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Market Potential and Distance Decay - Growth and decline of sectors across locations in urban regions

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Market Potential and Distance Decay

– Growth and decline of sectors across locations in urban regions

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Abstract

This paper introduces a model which identifies the economic activity of each local economy (location) and observes the time distance between each pair of locations as well as the average time distance between sub locations in each local economy. The study focuses on five categories of firms: knowledge-intensive and ordinary business services, knowledge-intensive and ordinary manufacturing, and household services. We model how these categories increase and decrease their employment in each location in response to the location's market potential. We also show how the location pattern depends on each locations market potential. In this endeavor we distinguish between demand and supply potential. In the econometric analysis the market potential of each location is determined endogenously, and this also makes it possible to determine the geographic extension of urban regions. This exercise also includes an endogenous determination of sector-specific distance-decay parameters. The model succeeds in depicting the gradual increase of service activities in certain locations and manufacturing activities in others.

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1 Introduction

Urban agglomerations differ in size and follow different patterns of growth and decline. Agglomeration advantages are perceived as a property of urban regions that explains the existence and growth of such regions. The concept is usually defined to comprise both localization and urbanization externalities, where the latter signifies a concentration of diversified activities and the former a cluster of diversified activities within a particular industry or a narrow group of activities sharing similar inputs and/or outputs.

The literature recognizes both static and dynamic agglomeration advantages. The first aspect refers to more efficient resource allocation obtained by a better match between the skill profiles of employees and qualification profiles of job descriptions, and a richer set of opportunities for firms to buy inputs from local suppliers (Duranton and Puga, 2004; Rosenthal and Strange, 2004). The dynamic aspect refers to diversity of knowledge flows that can stimulate innovation activities and new firm formation (Jacobs, 1984; Moretti, 2004). Negative agglomeration economies are often recognized as congestion and elevated land values. Following Fujita and Thisse (2002), the effect of increasing agglomeration economies is primarily reflected by increasing land values.

The presence of agglomeration economies in an urban region verifies itself in several attractiveness observations such as net in-migration, higher than average productivity and wage levels and above average land values. As a rule, agglomeration economies are assumed to increase as the size of city region grows.

In this paper we observe that an urban region (or city region) has an inner structure of nodes and networks for transport and contacts. We depict an urban region as an integrated constellation of dense concentrations, referred to as urban areas or local economies. The typical case is that one of the urban areas is larger than the others and plays the role of urban-region center, while being surrounded by associated (neighboring) urban areas of varying size. The different areas are affected by the region's agglomeration economies in different ways. In view of this, we introduce the concept market or agglomeration potential which is separated into an area's demand and supply potential, where these two potentials are calculated for each individual urban area.

We consider the location of five categories of industries (and firms), subdivided into (i) knowledge-intensive business services (KIBS), (ii) ordinary business services (OBS), (iii) knowledge-intensive manufacturing, (iv) ordinary manufacturing, and (v) household services. A location is identified as a specific urban area and the urban region in which area is embedded. The demand potential of a location is the distance-discounted demand in the particular urban area and in its neighboring urban areas (local economies). The distance-discounting procedure helps to separate accessible demand from demand that is satisfied by suppliers located in other regions.

In particular central-place system models recognize service supply as an activity that has a major part of its customer contacts and sales inside the region where the supply activity is located (Beckmann, 1968, 1999), whereas economic-base models assume that manufacturing firms typically have the major part of customers spread across other regions (McCann, 2001). In view of this we examine how well the location of our sectors can be explained by each urban area's (i) local demand potential, and (ii) its intra-regional demand potential. We

examine especially the strength of this relation for knowledge-intensive business services. Our examination relates to observations made by Coffey and Polèse (1989), who claim that KIBS firms are not likely to be located outside an urban regions central urban area. Referring to Johansson and Klaesson (2011) also investigates how the location of jobs in different sectors responds to each urban area's local and intra-regional demand potential. The main hypothesis is that KIBS firms have strong response of this type, based on the fact that these firms have all firms as customers, and that these firms deliver their services with a face-to-face technology.

Our second perspective is related to the role played KIBS firms as suppliers of diversified service inputs to all firms and especially to knowledge-intensive customer firms. In this case we determine for each urban area its supply potential in (i) the own local economy and in (ii) the rest of the own urban region. Now the angle is changed such that the supply potential of an urban region consists of the distance-discounted access to KIBS supply in the own local economy, and in the rest of local economies in the own urban region. With this setting we estimate for our different sectors how their location depends on the supply potential, and how the sector location changes in response to the supply potential. This form of conditioned response to the business-service supply is analyzed in Andersson (2006), where the conclusion is that manufacturing jobs are attracted business-service supply potential.

The paper is outlined as follows. Section 2 presents a framework for analyzing how a service-supplier's demand potential varies across alternative locations in an urban region, and how a service-buying customer's accessible service-supply potential varies over different locations in an urban region. In addition the section suggest a method to endogenously determine the time-distance sensitivity which affects for each location the size of the pertaining demand and supply potential. Section 3 shows how the concepts of demand and supply potential can be related to dynamics associated with New Economic Geography and its concepts "home market effect" and "productivity effects of diversified business service inputs" (Fujita and Thisse, 2002). Section 4 presents descriptive statistics and estimation method, followed by econometric results in Section 5. Section 6 concludes.

Outline

2 Research Questions and Previous Studies

2.1 Business and Household Services in Urban Agglomerations

Following suggestions in Anas, Arnott and Small (1998), we consider an urban region as a complex structure with several centers of varying size. This approach implies that one may identify fractal self-similarity between a center and its sub centers. However, in this study we constrain the structural decomposition of an urban region into (i) its largest urban area (called central urban area), and (ii) its attached urban areas, where the time distance between areas is small enough to allow for frequent commuting and face-to face contacts.

We use two complementary frugal models. In the first model suppliers of services in an urban region make choices about location and output capacity, and those choices depend on each supplier's distance-discounted access to demand (demand accessibility). Increased access to

demand stimulates differentiation of service supply. In the second model all firms make location and output choices that depend on the each firm's distance-discounted access to the supply of business/producer services. With this approach we try to shed light on a two-pronged research question associated with New Economic Geography (NEG). First, we provide an explanation of the structure of an urban agglomeration, describing where firms in different sectors have decided to locate their activities, ranging from service supply to manufacturing products. Second, we consider a model formulation that implies that agglomeration economies are associated with a disproportionate expansion of jobs in knowledge-intensive producer services and household services. The increased diversity that follows such an expansion is referred to in the literature as the Jacobs hypothesis (Jacobs, 1984).

An extension of Jacobs hypothesis is found in models in which increasing returns in an urban region are assumed to be generated by a diversified monopolistic-competition industry in the region producing a variety of intermediate inputs, where the multiplicity of differentiated inputs raise the productivity of firms using the inputs. Proponents of this approach to identify the causes of agglomeration economies are Matsuyama (1995), Rivera-Batiz (1988), Fujita and Thisse (2002). In the subsequent presentation we suggest that local business-service suppliers have the described productivity effect on export-oriented manufacturing firms in each urban region. The crucial mechanism is that increasing service supply also implies increasing differentiation of accessible services, and broader scope of differentiation enables firms to enhance their productivity and expand their output.

For suppliers of business services we stress that the pertinent firms make location decisions that consider the size of the demand potential associated with their respective location. A similar argument applies to suppliers of household services (Fujita and Thisse, 2002). Also for these suppliers the distance-discounted demand affect their revenues and possibility to survive. Moreover, as the diversity of household services in an agglomeration increases, new households are attracted to the agglomeration, which implies that urban agglomeration stimulates expansion of both labor supply and job demand. In view of this, we have strong reasons to compare the role of producer and consumer services in the process of agglomeration dynamics.

In a recent paper Johansson and Klaesson (2011) present a model depicting how the change of business-service supply in each urban area responds to the area's market potential, sub divided into local, intra-regional and extra-regional market potential. The empirical result, based on a non-linear specification, indicates that business-service supply grows as the local and intra-regional market potential becomes sufficiently large. In contradistinction, other sectors of the economy exhibit a different pattern of location change.

The ambition in Johansson and Klaesson is to examine how location decisions made by a business-service firm are influenced by the firm's demand potential (access to customer demand). In Johansson, Johansson and Wallin (2013), the second perspective is accentuated by showing that the development of new export products is positively stimulated by knowledge flows associated with the distance-discounted access to supply of knowledge-intensive business services. In this perspective the focus is on how knowledge milieu of an urban region can augment knowledge creation and innovation, following suggestions in Feldman and Audretsch (1999) and Fujita and Thisse (2002).

2.2 Accessibility Structures of Urban Agglomerations

Following the literature presented in the preceding sub section, this paper presents a model of the structure of an urban region, composed by urban areas (urban centers or locations), signified by r and s as indexes. Consider that r is any urban area in an urban region R . Then $s \in R(r)$ denotes a neighboring urban area, s , in the same region as r . The interaction between two urban areas, r and s , is assumed to be influenced by the time distance, t_{rs} , between the areas, while the interaction inside an urban area r is influenced by the average distance, t_{rr} , between zones inside area r .

Consider now the category of firms where each firm primarily supplies its output to local and intra-regional customers. A major part of these firms are service suppliers. For these firms we may define their local market or demand potential, M_r , and their intra-regional market potential, $MR_{R(r)}$, in the following way:

$$MR_r = \exp -\lambda_1 t_{rr} W_r \quad (2.1)$$

$$MR_{R(r)} = \sum_{s \in R(r)} \exp -\lambda_2 t_{rs} W_s \quad (2.2)$$

where W_s represents the customer demand in area s , λ_2 is the intra-regional time sensitivity for supplier-customer interaction, and where $\exp -\lambda_2 t_{rs} W_s$ is the distance-discounted demand originating in area s . Moreover, λ_1 is the local time sensitivity for supplier-customer interaction inside urban area r . We note that if a firm's sales to customers in area s are proportional to $\exp -\lambda_2 t_{rs} W_s$, the sales will reduce as λ_2 attains higher values and as t_{rs} increases. Previous studies indicate that $\lambda_2 > \lambda_1$ (Johansson, Klaesson and Olsson, 2003).

A similar specification of market potential as in (2.1) and (2.2) was proposed in Lakshmanan and Hansen (1965). The two formulas are interpreted as accessibility measures in Weibull (1976), and several scholars have shown that the type of measures given in (2.1) and (2.2) can be derived from random choice theory (e.g. Mattson, 1984; Johansson and Klaesson, 2011).

As the next step we turn to individual firms' proximity to suppliers of local inputs, especially service suppliers. Thus, we consider how a particular firm's opportunities to find a desirable composition of local inputs depend on the distance-discounted supply of input alternatives. To capture how a firm's location in an urban region affects its productivity we introduce the concept of the firm's input-supply potential or just supply potential. In this case we focus on the supply potential associated with business-service supply.

By analogy with our discussion of the demand potential, a firm in an urban region has a local supply potential, S_r and an intra-regional supply potential, $S_{R(r)}$ specified in formulas (2.3) and (2.4).

$$S_r = \exp -\lambda_1 t_{rr} V_r \quad (2.3)$$

$$S_{R(r)} = \sum_{s \in R(r)} \exp -\lambda_2 t_{rs} V_s \quad (2.4)$$

where V_s denotes the supply of business services in urban area s , and where λ_1 and λ_2 denote local and intra-regional time sensitivity, respectively. In view of the theoretical suggestion from previous literature we may conjecture that firms in urban region r will experience increasing returns from an expansion of S_r and $S_{R(r)}$.

Sub section 2.2 suggests (for each urban region) that there is a coupling between the size of the demand potential of business-service firms and the service-supply potential directed towards service-purchasing firms. Such a coupling indicates the possibility of cumulative dynamics as described in Figure 1.

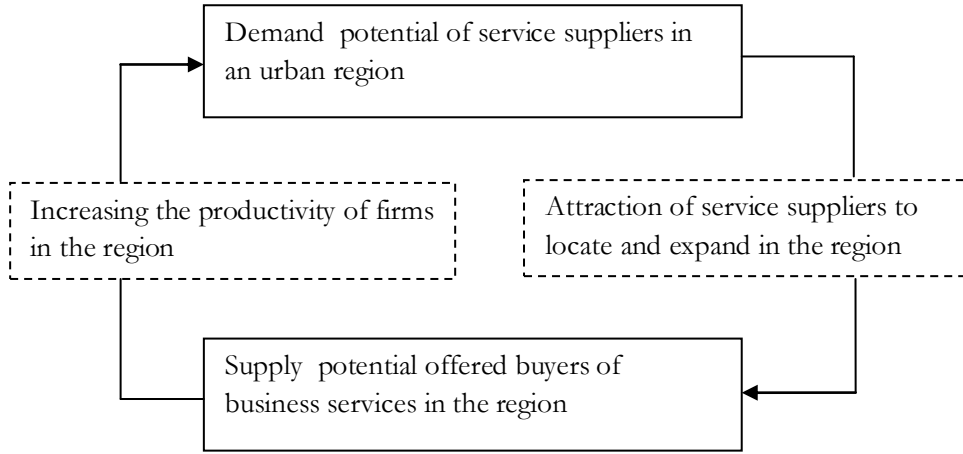


Figure 1: *Presence of cumulative dynamics affecting urban growth and decline*

2.3 Endogenous Determination of Time Sensitivity

In a sequence of papers the authors have presented and estimated parameterized models using accessibility measures of the kind specified in (2.1)-(2.4) (Johansson, Klaesson and Olsson, 2002 and 2003; Johansson and Klaesson 2011). In these contributions the λ -values have been imported from estimations based on modes of individuals' labor commuting behavior. In the present paper the time-sensitivity parameter is determined endogenously as an integral part of the regression approach.

We consider five different sector aggregates, and for each sector we observe the number of jobs, denoted by E . The sectors are KIBS, OBS, household services, knowledge-intensive manufacturing and ordinary manufacturing. All these sectors will be compared with regard to how their location is explained by (i) their demand potentials M_r and $M_{R(r)}$ and by (ii) their

supply potentials S_r and $S_{R(r)}$. In addition, we investigate how the number of jobs in each urban area can be explained by each area's demand and supply potentials.

At this stage we emphasize that each of the four measures $M_r(\lambda_1)M_{R(r)}(\lambda_2), S_r(\lambda_1)$ and $S_{R(r)}(\lambda_2)$ are all functions of the different time-sensitivity parameters. At the same time we want to avoid using exogenous λ -values. Instead we intend to determine the different λ -values as an integral part of the entire estimation procedure. This is done by running our regressions for systematically adjusted λ -values to finally settle with the regression that maximizes R-square.

We first outline the procedure for a regression model in which the dependent variable is the number of KIBS-jobs, E_r , in each urban area r . The regression equation is specified to generate parameters that have the form of elasticities. When the explanatory variables are the local and intra-regional demand potentials, the following specification applies:

$$\ln E_r = \alpha + \beta_1 \ln M_r(\lambda_1) + \beta_2 \ln M_{R(r)}(\lambda_2) + \varepsilon \quad (2.5)$$

where ε is an error term and where we note that we can apply the approach in (2.5) for all five sectors and then compare the λ - and β - parameters for all five sector aggregates. The pattern of job location can according to our framework also be influenced by the business-service supply potentials, and for this purpose we estimate the following regression equation for all sector aggregates except the KIBS-sector:

$$\ln E_r = \alpha + \beta_1 \ln S_r(\lambda_1) + \beta_2 \ln S_{R(r)}(\lambda_2) + \varepsilon \quad (2.6)$$

The regression results associated with equations (2.5) and (2.6) invites to interpret the estimated λ -values as the general business-interaction friction, whereas the associated β -parameters inform about the strength of each sector's response to the friction pattern.

The two equations (2.5) and (2.6) refer to the pattern job location at particular points in time and hence the estimates provide a static picture. Now, our setting opens the possibility to also depict the change process between time t and $t + \tau$, conditioned values of demand potentials and supply potential at date t . This gives us the following two sets of change-process regression equations as specified in (2.7) and (2.8):

$$\ln(E_{r,t+\tau} / E_{r,t}) = \alpha + \beta_1 \ln M_{r,t}(\lambda_1) + \beta_2 \ln M_{R(r),t}(\lambda_2) + \varepsilon \quad (2.7)$$

$$\ln(E_{r,t+\tau} / E_{r,t}) = \alpha + \beta_1 \ln S_{r,t}(\lambda_1) + \beta_2 \ln S_{R(r),t}(\lambda_2) + \varepsilon \quad (2.8)$$

The system in (2.5)-(2.8) makes it possible to examine and discuss to what extent the accessibility structure of a location affects the location pattern in a similar way for our different sectors of the economy. In addition, the four equations can be applied with separate regressions for the 72 central (largest) urban areas and for the group of other areas. Such an exercise can reveal if the central urban areas play a different role in the determination of sector location.

3 Reference Models of Agglomerative Forces

In the previous presentation we have referred to two different contributions of New Economic Geography (NEG). The first one has become the trade mark of Krugman (1991) and emphasizes “the home market effect, which corresponds to our concept “demand-potential effect”. The second contribution addresses the importance for a firm (and a sector) to have access of a rich variety of differentiated service inputs. Such diversity is considered to increase productivity (Quigley, 1998; Rivera-Batiz, 1988) and corresponds to our concept “supply-potential effect”. In this section the two NEG contributions are further discussed by means of two reference models – one for the demand potential and the other for the supply potential.

3.1 Demand Potential of Locations in an Urban Region

We consider a firm in location r that supplies local services to customers in location r and in locations s that are embedded in the same urban region as r . The service firms supply differentiated products in a monopolistic-competition framework. Our stylized model depicts a variety group where each firm produces an idiosyncratic variety, where all firms that supply a variety belonging to the group have similar demand and cost conditions. We consider a typical firm in r supplying variety i , while facing the following demand, x_{ri} , as derived in Andersson and Johansson (2012) from CES demand conditions:

$$x_{ri} = \delta_i G_i(M_r, M_{R(r)}) p_i^{-\theta} \quad (3.1)$$

where p_i is the price charged, θ is the common price elasticity that applies to all varieties in the variety group, δ_i is a variable that reduces as the number of varieties in the variety group increases, and where the two demand potentials M_r and $M_{R(r)}$ are defined in (2.1)-(2.2). With the demand function in (3.1), the optimal price for all varieties in the variety group becomes $p = \theta/(\theta-1)v$, where v is the variable cost per unit output that applies to all varieties in the same group. Moreover, each firm has a fixed cost F , which implies that a feasible market solution

$$p \geq v + F/x_{ir} + \rho_r \quad (3.2)$$

where ρ_r represents land-value costs per unit output associated with a location in r . From (3.1) it is obvious that for sufficiently small elasticity values, x_{ri} will get large as the price is increased. Inspecting (3.2), we can see that as x_{ri} grows F/x_{ri} becomes smaller and thus there exists a feasible solution. The crucial argument now is that as the demand potentials M_r and $M_{R(r)}$ grow, $G_i(M_r, M_{R(r)})$ will grow and x_{ri} can get larger. However, with free entry, this expansion will materialize in an increasing number of varieties that can satisfy the feasibility condition in (3.2). The equilibrium number of varieties obtain when (3.2) is satisfied as an equality. We may also observe that conventional land-value models predict

that ρ_r is a positive function of both M_r and $M_{R(r)}$, reflecting that many firms want to locate in places where $G_i(M_r, M_{R(r)})$ is large.

3.2 Supply Potential of Locations in an Urban Region

In this subsection we outline a perspective in which the location of KIBS firms is taken as given at each point in time. Each such firm has a location r or $s \in R(r)$ and supplies an intermediary service input i . Consider then a sector located in r which uses each input in proportion to the accessible supply as given by (2.3)-(2.4). We assume that each service firm i produces the amount q , which means that $V_s \approx n_s q$ determines the number of service varieties supplied in location s . From this we can determine the values $S_{ir} = S_r / n_r$ and $S_{jR(r)} = S_{R(r)} / n_{R(r)}$ and then introduce the assumption (Fujita and Thisse, 2002) that the productivity, Q_r of the sector in r is positively affected by input diversity as expressed in the following formula:

$$Q_r = \left[\sum_i S_{ir}^\sigma \right]^{1/\sigma} + \left[\sum_j S_{jR(r)}^\sigma \right]^{1/\sigma} \quad (3.3)$$

Given the productivity-enhancing mechanism in (3.3) we can also conclude that sectors will be attracted to locate in an area r with high values on the supply potentials S_r and $S_{R(r)}$. This agglomeration force represents the second feedback that is illustrated in Figure 1. In summary, sectors are attracted to locate and expand in urban areas with higher than average supply potential, and when such sectors grow they stimulate additional service-producing firms to operate in the same urban area. When density gets higher, the accessibility advantage may reduce, based on increased time distances, and in this way growth in certain areas may come to a halt.

One may remark that the supply capacity of business services is measured empirically by observing the number of jobs which may be considered as a crude measure. An alternative would be to weigh jobs by using information about wage levels for different jobs.

4 Data, Descriptive Statistics and Method

4.1 Geography of Urban Areas and Regions

The empirical analysis is based on observations of urban areas, which correspond to local government areas called municipalities. The time span of observations is 2000-2008 and the number of municipalities is 290. The analysis employs a time distance matrix which informs about the travel time by car between each pair of urban areas. In addition, there is information about the average time distance between zones in each urban area.

Urban areas are grouped into 72 urban regions, which are delineated on the basis of time distances and commuting flows. Three urban regions (Stockholm, Gothenburg and Malmö) are labeled large, with more than one million inhabitants. Another set of regions are classified as medium-sized, with more than 100 000 and less than 1 000 000 inhabitants. The remaining 49 regions are recognized as small.

Table 1 provides an overview of population change in the period 2000-2008. The picture is clear: Large (metropolitan) regions have grown by more than 8 per cent, medium-sized regions have grown moderately and small regions have – as group – declined.

Table 1: *Development of population between 2000 and 2008 in three categories of regions*

	2000	2008	Change	Change %
Large	4104994	4447519	342525	8.3
Medium	3495038	3573934	78896	2.3
Small	1269107	1234894	-34213	-2.7
Total	8869139	9256347	387208	4.4

Source: Statistics Sweden

Demand and supply potentials are both positively related to the population size of urban regions. In view of this we may remark that urban growth is clearly correlated as illustrated in Figure 2, where the growth between 2000 and 2008 is regressed against the population size at the beginning of the period.

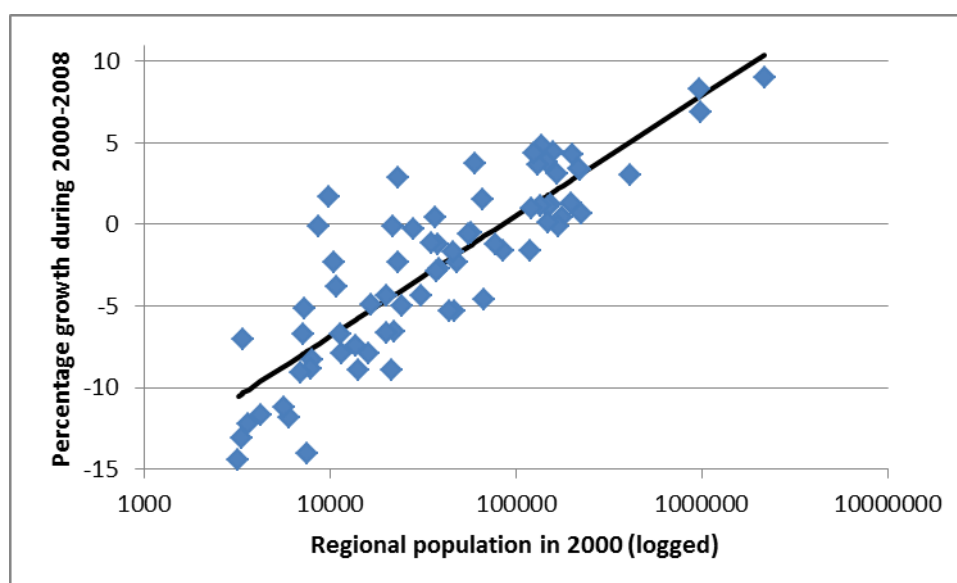


Figure 2: *Relationship between regional size and growth*

(Source: Statistics Sweden)

4.2 Sector Aggregates and Sector Characteristics

In the empirical study, the economy of each urban area is divided into five sector aggregates as described in Table 2. Our main focus is on knowledge-intensive business services (KIBS) and knowledge-intensive manufacturing, where KIBS are assumed to locate and develop in response to the size of the demand potentials based on all sectors of the economy, arguing that all firms are KIBS-sector customers. Knowledge-intensive manufacturing is instead assumed to be dependent on the KIBS-based supply potential, reflection outsourcing of knowledge-based development activities supplied by KIBS-firms. A third issue is find out similarities between business and household services in their response to accessibility structures in urban areas.

Table 2: *Composition of sector aggregates*

Sector aggregates	Activities
Knowledge intensive business services	Legal activities, Computer and related activities, Research and development, Insurance and banking
Less knowledge intensive business services	Renting of machinery, Auxiliary transport activities, Wholesale, Real Estate, Education
Household services	Hotels and restaurants, Retail, Health and social work
Knowledge intensive manufacturing	Chemicals, Computers and telecom, Precision instruments, Pharmaceuticals
Less knowledge intensive manufacturing	Wood, Metal, Food and beverages, Plastics
Rest of the economy	Agriculture, Construction, Mining, Water supply

Source: Statistics Sweden

Table 3 presents the relative size of the five sector aggregates in the entire Swedish economy. In sectors that are classified as knowledge intensive more than 30 per cent of the employment have at least three years of university studies. For household services there is a marked difference maximum and minimum values among observations.

Table 3: *Employment shares for five sectors of the Swedish economy 2000 and 2008*

	2000	2008	Absolute change	Change in %
Knowledge intensive business services	10.3	12.1	114777	27.4
Less knowledge intensive business services	12.9	12.3	17666	3.4
Household services	47.4	49.6	265504	13.8
Knowledge intensive manufacturing	5.0	3.6	-45234	-22.2
Less knowledge intensive manufacturing	13.9	12.0	-35849	-6.4

Rest of the economy	10.4	10.4	38055	9.0
Total	100	100	354919	8.8

Source: Statistics Sweden

Table 4 presents the same type of information as found in Table 3, but now with observations specified for each type of urban region. There are three structural changes. First, the number of persons employed in manufacturing industries reduces in a marked way: Second, the employment in KIBS-firms increase fast, Third, there is a considerable increase of jobs in household services, where much of the growth takes place in the three largest urban regions.

Table 4: Sector growth 2000-2008 by regional category (percentage growth in parenthesis)

Region type	Large	Medium	Small	Total
Knowledge intensive business services	67984 (24.4)	37606 (34.1)	9187 (31.3)	114777 (27.4)
Less knowledge intensive business services	12970 (4.0)	3200 (2.0)	1496 (3.5)	17666 (3.4)
Household services	162628 (18.3)	87870 (11.4)	15006 (5.8)	265504 (13.8)
Knowledge intensive manufacturing	-19446 (-17.1)	-21413 (-31.1)	-4375 (-20.2)	-45234 (-22.2)
Less knowledge intensive manufacturing	-8267 (-5.0)	-20716 (-7.5)	-6866 (-5.5)	-35849 (-6.4)
Rest of the economy	6467 (3.4)	21535 (13.2)	10053 (14.7)	38055 (9.0)

Source: Statistics Sweden

4.3 Specification of Dependent and Independent Variables and Interpretations

In the empirical analysis a basic distinction is made between the 72 central and 218 non-central urban areas, by making separate regressions for these two groups. A structural difference between the two groups is that for a central urban area M_r (local demand potential) is large relative to $M_{R(r)}$ (intra-regional demand potential), whereas the opposite applies for non-central urban areas.

For each of our two groups of urban areas we have two sets of dependent variables, describing (i) location pattern and (ii) location dynamics, respectively. The first set contains

the number of jobs in each urban area with regard to five sector aggregates, represented by E_r^1, \dots, E_r^5 , where E_r^k is the number of sector k jobs in area r and where $k=1$ refers to the KIBS sector, and where all sector numbers are given in Table 4. The regressions which aim at explaining the E -values are carried out for $k = 1, \dots, 5$. Regression equations have $\ln E_r^k$ as dependent variable.

The second set of dependent variables contains indicators intended to depict the location dynamics. These indicators are represented by $\ln(E_r^k(t+\tau)/E_r^k(t))$, where $t = 2000$, $\tau=8$ and $k = 1, \dots, 5$. This implies that the indicator describes the change of jobs for an eight years period, and the change is measured as a growth rate.

The first objective is to match the variables E_r^1, \dots, E_r^5 against the demand potentials $M_r = \exp -\lambda_1 t_{rr} W_r$ and $M_{R(r)} = \sum_{s \in R(r)} \exp -\lambda_2 t_{rs} W_s$ which both reflect the distance-

discounted value of the wage sum in area r and in the other areas in the same region. We first observe that the wage sum reflects the purchasing power of each urban area, and that it for most urban areas is approximately proportional to gross regional product of each area. This is a relevant argument for the KIBS-sector which has all firms in each local economy as possible customers, whereas this does not apply to the manufacturing sector.

The wage sum is assumed to capture the size of potential customer demand (the size of the economy in the urban area). For the sector of KIBS-suppliers this is obviously a meaningful demand indicator, implying that KIBS-suppliers are attracted to locate in area r in proportion to the size of $M_r = \exp -\lambda_1 t_{rr} W_r$ and $M_{R(r)} = \sum_{s \in R(r)} \exp -\lambda_2 t_{rs} W_s$, where W_s is the wage

sum in urban area s . Given this, we apply the same regressions to sector 2, 3, 4 and 5 in order to compare estimation result across all five sectors. The main interest is however to explain the temporary (static) location pattern of KIBS-supply.

The second objective is to examine for the KIBS-sector how the change indicator responds to the local and intra-regional demand potentials. In other words, in this case we investigate to which extent the change process can be explained by same independent variables as those that we have used to explain the location pattern. We may observe that the local and intra-regional demand potential are in a fundamental way essential for firms in the sectors KIBS, OBS, and household services. Hence, the growth of jobs in these sectors is in trivial way affected by the size of M_r and $M_{R(r)}$. The location change of manufacturing jobs may be correlated with these measures as an indirect effect of the fact that the KIBS-supply potential in area r is high when M_r and $M_{R(r)}$ have high values. Thus, a spurious correlation.

The second objective of the study is to show that the KIBS-supply potentials of each area function as an additional agglomeration factor that affects the location pattern, E_r^2, \dots, E_r^5 , and the location change, $\ln(E_r^k(t+\tau)/E_r^k(t))$ for $k = 2, \dots, 5$. We observe that since the KIBS-sector supply is an explanatory factor, it is not included in the set of dependent variables.

For each urban area r , the local and the intra-regional supply potentials are given by the following two expressions: $S_r = \exp -\lambda_1 t_{rr} V_r$ and $S_{R(r)} = \sum_{s \in R(r)} \exp -\lambda_2 t_{rs} V_s$. The non-discounted KIBS-supply capacity in urban area s is given by V_s . How can we observe and measure this capacity? There are two alternatives in the data set that has been available for this study: V_s can, for urban area s , represent either the wage sum or the number of jobs of KIBS firms. We think that the latter may better reflect the KIBS-supply capacity.

4.4 Estimation Method and Hypotheses

The equations too be estimated are introduce in formulas (2.5)-(2.8). The equations will here be specified in more detail to clarify the estimation procedure. The location-pattern equations refer to one point in time ($t = 2008$) and have the following specification:

Location pattern, demand potential:

$$\ln E_r^k = \alpha^k + \beta_1^k \ln M_r(\lambda_1^k) + \beta_2^k \ln M_{R(r)}(\lambda_2^k) + \varepsilon, k = 1, \dots, 5 \quad (2.5')$$

Location pattern, supply potential:

$$\ln E_r^k = \alpha^k + \beta_1^k \ln S_r(\lambda_1^k) + \beta_2^k \ln S_{R(r)}(\lambda_2^k) + \varepsilon, k = 2, \dots, 5 \quad (2.6')$$

Regressions are carried out for each sector k separately. Each regression is made for a given pair $(\lambda_1^k, \lambda_2^k)$, and then the regressions for new λ -pairs until the objective of a maximized value of R-square is reached. As a consequence, the λ -pairs may vary between sectors. The constraints applied to the optimization procedure comprise: (i) $\lambda_2^k > \lambda_1^k > 0$, (ii) $\beta_1^k > \beta_2^k > 0$. In case multiple optima are present, these constraints serve to prevent the appearance of optima that are not meaningful according to location theory.

For the location change process we consult equations (2.7) and (2.8) which are re-specified as follows:

Location change, demand potential:

$$\ln(E_{r,t+\tau}^k / E_{r,t}^k) = \alpha^k + \beta_1^k \ln M_{r,t}(\lambda_1^k) + \beta_2^k \ln M_{R(r),t}(\lambda_2^k) + \varepsilon, k = 1, \dots, 5 \quad (2.7')$$

Location change, supply potential:

$$\ln(E_{r,t+\tau}^k / E_{r,t}^k) = \alpha^k + \beta_1^k \ln S_{r,t}(\lambda_1^k) + \beta_2^k \ln S_{R(r),t}(\lambda_2^k) + \varepsilon, k = 2, \dots, 5 \quad (2.8')$$

The estimation procedure is the same for the location-change regressions as for the location pattern regressions, with similar constraints guiding the search for optimal λ -pairs. What do we expect? First, we would like to find that across all regressions the pairs $(\lambda_1^k, \lambda_2^k)$ remain approximately invariant. Second, we would like to see that – for each of the two types of demand-potential regressions – the KIBS-sector has higher β_1^1 - and β_2^1 -parameters than any other sector $k = 2, \dots, 5$. Moreover, we would expect that manufacturing has higher supply-potential β_1^1 - and β_2^1 -parameters than other sectors.

5 Regression Results and Interpretation

KIBS = Knowledge intensive business services

LKIBS = Less knowledge intensive business services

HS = Household services

KIM = Knowledge intensive manufacturing

LKIM = Less knowledge intensive manufacturing

Table X.X: *Central urban areas: Market potential explaining the location of economic sectors*

	KIBS	LKIBS	HS	KIM	LKIM
Intercept	-2.15	-1.62	1.94	-3.14	-88.51
(t=)	(-7.49)	(-5.58)	(19.11)	(-3.38)	(-4.94)
Local	1.30	1.13	0.94	1.11	0.74
(t=)	(36.11)	(37.97)	(56.37)	(12.77)	(20.71)
Regional	-0.15	-0.02	-0.06	0.04	6.63
(t=)	(-4.09)	(-0.75)	(-4.49)	(0.42)	(5.03)
R2	0.96	0.96	0.99	0.77	0.87
Lambda1	0	0	0.0011	0.0046	0.0127
Lambda2	0.0224	0.0144	0.0401	0.0122	0.0002

Table X.X: *Non-central urban areas: Market potential explaining the location of economic sectors*

	KIBS	LKIBS	HS	KIM	LKIM
Intercept	-2.70	-1.67	1.53	-3.54	4.18
(t=)	(-8.58)	(-7.64)	(10.64)	(-6.61)	(13.99)
Local	1.14	1.08	0.91	1.28	0.91
(t=)	(24.36)	(32.96)	(41.27)	(13.05)	(15.62)
Regional	0.11	0.09	-0.02	-0.02	-0.39
(t=)	(5.08)	(6.40)	(-2.06)	(-0.51)	(-9.78)
R2	0.82	0.89	0.91	0.56	0.54

Lambda1	0	0	0	0.0225	0.0305
Lambda2	0.5276	0.4243	0.3038	0.1711	0.0722

Table X.X: *Central urban areas: Market potential explaining the growth of economic sectors*

	KIBS	LKIBS	HS	KIM	LKIM
Intercept	0.88	-0.39	-0.14	-1.47	-0.38
(t=)	(5.33)	(-4.50)	(-2.20)	(-2.72)	(-2.61)
Local	-0.09	0.06	0.02	0.03	0.03
(t=)	(-3.25)	(3.29)	-2.50	(0.45)	(1.29)
Regional	0.03	-0.01	0.01	0.10	0.01
(t=)	(1.66)	(-0.70)	(1.10)	(1.70)	(0.39)
R2	0.13	0.18	0.24	0.07	0.05
Lambda1	0	0.0182	0	0	0.0039
Lambda2	0.0933	0.0759	0.1394	0.0376	0.042

Table X.X: *Non-central urban areas: Market potential explaining the growth of economic sectors*

	KIBS	LKIBS	HS	KIM	LKIM
Intercept	0.38	-0.25	0.02	0.26	-0.58
(t=)	(5.14)	(-3.05)	(2.51)	(0.70)	(-2.83)
Local	0	0.05	0.00	-0.15	0.01
(t=)	(-0.26)	(3.41)	(1.53)	(-2.48)	(0.27)
Regional	-0.02	-0.07	0.02	0.08	0.04
(t=)	(-1.21)	(-1.40)	(6.89)	(2.19)	(2.04)
R2	0.01	0.05	0.33	0.03	0.03
Lambda1	0.1479	0.075	0.3388	0	0
Lambda2	0.5598	1.268	0.3578	0.086	0.0225

Table X.X: *Central urban areas: Supply potential explaining the location of economic sectors*

	KIBS	LKIBS	HS	KIM	LKIM
Intercept	0.00	1.82	4.58	0.90	5.42
(t=)	(-6.93)	(11.37)	(37.74)	(2.58)	(38.47)
Local	1	0.81	0.66	0.82	0.41
(t=)	(xxxx)	(32.34)	(35.74)	(14.97)	(16.45)
Regional	0	0.07	1.05	-xxxx	xxxx
(t=)	(-2.05)	(1.26)	(0.67)	(-0.44)	(1.70)

R2	1	0.95	0.95	0.75	0.79
Lambda1	0	0.0109	0.0105	0.0208	0.0679
Lambda2	0.402	0.5227	1.4847	5.0077	4.9256

Table X.X: *Non-central urban areas: Supply potential explaining the location of economic sectors*

	KIBS	LKIBS	HS	KIM	LKIM
Intercept	0	1.41	4.45	0.74	7.05
(t=)	(-10.4)	(8.17)	(34.5)	(2.34)	(28.60)
Local	1	0.70	0.64	0.89	0.45
(t=)	(xxxx)	(19.49)	(25.14)	(11.76)	(8.05)
Regional	0	0.12	-0.05	-0.08	-0.29
(t=)	(-6.69)	(4.45)	(-2.91)	(-1.68)	(-5.94)
R2	1	0.80	0.81	0.49	0.24
Lambda1	0	0.0003	0	0.0441	0.0708
Lambda2	0.5	0.0713	0.4875	0.3753	0.0749

Table X.X: *Central urban areas: Supply potential explaining the growth of economic sectors*

	KIBS	LKIBS	HS	KIM	LKIM
Intercept	0.79	-9.72	-0.08	-1.24	-0.27
(t=)	(7.73)	(-1.89)	(-2.15)	(-3.01)	(-2.66)
Local	-0.09	0.05	0.02	0.03	0.02
(t=)	(-4.66)	(4.4)	(3.03)	(0.57)	(1.28)
Regional	0.03	0.73	0.00	0.09	0.00
(t=)	(2.21)	(1.83)	(0.75)	(1.62)	(0.29)
R2	0.23	0.20	0.27	0.06	0.04
Lambda1	0	0.0021	0.0114	0	0.0228
Lambda2	0.09	0.0001	0.1305	0.0373	0.0417

Table X.X: *Non-central urban areas: Supply potential explaining the growth of economic sectors*

	KIBS	LKIBS	HS	KIM	LKIM
Intercept	0.55	-0.45	0.02	-0.05	-0.56
(t=)	(4.92)	(-2.03)	(2.73)	(-0.23)	(-3.16)
Local	-0.11	0.02	0.01	-0.12	0.01
(t=)	(-4.53)	(1.22)	(1.95)	(-2.60)	(0.78)
Regional	0.04	0.04	0.02	0.07	0.04
(t=)	(2.25)	(1.60)	(5.73)	(2.38)	(2.10)
R2	0.10	0.05	0.32	0.04	0.04

Lambda1	0.0286	0.0839	0.2232	0.002	0
Lambda2	0.0664	0.0162	0.2971	0.0942	0.019

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