with Endogenous Time Scale

When product innovation refers to service production the activity location spreads primarily in the form of diffusion processes. In a formal model this diffusion looks like an imitation process. In the modern economy such diffusion is related to the WT and BC activities analysed in section 4. In view of this we shall in section 4 investigate if the dynamic location of all jobs (as an aggregate) is influenced by the same location attributes which can be associated with WT and BC activities, as revealed by the previous analysis.

Swedish studies of the above process of change have been inspired by a study by Mills and Carlino (1989) in which they collect a vector of structural variables from all counties in US (ca 2500) for the years 1970 and 1980. In a quasi-dynamic econometric model they use these structural characteristics of each region to explain the population change across counties during the decade. The results support the hypothesis that the gradual relocation of households among regions is influenced by the attributes of the regional milieu in the beginning of the period. These attributes comprise infrastructure, the built environment and accessibility properties.

The subsequent analysis refers to a study by Holmberg and Strömqvist (1988) which in turn has been inspired by the approach developed by Mills and Carlino. This type of model is designed to depict the interaction between slowly changing location attributes and changes in location patterns which adjust on a comparatively faster time scale. In the Swedish study the following equilibrium condition is introduced:

$$L_r^* = H(B_r, \hat{B}_r, x_r) \tag{5.1}$$

where L_r^* denotes the equilibrium of jobs and population in municipality r, given the location attributes of the municipality as specified by the vector x_r and the current values of B_r (population in r), $\hat{B}_r$ (population in adjacent municipalities), and L (jobs in r). According to model assumptions, the system in (5.1) continues to change as long as $L_r^* \neq L_r$. The adjustment towards equilibrium is assumed to be gradual and slow. In order to detect this kind of change process with limited data, the econometric analysis is based on observations of B_r, $\hat{B}_r$ and L_r from year $t=1980$ and $t+\tau=1988$. The model is specified as follows:

$$L_r(t+\tau) = L_r(t) + \lambda(L_r^* - L_r(t)) \tag{5.2}$$

where L_r^* and λ are dependent variables and hence estimated, and where λ denotes the speed at which the gap $(L_r^* - L_r(t))$ is closed, given that the process is allowed to come to rest without further disturbances or incitement. We may first note that the econometric results imply that λ has a low value, corresponding to an adjustment period longer than two decades.

On the basis of the experience reported above a similar type of model is now formulated (cf Holmberg and Johansson, 1992). The two observation years are given by $t=1980$ and $t+\tau=1990$:

A_r = Total number of private work-places (jobs) in region r

$$\Delta A_r = A_r(t+\tau) - A_r(t)$$

$H_r(t)$ = Labour supply in region r

$a_{rj}(t)$ = Location advantage index referring to economic sector $j = WT$, BC and C.

$$A^*_r(t+\tau)_j = a_{rj}(t)^\gamma H_r(\mathrm{t})^\delta \tag{5.3}$$

Consider then the following model of job adjustments

$$\Delta A_r = \lambda[A^*_r(t+\tau)_i - A_r(t)] \tag{5.4}$$

where λ, δ and γ are endogenously determined by the estimation of (5.4), and where λ denotes the adjustment speed. In the sequel we present results from regressions where three location advantage indexes specified in **Table 4.6** are applied. This means that we will use three different specifications of $A^*_r(t+\tau)_j$ in formula (5.3), i. e., $j = WT$, BC and C.

(2) Estimation of the Change Process

The hypothesis presented in the previous subsection

Table 5.1 Job location change as a function of location advantage index from **Table 4.6**

Parameter	BC sector	WT sector	C sector
a-index (location advantage index ; parameter$=\gamma$)	0.32 (0.02)	0.31 (0.04)	0.15 (0.02)
Labour supply (parameters$=\delta$)	0.99 (0.006)	0.99 (0.01)	1.01 (0.006)
Adjustment speed (parameter$=(\lambda)$)	0.17 (0.015)	0.16 (0.015)	0.19 (0.02)
F-value	824	801	762

Source : Holmberg and Johansson (1992)

states that one should expect fast growth of private sector jobs in municipalities with a high location advantage index with regard to WT, BC and C. **Table 5.1** confirms that such a hypothesis is worthwhile to examine. The location advantage index is highly significant in all three estimated equations. Following the size of the F-value one may suggest that the location advantage index of the BC-sector is the strongest predictor of private sector job changes across municipalities.

The size of the F-value indicates that the variables a_r and H_r have a strong influence on the direction of the change process. At the same time, the λ-parameter which reflects the speed of change has a relatively low and robust value-irrespective of which a-index is used. One may interpret the model in (5.3)-(5.4) as a process in which the number of jobs change in response to the size of the gap $A^*_r(t+\tau)_j - A_r(t)_j$. The response is relatively slow which is consistent with the classification of labour supply in municipalities as a slowly adjusting variable.

(3) Concluding Remarks

The observed correlation between regional densities and location intensities in section 3 provides a robust overall support to the inter-urban location model outlined in this paper. However, this type of test is indeed coarse. Section 4 provides a more elaborate statistical analysis of the location model. In this case one may complain about the lack of alternative observables to represent location attributes. Moreover, it would have been desirable with another sectoral specification. A shadow from these limitations also falls on the quasi-dynamic model in section 5. Hence, all results must be classified as tentative or exploratory. However, the strong model results in section 5 should be a challenge to continue this type of analysis.

The formal model outlined in section 2 emphasises scale and agglomeration effects as driving forces for location decisions, including decisions to expand and contract already established firms. The existence of such effects implies that at each point in time the future in general contain multiple location equilibria. This means that small perturbations may alter the direction of a change process. Differences in location attributes can influence the selection of competing paths towards alternative equilibria (Andersson and Johansson, 1994a ; Krugman, 1991). Only fragments of the associated research issues have yet been touched upon by economists and regional scientists.

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