The Internal Structure of Cities:

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5 Co-agglomeration of knowledge intensive business services and multinational enterprises*

5.1 Introduction

The spatial behaviour of knowledge-intensive business services (KIBS) as well as their contribution to regional growth and innovation systems has gained growing scholarly attention over the last decade (Miles et al., 1995; Den Hertog, 2000; Müller and Zenker, 2001; Wood, 2002; Keeble and Nachum, 2002; Koch and Stahlecker, 2006). It has been argued that within innovation processes and policy there is a need for a more service-oriented focus besides the traditional emphasis on manufacturing-related research and development (Wood, 2009). Service innovation is much more 'hidden' because it is less traceable (e.g. through patents) and more implicit and tacit in nature. Service innovation relies on close interaction, on cognitive proximities and on customer-specific, intangible products. Moreover, innovation in services and the presence of KIBS are considered to be crucial for the development of a city's international competitiveness in the knowledge-based economy (OECD, 2005; Raspe and Van Oort, 2006; Simmie and Strambach, 2006).

In addition to the observation that KIBS act as creators, carriers and diffusers of knowledge, geographers and economists have begun to analyse the locational behaviour of KIBS. In empirical case studies, scholars have suggested that KIBS cluster in large metropolitan areas due to the agglomeration benefits they enjoy with their (globally operational) clients (Keeble and Nachum, 2002; Shearmur and Avergne, 2002; Shearmur and Doloreux, 2008; Müller and Doloreux, 2009). This is related to theory on agglomeration economies, which concerns itself with the presence of positive externalities that stem from the localisation of similar types of industry. As already stressed in previous chapters, these positive externalities include, most notably, input sharing, knowledge spillovers and a specialised labour force, which result in increasing returns to scale. The argument can also be made that the co-location of KIBS and their (international) clients stems from other externalities generated by urban density, which include the availability of urban amenities, the cosmopolitan atmosphere of a place, the presence of universities and government administration, and easily accessible, internationally well-connected transportation hubs. It is often argued that it is the diversity of economic activity, offered by large cities, that leads to the development of new products, services and markets (Frenken et al., 2007).[91] Other reasons for co-location of firms than learning and profiting from urban externalities may also be important. For instance, a similar need for real estate categories, a common consumer or labour

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[91] This explanation of the co-location of KIBS (or what is referred to as advanced producer services) with corporate headquarters of MNE-clients within the CBDs of vibrant and diverse urban settings, also forms the basic premise of Sassen's (2002) thesis on the 'global city'.

market, zoning and regulation may be important determinants of co-location of firms as well (Hayter, 1997; DiPasquale and Wheaton, 1996; Capello, 2007).

Explaining the location pattern of KIBS, however, becomes less straightforward on the intra-metropolitan level and on sub-sectoral levels of the types of KIBS. Porter (1995) argues that the most obvious place for KIBS and multinational enterprises (MNEs) to (co)locate is in inner cities because there is where one finds the four 'true advantages of the inner city': market access, strategic location, human resources and the integration possibilities with regional clusters. Although the inner city is still regarded as favourable location of KIBS and MNEs (see for a recent reappraisal Hutton, 2008), other assessments after Porter (1995) indicate that the inner city or central business district (CBD) is not the only 'true' location that can provide these advantages. For example, because smaller-sized KIBS and start-ups face barriers in their attempt to enter metropolitan cores (e.g. high office rents), they might opt for decentralised locations within the metro-area, whereas on the sub-sectoral level certain specialised types of KIBS may prefer suburban office parks to traditional CBDs (see Keeble and Nachum, 2002 for Greater London; see Shearmur and Avergne, 2002 for Ile-de-France).

More fundamentally, the impact of multinational enterprises on the birth of knowledge intensive business services within a regional economy has not been satisfactorily studied. The lack of such empirical research is surprising given the fact that many researchers have highlighted the importance of the co-location of multinational head offices and business services in the metropolitan cores of world cities (see Sassen, 2002; Taylor, 2004). Co-location suggests the presence of dynamic urbanisation externalities, with both populations benefiting from each other's presence, resulting in innovations and new firm formation. Locations that host MNE head offices are also reservoirs of human capital and increase the likelihood of new firm formation through spin-offs and spinouts (Henderson and Ono, 2008; Avnimelech and Feldman, 2010). Research on new firm formation and entrepreneurship within KIBS-activities is, however, scarce (but see: Koch and Stahlecker, 2006).

Feser and Sweeney (2002, pp. 226-227) observe a severe disconnect between broad theories of clustering and quantitative empirical research. The main cause of the disconnect can be largely traced to the absence of reliable and accurate data measuring clustering on a detailed scale, able to test the burgeoning amount of relevant theories (like New Economic Geography and endogenous growth theory). Specifying factors hypothesised to drive clustering in detail and develop methods to isolate them is of key importance. In our analysis on co-location of KIBS and MNEs, we therefore aim for identifying and isolating relevant location specific attributes, and control for (and conclude on) them in our empirical models.

Our theoretical propositions then are as follows: 1) geographical proximity with clients (like MNEs) matters to newly founded KIBS; 2) spatially bounded, cumulative causation effects foster entrepreneurship among KIBS; and 3) corporate head offices are more likely to spawn newly founded firms that locate in their vicinity. Based upon these propositions we would expect that the proximity of multinational firms is a factor in the birth of KIBS. Our central question is therefore: does the spatial proximity of MNEs and established KIBS foster the births of KIBS-firms?[92] We test our propositions in

[92] We use the terms births, new entries and start-ups interchangeably throughout this chapter.

the so-called Northwing of the Randstad region in the Netherlands (containing the cities of Amsterdam and Utrecht). This region is similar to other "global city-regions" in Europe, like Frankfurt, Lombardy, Catalunia, and Bavaria in size, density, sector structure, and many important location factors (Thissen et al., 2012). It therefore forms a good (quantitative) case study with wider implications of our outcomes than only the Dutch case.

In addressing this empirical question, we take both a theoretical and methodological step forward. We contribute to the more theoretically grounded debate on the evolution of regionalised service economies as encouraged by Coe and Townsend (1998; see also Strambach, 2008). We examine whether location factors that matter for industrial location (summarised e.g. in Hayter, 1997) also hold for service sector activities. More specifically we want to fill the gap in research on knowledge intensive business services on the issue of entrepreneurship, especially in relation with MNEs and how this differentiates across different KIBS subsectors, and policy strategies that are related to this. Empirically, we actively take up the plea for detailed (point-process modelled) analysis in clustering posed by Feser and Sweeney (2002). Our models apply spatial-economic modelling on a refined spatial scale, approaching continuous space. Many studies within urban economics and economic geography typically use administrative spatial units when measuring agglomeration effects. This is problematic because in reality these units tend to be of different sizes, are often treated as symmetric and may induce sorting effects (Duranton and Overman, 2005; Combes et al., 2008; Briant et al., 2010). We employ the nonparametric methodology proposed by Duranton and Overman (2005) because we know the exact locations of firms (both KIBS and MNEs). We show that KIBS, KIBS-births and MNEs are all significantly localised, and also that KIBS and KIBS-births are co-agglomerated with MNEs. Subsequently, we determine the magnitude of the impact of nearby KIBS and MNEs on the number of entries of KIBS in a certain location using a conditional Logit model.

This chapter proceeds as follows. Section 5.2 presents the main conceptual argument by building on the theoretical insights of economic geography, location theory and urban economics upon which we examine our hypotheses. Section 5.3 presents our empirical methodology while the Section 5.4 presents the data. In Section 5.5 the results will be presented and discussed. In Section 5.6 we draw conclusions, address policy implications, and discuss limitations of the current study and further avenues of research.

5.2 Regionalised service economies: innovation, agglomeration, scale and entrepreneurship

A. Literature

The goal of this literature review is to further frame the discussion as introduced above and address empirical hypotheses. A large body of empirical literature has emerged in the field of regional science and urban economics that examines the question of whether spatial circumstances give rise to agglomeration economies that endogenously induce localised economic growth. Many of these empirical studies convincingly show that agglomeration economies may be one source of the uneven distribution of economic activities and economic growth across cities and regions. In their survey of this empirical literature on the benefits of agglomeration, Rosenthal and Strange (2004) point out that the elasticity of productivity to city and industry size typically ranges between three and eight percent. We showed in Chapter 3 and 4 that these benefits may be even larger in the office market. The effect of agglomeration economies on localised firm behaviour can be expected to differ, however, across sectors, space, and time (Van Oort et al., 2012). At the same time, little is known about the importance of agglomeration economies for the location decisions of individual firms. Although the scarcity of firm level evidence in the locational choice and agglomeration literature can be ascribed to data limitations and confidentiality restrictions, its absence is nevertheless disturbing, as the theories (e.g. New Economic Geography) that underlie agglomeration economies are microeconomic in nature (Martin et al., 2008). In other words, agglomeration economies do foster regional economic growth indirectly through their effect on firm performance and location decisions (Neumark et al., 2006).

It is generally accepted that, to a large extent, the international competitiveness of firms, cities and regional economies is dependent on their capacity to innovate, absorb new knowledge and talent, and insert themselves into global networks of exchange (Porter, 1995; Knight, 1995; Storper, 1997; Bathelt et al., 2004). Within this context, it is important to note that knowledge and innovation still concentrate geographically (Audretsch and Feldman, 1996) despite the advantages of improved communication systems. Some types of knowledge are so tacit that they are only absorbed by the actors who are in close cognitive proximity to each other, which is facilitated by spatial proximity (Boschma, 2005; Malmberg and Maskell, 2006).

While these insights are typically used to explain the concentration of R&D activities within clusters and industrial districts, they are also said to be relevant for knowledge intensive business services (see Müller and Zenker, 2001; Shearmur and Doloreux, 2008; Wood, 2009). Despite their heterogeneity, KIBS can be understood as having a number of defining characteristics (see Strambach, 2008). In contrast to more technology-related R&D activities, KIBS are characterised by intense interaction with clients, by their capability to simultaneously de-contextualise and customise knowledge, and by the often-intangible nature of the knowledge output they supply. The tacit-ness of knowledge involved in business service innovation, in addition to the need for intense interaction with clients, implies that spatial proximity with client firms provides significant advantages (Bennett et al., 2000). Spatial proximity facilitates the building of trust and reputation necessary for the provision of 'organisational commodities' by KIBS to globally operating clients (Sassen, 2010). It generates absorptive capacity among KIBS to tackle market demand (Nooteboom, 2000). It lowers transaction and search costs and allows both KIBS and their clients to profit from 'untraded interdependencies' (Storper, 1997). Given these characteristics, it comes as no surprise that KIBS have an urban profile (Simmie and Strambach, 2006).

According to Shearmur and Doloreux (2008), the role of KIBS in regional development in the 2000s has been studied from two different perspectives, each with their own set of causal mechanisms. The first perspective views KIBS as 'vectors of information exchange' and highlights the role KIBS play in the creation and diffusion of new knowledge in relatively closed regional innovation systems (Müller and Zenker, 2001). Endogenous growth will then be fostered through these local interactions. The second perspective takes a macro-geographical approach to the analyses of KIBS and regional development. This perspective highlights the distribution of KIBS across (pre-dominantly national) urban systems and explains the tendency of KIBS to cluster in large metropolitan areas through the presence of dynamic agglomeration externalities. The overlap between the two approaches, as identified by Shearmur and Doloreux (2008), is that they both take into account the importance of KIBS for localised learning and the development of dynamic capabilities. The difference is that the latter approach also acknowledges the importance of external linkages, most importantly those locally provided by the global networks of client firms. Indeed, as observed by Keeble and Nachum (2002, pp. 86) in their study of Southeast England, "*cluster SMEs* [Small and Medium Sized Enterprises] *are significantly more globally orientated than their decentralised counterparts, in terms of client revenues, overseas offices, collabourative arrangements and even professional staff recruitment*". The location of KIBS in proximity to the multinational head offices of clients suggests the presence of dynamic urbanisation externalities. The clustering of both KIBS and international client firms within urban centres represents a diversity of different economic activities in close proximity, which is understood to foster innovation and growth (Glaeser et al., 1992). More specifically, a large presence of MNEs within a region can provide sufficient market demand for KIBS services, allowing for start-ups to fill the gap. What is more, locations with a high number of corporate head offices are often characterised by concentrations of talent and professional networks, increasing the likelihood of local spin-offs and potential local entrepreneurs (Henderson and Ono, 2008; Avnimelech and Feldman, 2010). It might be the case that spin-offs spawn from internationally operating KIBS or through the outsourcing of KIBS-related business functions by large MNEs. At the same time, it has been argued that multinational firms act as global pipelines that distribute new knowledge and best practices into local clusters while challenging local suppliers to meet their standards (Bathelt et al., 2004; Ernst and Kim, 2002). As such, large international clients demand more from their local suppliers of business services, increasing the likelihood that these service firms will possess and develop better skills and hence have greater chance of survival.

B. Hypotheses

Our examination of the agglomeration of KIBS, their start-ups and the characteristics of their co-location with MNEs leads to a series of testable hypotheses.

Spatial concentration within local clusters provides external benefits to firms, such as better information about market opportunities and the presence of a specialised labour market. In times of overall industry growth, we can expect that the regional concentration of firms in certain locations increases over time. Therefore, we propose the following hypothesis:

H1: KIBS have become more concentrated in the urban region over time

Regionally growing KIBS may be attributed to corporate spawning in which spin-offs or spin-outs emerge from the existing KIBS populations. Spatial concentration is enhanced, as spin-offs are more likely to stay close to the mother while start-ups are more likely to emerge close to the entrepreneur's home and to their social networks (see Stam, 2007). Indeed, regions that have a concentration of firms of a certain kind tend to generate a large number of new firms of the same kind (Stam, 2010), following the logic of localisation economies. Therefore, the following hypothesis seems reasonable:

H2: Entries of KIBS in the urban region are spatially concentrated

Given the expectation that KIBS increasingly cluster over time, it can be argued that KIBS start-ups are more likely to be found in existing concentrations as competition fosters innovation and new firm formation even though competition reduces survival chances (Porter, 1996). Therefore, we hypothesise as follows:

H3: The location of entries of KIBS depends on spatial proximity to existing KIBS

Ultimately, we want to know to what extent the number of KIBS births is related to co-location with (and spatial proximity to) multinational enterprises. As argued before, MNEs may offer (dynamic) urbanisation externalities in the form of the presence of a highly skilled labour market, knowledge spillovers and a concentration of clients, among other things. Therefore, we propose the following hypothesis:

H4: The number of entries of KIBS depends on spatial proximity to MNEs

However, we should take into account the heterogeneity of KIBS. While KIBS might have some common characteristics, they also differ greatly in the type of services they provide, their client base and their location pattern within the regional economy (see Shearmur and Alvergne, 2002). Thus, we expect that the role of MNEs varies for different types of KIBS:

H5: The effect of MNEs on KIBS entries differs for subsectors of KIBS

Note that we do not hypothesise a dual causality; the presence of KIBS *start-ups* will not likely act as an incentive for MNEs to locate in a certain place. Following the logic of supply and demand, it is the business service firms that have the most to gain when locating in proximity of their clients. What is more, MNEs are less dependent on the local host environment than KIBS start-ups.

We will apply these hypotheses to one particular regionalised service economy, namely the Northwing of the Randstad in the Netherlands (Figure 5.1). The Northwing of the Randstad consists of two metropolitan cores, namely the cities of Amsterdam and Utrecht, along with a number of middle-sized cities and towns that offer more suburban environments. The case of the Northwing of the Randstad has been selected for two reasons. First, the region is generally regarded as the national centre of both internationally operating business services and foreign direct investment (see Van Oort et al., 2010). Not only are the majority of Dutch-based multinationals headquartered here (e.g. Philips, Akzo Nobel), many foreign multinationals also locate their executive and marketing and sales operations in the region (e.g. Hewlett Packard, IBM, Canon). The second reason is more policy-driven. The national government has recently designated the Northwing Randstad as an important centre of innovation and international competitiveness. A cluster policy is proposed for this region, building on new firm formation by KIBS in relation to MNEs. A good formulation of the potential of such a strategy is dependent on an understanding of the statistical relationship between KIBS and MNEs in the recent past. We now proceed by introducing our empirical methodology and our data, after which we present our results.

FIGURE 5.1 — LOCATION OF THE RANDSTAD NORTHWING IN THE NETHERLANDS

5.3 Empirical methodology

A. Measuring concentration

The first step in the empirical analysis is to test whether KIBS become more spatially concentrated over time, whether births of KIBS are localised, and whether KIBS are co-agglomerated with MNEs. Duranton and Overman (2005) argue that many measures of concentration use arbitrary spatial units (such as provinces, municipalities or postcodes), which may be problematic as it may lead to biases (see Briant et al., 2010 for a discussion).[93] We therefore use a calculation of employment concentration that is continuous over space, as we have individual, firm-level data at a very detailed level (postcode six-digit, PC6). So our data is essentially continuous over space.[94] We employ the method of Duranton and Overman (2005; 2008) to estimate kernel densities for a given industry (e.g. KIBS, MNEs) in a specific year. This concentration index controls for overall agglomeration, is comparable across industries, is invariant to scale and aggregation and provides an indication of statistical significance. Below, we

[93] More specifically, spatial units are often very different in size and are therefore not comparable. A solution is to use relative indices such as location quotients, but these measures tell us little about the absolute concentration of an industry. Further, spatial units are treated symmetrically, so firms in the neighbouring region are treated in exactly the same way as a firm which is located further away (Duranton and Overman 2005).
[94] A PC6 area is a very small area (comparable to the size of a census block in the United States). It includes on average about 25 workers.

briefly discuss the procedure. For more details, we refer the reader to Duranton and Overman (2005; 2008).

Let $\widehat{K}_{st}(d)$ denote the estimated kernel density of industrial sector s in year t at a given distance d, d_{ij} denotes the distance between firm i and j, where $i = 1, \dots, I$ and n_{ist} represents the number of employees of firm i in industry s in year t. Then:

(5.1) $$\widehat{K}_{st}(d) = \frac{1}{h\sum_{i=1}^{I-1}\sum_{j=i+1}^{I} n_{ist}n_{jst}} \sum_{i=1}^{I-1}\sum_{j=i+1}^{I} n_{ist}n_{jst}\,\Omega\left(\frac{d-d_{ij}}{h}\right),$$

where h is the bandwidth and we define:

(5.2) $$\Omega(\cdot) = \frac{1}{\sqrt{2\pi}} \mathrm{e}^{-\frac{1}{2}\left(\frac{d-d_{ij}}{h}\right)^2},$$

so we use a Gaussian weighting function. An important parameter of the kernel density function is h. Following Duranton and Overman (2005; 2008) and Klier and McMillen (2008), we set the bandwidth equal to Silverman's plug-in bandwidth (see Silverman, 1986).[95] We estimate $\widehat{K}_{st}(d)$ for $d \leq 25$ because the median distance between firms in our region appears to be 25 kilometres.[96] Distances d cannot be negative. To deal with this issue, we use the reflection method, proposed by Silverman (1986).

We aim to test whether the estimated concentration is statistically significant or simply random; so we have to define a counterfactual location pattern. For that we randomly assign firms of a specific industry s in a given year t to PC6-locations. Note that the density of PC6-locations is much higher in urban areas, so this should control for the overall agglomeration of people and firms.

We determine the five percent local confidence bands by ranking the simulations of the counterfactual location patterns in ascending order and choose the 5th and 95th percentile to obtain the five percent lower and upper confidence intervals. However, we are more interested in whether *global* location patterns of firms depart from randomness. We determine global confidence intervals by treating each of the estimated density functions for each simulation as a single observation. Like Duranton and Overman (2005), we choose identical local confidence levels, in such a way that the global confidence level is 5 percent.[97] The upper and lower five percent confidence bands are then defined as $\overline{K}_{st}(d)$ and $\underline{K}_{st}(d)$. When $\widehat{K}_{st}(d) > \overline{K}_{st}(d)$ for at least one $d \in [0,25]$, we conclude that an industry is statistically significantly localised at the five percent level. An industry is significantly dispersed when it is not localised *and* when $\widehat{K}_{st}(d) < \underline{K}_{st}(d)$ for at least one $d \in [0,25]$. We then may define a global index of localisation $\mathcal{L}_{st}$ that is comparable across industries and time:

(5.3) $$\mathcal{L}_{st} \equiv \begin{cases} L_{st} & \\ D_{st} & \text{if } L_{st} = 0 \end{cases},$$

where $L_{st} = \sum_{d=0}^{25} \max\left(\widehat{K}_{st}(d) - \overline{K}_{st}(d), 0\right)$ and $D_{st} = \sum_{d=0}^{25} \min\left(\widehat{K}_{st}(d) - \underline{K}_{st}(d), 0\right)$. As shown in Ellison et al. (2010), this index equals zero when there is neither localisation nor dispersion; it is positive when

[95] More specifically, $h = 1.06\sigma_{d_{ij}} I^{-1/5}$, where $\sigma_{d_{ij}}$ is the standard deviation of the estimated bilateral distances between firms in a specific sector, so this is given the industry and year.
[96] Information for larger distances is superfluous, as industries that are localised at very small distances are by construction dispersed at very large distances (as there are too few firms located far from each other).
[97] For a detailed description on how to construct the global confidence intervals, we refer to Klier and McMillen (2008).

an industry is statistically significantly localised, and it is negative when the industry is statistically significantly dispersed.[98]

We also use this procedure to investigate whether KIBS and MNEs are co-agglomerated. In this case, the kernel density function is slightly different because we consider the bilateral distances between a sector s and r (see Ellison et al., 2010):[99]

(5.4) $$\widehat{K}^{CO}_{srt}(d) = \frac{1}{h\sum_{i=1}^{I}\sum_{j=1}^{J} n_{ist}n_{jrt}} \sum_{i=1}^{I}\sum_{j=1}^{J} n_{ist}n_{jrt}\,\Omega\left(\frac{d-d_{ij}}{h}\right),$$

An index of co-agglomeration is then defined as:

(5.5) $$\mathcal{C}_{st} \equiv \begin{cases} L^{CO}_{st} \\ D^{CO}_{st} & \text{if } L^{CO}_{st} = 0 \end{cases},$$

where $L^{CO}_{st} = \sum_{d=0}^{25} \max\left(\widehat{K}^{CO}_{srt}(d) - \overline{K}_{srt}(d), 0\right)$ and $D_{st} = \sum_{d=0}^{25} \min\left(\widehat{K}^{CO}_{srt}(d) - \underline{K}_{srt}(d), 0\right)$. The counterfactuals are constructed in a similar way. It is important to note that we cannot distinguish empirically between joint-localisation and co-localisation (Duranton and Overman, 2008; Ellison et al., 2010). For example, two industries may co-locate because of unobserved locational advantages (e.g. natural resources, accessibility). In the next section, we discuss the methodology that enables us to filter out the impact of factors that may cause the observed co-agglomeration patterns.

B. Measuring the effect of proximity to MNE and KIBS on births

To investigate the magnitude of the effect of concentrations of MNEs and KIBS on KIBS-births, we employ a standard random profit framework. We assume that firm i will choose a location j in such a way that it maximises profits. Location j is defined as a postcode six-digit (PC6) area.

The proximity to MNEs is defined as Γ_j. Similar to the previous section, the index is defined as an exponential distance decay function with respect to employment:

(5.6) $$\Gamma_k = \sum_{\kappa=1}^{K} e^{-\delta d_{k\kappa}} m_\kappa,$$

where $d_{k\kappa}$ is the distance between location k and κ, where $\kappa = 1, \dots, K$, m_κ are the number of employees in MNEs at location κ and δ denotes a distance decay parameter.

Similarly, we may expect that proximity to other KIBS, defined as Δ_j, may have a positive impact on profits because it implies access to potential customers and talented employees and may facilitate knowledge spillovers among business services firms. We use a formula analogous to (6) to estimate the weighted number of employees in KIBS firms at each location. Similarly, we also take into account the proximity to employment in all other firms, Θ_j. Profits are not only influenced by proximity to firms, but also by other attributes of location X_j (e.g. distance to highways, universities, land use etc.). We introduce and explain these controls in the next section.

The profit function of a firm is then defined as:

(5.7) $$\max \pi_{ik} = X'_k\alpha + \beta\Gamma_k + \gamma\Delta_k + \zeta\Theta_k + F'_k\eta + \xi_k + \epsilon_{ik},$$

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[98] See Ellison et al. (2010), pp. 20 of the Data and Empirical Appendix.

[99] So, in our application, r are multinational enterprises.

where π denotes profits of firm i choosing location k; α, β, γ, ζ and η are parameters to be estimated, F are municipality fixed effects that control for unobserved spatial heterogeneity (for example, unobserved factors related to the regulatory framework that may attract firms), ξ_j is a random effect and ϵ_{ij} is an idiosyncratic constant. For convenience, we assume that e^{ξ_j} follows an independent and identically distributed gamma distribution with (μ^{-1}, μ^{-1}) parameters and ϵ_{ij} has an Extreme Value Type I distribution. Then, it may be shown that:

$$\Pi_{ik} = \frac{\exp(X_k'\alpha + \beta\Gamma_k + \gamma\Delta_k + \zeta\Theta_k + F_k'\eta + \xi_k)}{\sum_{\kappa=1}^{K} \exp(X_\kappa'\alpha + \beta\Gamma_\kappa + \gamma\Delta_\kappa + \zeta\Theta_\kappa + F_\kappa'\eta + \xi_\kappa)}, \quad (5.8)$$

where $\Pi_{i\kappa}$ denotes the probability that firm i chooses location j. Guimarães et al. (2003) show that the log-likelihood function of a conditional logit model (CLM) is equivalent to that of a Poisson model. With the inclusion of random effects ξ_j, this model collapses to a standard negative binomial regression (Hausman et al., 1984; Cameron and Trivedi, 1998; Guimarães et al., 2004). Thus, we may estimate this model by applying a negative binomial regression and regress the number of births per location on X, Γ, Δ, Θ and F (see also Rosenthal and Strange, 2003).

5.4 Data

A. Datasets

The micro-data on KIBS and other firms within the region are derived from LISA (for North-Holland/Amsterdam) and PAR (for Utrecht) databases (both are based on Chambers of Commerce data complemented with data on non-commercial employment via all-encompassing questionnaires). See Van Oort (2004) for a detailed description of these data. They include all new entries and establishments that have already been registered within our defined region, including their names, exact location (on postcode six digit-level) and number of employees. For KIBS-births we have information per year for the period 2000-2009. Whilst some have argued that Standard Industry Classifications (SIC) are not very useful in the empirical analyses of KIBS, we nonetheless proceed by defining KIBS accordingly (Hipp, 1999). This is almost inevitable if one wants to make regional aggregations based upon data of a large research population. In this chapter we define KIBS in terms of NACE codification.[100] Following Strambach (2008), we aggregate the KIBS sub-sectors into the following branches: R&D services, Economic Services, Technical/IT Services and Marketing/Advertising (see Table 5.A1 in Appendix 5.A). The distinction in these four classes is based upon the different types of knowledge they develop and possess.[101] In line with insights of Shearmur and Alvergne (2002), we expect that these different KIBS sub-sectors also display different locational preferences. Some global financial services prefer a location in the CBD that matches their international status while IT-Services and auditing firms prefer easy access to highways at the urban fringe so that their staff can travel easily with their lease cars to clients across the region.

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[100] NACE: Nomenclature statistique des Activites dans la Communaute Europeenne.

[101] According to Strambach (2008) different types of KIBS possess and develop different types of knowledge. While R&D services are more engaged in analytical knowledge, economic service and technical-and IT services include more synthetic knowledge. Marketing and advertising activities rely upon symbolic and intangible knowledge.

The data on MNEs are derived from the Achilles database for foreign-owned multinationals. The Achilles database is compiled by the Dutch national agency for foreign direct investment (NFIA) and consists of MNE establishments at locations in the Netherlands, including their year of establishment in the Netherlands and their number of employees.[102] This database provides us with a total of 1,182 MNE establishments in the defined region, generating 117,224 jobs in 2000. As we have only data of MNE establishments in 2000, we select KIBS-births from 2001 to 2004 because we may expect that the pattern of MNE establishments has not changed drastically between 2001 and 2004.

We also gathered information on a wide range of other locational attributes in 2000. In particular, we control for population density at the postcode four-digit level. Population density may be a proxy for crowding effects, such as high rents, traffic congestion and higher wages. On the other hand, previous studies have confirmed that population density does positively affect entrepreneurship (Reynolds et al., 1994; Wagner and Sternberg, 2004) because high population density provides the advantage of easier access to customers and input factors. We also control for the distance to the nearest highway ramp and train station to capture accessibility, distance to hectares of water and hectares of open space to capture natural amenities, and distance to universities and the Schiphol international airport. We furthermore include a dummy that indicates whether a location is in the so-called Green Heart, where regional planning restrictions apply. We control for zoning (which restricts the choice set of locations) by only selecting PC6 locations that had more than 10 employees in 2000 (see also Duranton and Overman, 2005).[103] In the Netherlands, there are quite strict planning regulations on the urban level that prohibit firms from locating wherever they would like. Municipalities in the Netherlands generally pursue an active land policy (Buitelaar et al., 2007). Given this convention, the local government acquires Greenfield sites, assigns land uses and sells them to the private developer in order to recoup the costs of public amenities. Further, municipalities strictly designate zones for shopping and living; provinces focus on nature reserve areas and secure water provision; and the national government is concerned with national parks (including the already-mentioned Green Hart, bordering the cities of Amsterdam in the south and Utrecht in the West) and sea protection (Van der Cammen and De Klerk, 2003). Selecting locations with more than 10 employees in 2000 also makes it more likely that we are only selecting employment locations rather than residential locations. This is important because we want to rule out the possibility that entrepreneurs might work from home and make a joint location decision where to work and live, muting the effect of the variables of interest. Our dataset then consists of 13,655 PC6 locations.

[102] We notice that we have only information on foreign-owned MNEs, which may lead to a sample selection bias. However, we have a dataset of all MNEs (including domestic MNEs) in 2011, and it appears that foreign-owned multinationals account for about 80 percent of the population, so although we do not have information on the full population of MNEs, our sample seems to be large enough to make relevant claims about the location patterns of MNEs.

[103] As the threshold value of 10 employees is arbitrary, we will test the robustness of our results with respect to this threshold in the sensitivity analysis in Appendix 5.B.

B. Descriptives

The descriptives statistics of the variables are presented in Table 5.A2 in Appendix 5.A, which shows that, given our selection of locations with more than 10 employees in 2000, the average number of births per PC6 location is 0.44. The descriptives further indicate that the variance is much larger than the mean, implying overdispersion, which makes the use of a negative binomial regression preferable over an ordinary Poisson model. Table 5.A3 shows that the correlation between KIBS Δ, MNEs Γ and other firms Θ is modest, so we can separately identify the effects in our econometric models.[104] We map the pattern of agglomeration of knowledge intensive business services and multinational enterprises in the region of our analysis, estimating the average Δ and Γ for each postcode four-digit area (PC4) (see Figure 5.2).

KIBS are primarily concentrated in the major cities of Amsterdam and Utrecht and to a lesser extent in the medium-sized cities of Haarlem and Almere. We see a strong clustering in the city centre of Amsterdam. The pattern of agglomeration of MNEs is somewhat similar to that of KIBS. However, we observe notable differences. First, MNEs are more agglomerated near the international airport Schiphol and in the south of Amsterdam. Schiphol may be a favourable location because it implies a better connection with global cities such as London and New York. For example, the (regional) headquarters of AirFrance-KLM is located in Amstelveen, which is relatively close to Schiphol. Many international firms, including the head offices of the Dutch financial corporations ING and ABN-Amro as well as auxiliary KIBS in the field of management consultancy, executive search, auditing and legal advice, are also located at and near the so-called Zuidas (a prestigious dedicated business park in Amsterdam that has developed since the late 1990s). Second, a number of MNEs, for example, Atos Origin and CapGemini, which can be considered KIBS in their own right, are located in the western part of Utrecht whereas domestic-based KIBS are more concentrated near the campus of Utrecht University east of the city. All these locations can be characterised by their close proximity to the main highways connecting the region.

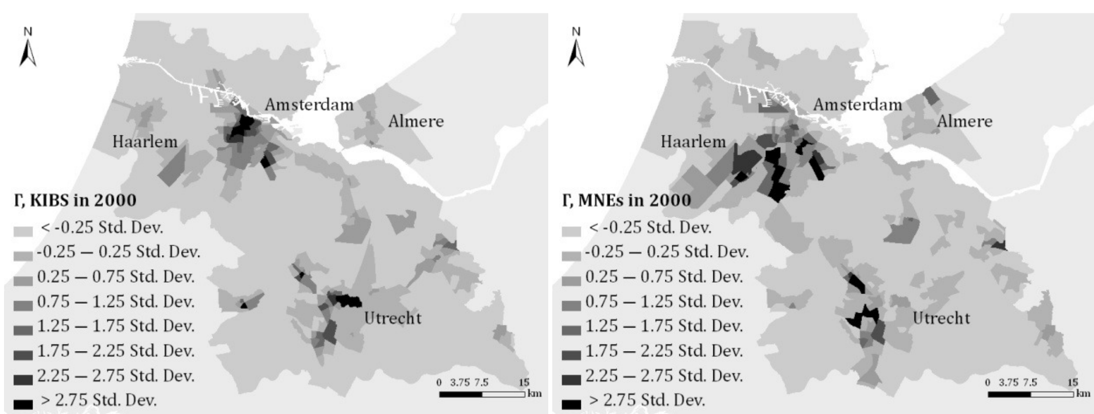

FIGURE 5.2 — AGGLOMERATION OF KIBS (LEFT) AND MNES (RIGHT) IN THE RANDSTAD NORTHWING
Note: In this Figure, we estimate the agglomeration indices Γ and Δ for each PC6-location and take the average of all PC6-locations within a PC4-location.

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[104] When we take logs, the correlations are even lower.

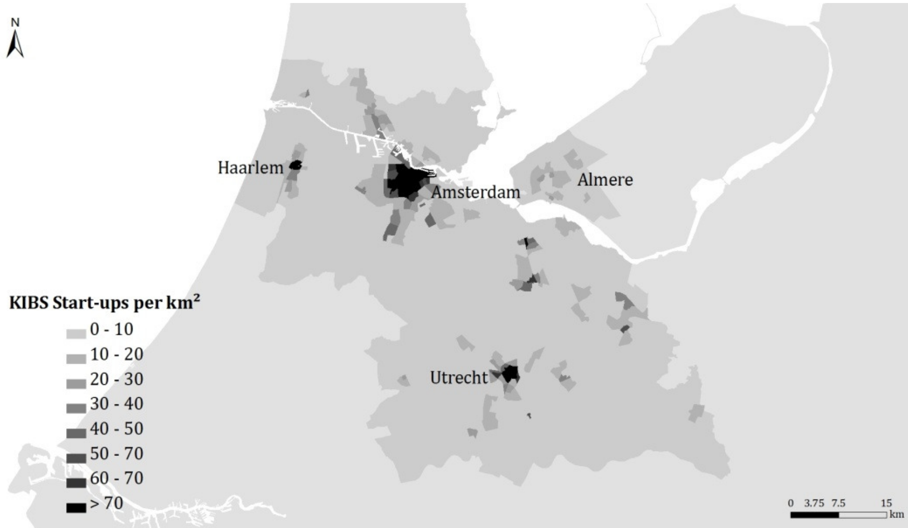


FIGURE 5.3 — KIBS-BIRTHS IN THE RANDSTAD NORTHWING

Figure 5.3 indicates that KIBS start-ups tend to be concentrated in urban areas. The density of KIBS start-ups is rather high in the two largest cities of the region, Amsterdam and Utrecht. This corresponds to the general concentration pattern of KIBS presented in Figure 5.2. This can therefore be considered the first piece of evidence that new entries tend to be spatially concentrated within dense locations (see hypothesis 2). This may also be attributed to the fact that urbanisation economies, stimulate entrepreneurship (see Glaeser, 2011; Wagner and Sternberg, 2004)

Table 5.1 shows that the last decade has seen a significant growth in the number of KIBS. In terms of the total number of KIBS establishments, we note a growth of 85.6 percent in the period 2000-2009. Similarly, the total employment of KIBS in the region experienced a growth of 29.6 percent. The difference between the growth rates of establishments and employment indicates that the average firm size has decreased, in line with Figure 3.1A, Chapter 3. This is especially attributable to an increased number of start-up firms in the region. The share of KIBS in the total employment of the Northwing area increased from 8 percent to 9 percent. The share of KIBS in the total number of establishments increased from 13 percent to 18 percent. When we look at the individual KIBS types, we see some profound differences between them although all types experienced growth. The largest growth of firm establishments in both absolute and relative terms can be observed in Economic Services, which has doubled its presence in the region. Also remarkable is the strong relative growth in terms of the number of establishments of the smallest group, the R&D Services. Furthermore, we observe, in particular, how for Technical and ICT Services and R&D Services the average firm size has declined although these types of KIBS are still, on average, the largest firms. Technical and ICT Services and Economic Services have the most start-ups during this period.

TABLE 5.1 — NUMBER OF AND EMPLOYMENT IN KIBS IN 2000 AND 2009 IN THE RANDSTAD NORTHWING

Type of KIBS	*2000*		*2009*		*Change*	
	Est.	Empl.	Est.	Empl.	Est.	Empl.
Economic services	10,952	43,445	23,214	67,957	+ 12,262 (112%)	+ 24,512 (56%)
Marketing services	6,922	26,293	10,577	32,101	+ 3,655 (53%)	+ 5,808 (22%)
Technical and ICT services	5,956	49,277	10,461	54,706	+ 4,505 (76%)	+ 5,429 (11%)
R&D services	358	5,865	649	7,113	+291 (81%)	+ 1,248 (21%)
Total KIBS	24,188	124,880	44,901	161,877	+ 20,713 (86%)	+ 36,997 (30%)
Total all firms	184,023	1,604,816	254,925	1,804,687	+ 70,902 (39%)	+ 199,871 (13%)

5.5 Results

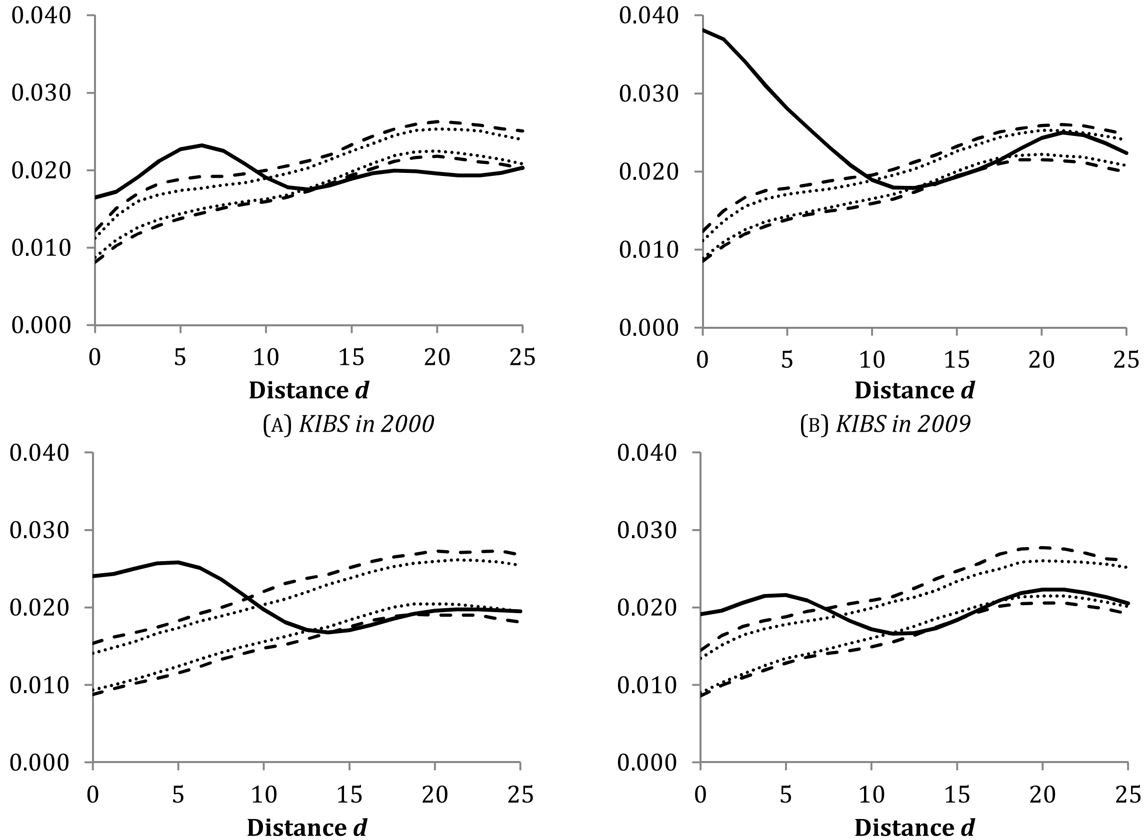
A. Localisation and co-agglomeration

In this subsection, we first analyse the results of the localisation index $\mathcal{L}$ (see equation (5.3)) to test hypotheses 1 and 2. We ran 250 simulations to generate counterfactual location patterns for each industry.[105] Figure 5.4 shows the results of the estimated kernel densities for KIBS and KIBS-births. It shows that KIBS and KIBS-births are all significantly localised. We find that the estimated kernel densities are above the global confidence band especially when the distance is small (less than 10 kilometres). It is striking that KIBS in 2009 are much more concentrated within shorter distances than were KIBS in 2000. Ellison and Glaeser (1997, 1999) and Bayer and Timmins (2007), among others, argue that natural advantages are a major reason for clustering. However, (unobserved) natural advantages remain fairly constant over time, so the difference in concentration may be attributable to the presence of Marshallian externalities, such as knowledge spillovers, access to specialised labour markets and suppliers. In the next section, we explore the importance of these types of externalities in more detail.

Table 5.2 presents the results for the estimated localisation index $\mathcal{L}$ and the index for co-agglomeration $\mathcal{C}$ for KIBS, KIBS start-ups, MNEs and also KIBS-subsectors. The table shows that all industries are significantly localised, although the values of $\mathcal{L}$ are substantially different between industries. First, the results confirm that KIBS have become more spatially concentrated between 2000 and 2009; the index more than quadruples. The results of subsectors reveal that there is substantial heterogeneity in the magnitude of the index. Especially marketing services and R&D services are relatively concentrated whereas technical and ICT services are hardly concentrated. It is also notable that economic services have become less spatially concentrated despite the general trend of KIBS to become more spatially concentrated.

We also investigated whether KIBS-births are spatially concentrated. It appears that both in 2001 and in 2008 KIBS start-ups were significantly concentrated, which is in line with Figure 5.4. This suggests that spin-offs are more likely to locate close to the parental firm and start-ups are more likely to emerge in concentrations of KIBS. Although start-ups are concentrated, notice that the concentration of births has not increased between 2001 and 2008. This may seem surprising, but start-ups do not necessarily have to follow the tendency of KIBS to become more spatially concentrated (Dumais et al.,

[105] For some industries, we also run 1,000 and 2,500 simulations, but the results were very similar.



(A) *KIBS in 2000* (B) *KIBS in 2009*

(C) *KIBS-births in 2001* (D) *KIBS-births in 2008*

FIGURE 5.4 — KERNEL DENSITIES, LOCAL AND GLOBAL CONFIDENCE INTERVALS

Note: The black line represent the kernel density at a given distance, the dotted and dashed lines are the 5 percent local and global confidence bands, respectively.

2002; Duranton and Overman, 2008).[106] We further estimated the concentration index for MNEs. We observed that MNEs had a relatively strong tendency to concentrate, even relative to KIBS. This is in line with the results shown in Figure 5.2, which also suggests the clustering of multinational enterprises. We now turn to the results of the co-agglomeration index C (see Table 5.2). In general, knowledge intensive business services are co-agglomerated with multinational enterprises. The new entries of KIBS are also co-agglomerated with multinational enterprises. Between different subsectors there are noticeable differences. Economic services and especially marketing services tend to agglomerate with MNEs whereas R&D services are co-dispersed. So, distances between R&D services and MNEs are larger than we should expect from a randomly drawn location pattern. The main reason for this outcome is

[106] We may illustrate this with an example. Consider the case that KIBS are only located in two clusters in a region. Our localization measure will then find that KIBS are clustered more than can be expected from a random pattern. However, consider two entries of KIBS, one in each cluster. Then, the localization measure of KIBS-births will signify dispersion.

TABLE 5.2 — LOCALISATION OF KIBS AND MNES

	$\hat{\mathcal{L}}$		$\hat{\mathcal{C}}$
	2000	2009	2000
KIBS	0.030	0.127	0.038
Economic services	0.037	0.013	0.029
Marketing services	0.115	0.134	0.070
Technical and ICT services	0.008	0.014	0.009
R&D services	0.032	0.077	-0.147
KIBS-births	0.064	0.023	0.028
MNEs	0.083		

Note: KIBS-births refer to births in 2001 and 2008. We ran 250 Monte Carlo simulations for the counterfactual location patterns.

probably that R&D services tend to agglomerate near universities whereas MNEs prefer locations in the inner city.[107] In the regression analysis, we therefore may expect that MNEs have no or a negative impact on entries of R&D Services. Table 5.2 also shows that technical and ICT services are hardly co-agglomerated with MNEs. The main reason is probably that these generally small firms are relatively more footloose (with human capital as main resource) and hence do not have a strong tendency to localise. In the next section, we aim to distinguish between joint-localisation and co-localisation: we controlled for locational factors that may lead to joint-localisation (e.g. highways, dense cities, etc.) to verify the impact of MNEs and KIBS on the number of entries of KIBS.

B. *Results from negative binomial regressions*

Based on the previous subsection, we established that KIBS entries tend to cluster at a local level and are spatially co-agglomerated with MNEs. In what follows, we assume that $\delta = 2.5$, so that most of the weight of the estimated potentials is within 1.5 kilometres.[108] In Table 5.3, negative binomial regressions are presented.

When we include only the weighted employment of MNEs, KIBS and other firms in the regression, Specification (1), the MNEs have a statistically significant, but rather small, impact on KIBS-births. Doubling the weighted employment in MNEs Γ leads to a 5.1 percent increase in KIBS-births.[109] An area with many KIBS firms is likely to generate more KIBS-births. Doubling the weighted employment in KIBS Δ leads to an increase of KIBS-births of 32 percent. In contrast, concentrations of firms other than KIBS lower the probability of births. Doubling the weighted employment in other firms Θ leads to a decrease in KIBS-births of 21 percent. This is in line with previous studies that found localisation (own-industry) factors to be more important than urbanisation (between-industry) factors (Head et al., 1995; Guimarães et al., 2000; Figueiredo et al., 2002; Rosenthal and Strange, 2003; Barrios et al., 2006). The positive effect of nearby KIBS on births is also in accordance with previous results, where we observed a

[107] The more technologically oriented faculties of the universities of Amsterdam (VU University) and Utrecht are located on (campus) science parks in the suburbs.
[108] We test for robustness of the choice of δ in the sensitivity analysis in Appendix B. We then also include locations with more than respectively 5 and 15 employees in 2000. It is shown that the results are reasonably robust.
[109] This is calculated as follows: $\log(2) \cdot 0.074 = 0.051$

TABLE 5.3 — REGRESSION RESULTS OF THE IMPACT OF MNES AND KIBS ON KIBS-BIRTHS
(Dependent variable: the number of KIBS-births per PC6-location)

	(1)		(2)		(3)		(4)	
MNEs Γ *(log)*	0.074	(0.013)***	0.060	(0.022)***	0.181	(0.038)***	0.060	(0.028)**
KIBS Δ *(log)*	0.468	(0.031)***	0.471	(0.040)***	0.517	(0.061)***	0.411	(0.052)***
Other firms Θ *(log)*	-0.307	(0.033)***	-0.266	(0.051)***	-0.219	(0.071)***	-0.245	(0.052)***
Distance to university *(log)*			-0.045	(0.025)*	-0.059	(0.044)	-0.042	(0.024)*
Distance to Schiphol *(log)*			0.088	(0.121)	0.343	(0.190)*	0.058	(0.126)
Distance to ramp *(log)*			-0.037	(0.046)	-0.223	(0.071)***	-0.047	(0.048)
Distance to station *(log)*			-0.012	(0.039)	-0.046	(0.065)	-0.075	(0.058)
Highway <150m			0.206	(0.073)***	0.304	(0.108)***	0.235	(0.093)**
Railway <150m			-0.060	(0.096)	0.131	(0.167)	-0.137	(0.113)
Water <150m			0.101	(0.050)**	0.043	(0.085)	-0.001	(0.081)
Open space <150m			0.162	(0.047)***	0.260	(0.076)***	0.109	(0.070)
Green Heart			0.077	(0.197)	0.311	(0.385)	0.026	(0.198)
Population density *(log)*			-0.125	(0.015)***	-0.205	(0.023)***	-0.110	(0.025)***
Municipality FE (61)	No		Yes		Yes		Yes	
Log-likelihood	-11,235.643		-11,072.352		-4,537.268		-11,056.970	
Vuong *Z*-test (probability)							2.620	(0.004)
Number of locations	13,655		13,655		13,655		13,655	
Number of births	6,275		6,275		2,357		6,275	

Notes: We selected locations that have more than 10 employees in 2000. In Specification (3), the dependent variable is the number of KIBS-births with at least three employees. Specification (4) is a zero-inflated negative binomial regression, where we include all variables except municipality dummies in the inflation equation in order to reach convergence (results are available upon request). The inflation equation is a Probit model. Robust standard errors are between parentheses.

*** Significant at the 0.01 level
** Significant at the 0.05 level
* Significant at the 0.10 level

considerable increase in the concentration of KIBS between 2000 and 2009. In Specification (2), which is our preferred specification, we included a range of control variables as well as municipality fixed effects. The specification shows that the coefficients are very comparable to those presented in Specification (1), suggesting that the variables of interest are not strongly correlated to observed non-local (natural) advantages. The effect of MNEs is now slightly lower: doubling of Γ leads to an increase in births of 4.2 percent. The coefficient of KIBS Δ is almost identical.[110]

In Specifications (1) and (2) we took into account KIBS-births of all sizes. It may well be that small KIBS firms (one or two employees) make different location decisions than do larger start-ups. For example, entrepreneurs may work from home, so their location decision is a joint-decision about where to work and live. It may therefore be expected that larger KIBS have a stronger preference to locate near MNEs and other KIBS. Specification (3), where we only selected births with at least three employees,

[110] One may argue that our estimates are suffering from an omitted variable bias: unobserved natural advantages may be correlated with the density measures and may partly explain the positive effect of our density measures (see e.g. Ellison and Glaeser, 1997; 1999; Bayer and Timmins, 2007). We cannot rule out the possibility that the effect of agglomeration economies is overstated, because we lack good instruments. Note, however, that we include municipality fixed effects that should correct for unobserved advantages at the municipality level and, more important, the estimates of Specification (1) and (2) are very similar, suggesting that at least non-local natural advantages are not correlated with out density measures. Recent empirical studies also show that controlling for endogeneity only slightly reduces the effects of agglomeration economies (see Combes et al., 2010; Puga, 2010; and a meta-analysis of Melo et al., 2008).

confirms this suggestion. Doubling the weighted employment in MNEs leads to an increase in births of 13 percent, which is much higher than the effect of 4.2 percent. Additionally, doubling the weighted employment in KIBS leads to an increase in start-ups of 36 percent, which is slightly higher than the effect found in the previous specifications.

In Specification (4), we estimated a zero-inflated, negative binomial regression (for all births) because the number of zeroes (PC6 areas without any KIBS-births) may be excessive (see as an illustration Figure 5.A1 in Appendix 5.A). It appears that the results are very similar to those of Specification (2). The Vuong test highlights the statistical significance of the improvement by estimating the zero-inflated model, but because the model leads to very similar results for the variables of interest, we prefer presenting and interpreting the results of the standard negative binomial regressions.

The control variables on location factors are in general plausible. Population density has a negative effect, suggesting that there are crowding effects (commonly found in the Netherlands, see Broersma and Oosterhaven, 2009). Locations near highways attract about 21 percent more KIBS, which is not surprising because so-called sight-locations are considered attractive (De Vor and De Groot, 2008; Olden, 2010). Locations near open spaces (amenities) attract about 16 percent more births. Proximity to universities, related to the innovation generation hypothesis of KIBS, only has a small effect on attracting new KIBS births. Proximity to railways and railway stations does not have a significant relation with KIBS births.

The populations of KIBS and MNEs are known for their heterogeneity. It may well be that a separation of KIBS and MNEs according to function, sector or market will yield different co-location behaviour. To test for this, the next section refines the analyses by investigating whether the effects of MNEs and KIBS are different for different KIBS and MNE subpopulations. We first focus on KIBS subsectors. We then examine whether the effects are different when we take into account employment in MNE-KIBS compared to MNEs that are not KIBS, MNE headquarters and MNEs that are subsidiaries. Finally, we examine whether the location choices of survivors and deaths are different.

C. Results for different sectors

It has been argued that economic geography should look more deeply into micro-heterogeneity in order to understand how firm-specificity impacts the intensity of agglomeration economies (Ottaviano, 2011). Shearmur and Alvergne (2002) show differentiated location patterns for KIBS subsectors while Shearmur and Doloreux (2008) demonstrate that the innovative capacity of KIBS first decreases with distance to the CBD and then increases again. Coe and Townsend (1998) illustrate how the cumulative causation of growth of populations of some types of KIBS only occurs at some locations in the Greater London region. The heterogeneity of KIBS thus generates differentiated outcomes. Results of negative binomial regressions allowing for this heterogeneity are presented in Table 5.4. It appears that focusing on the KIBS subsector indeed reveals heterogeneity with respect to locational preferences and MNEs.

Specification (5) indicates that the presence of multinational enterprises does not influence the location decisions of economic services start-ups whereas already existing KIBS foster the births of these firms: doubling the weighted employment in KIBS increases the number of births by 41 percent. For start-ups in Marketing and Advertisement and in Technical and IT services, the presence of

TABLE 5.4 — REGRESSION RESULTS OF THE IMPACT ON KIBS-BIRTHS FOR DIFFERENT SECTORS
(Dependent variable: the number of KIBS-births per PC6-location)

	(5) Economic services		(6) Marketing services		(7) IT services		(8) R&D services	
MNEs Γ *(log)*	0.013	(0.029)	0.068	(0.032)**	0.109	(0.034)***	-0.066	(0.117)
KIBS Δ *(log)*	0.586	(0.056)***	0.326	(0.051)***	0.401	(0.060)***	0.555	(0.215)***
Other firms Θ *(log)*	-0.339	(0.068)***	-0.178	(0.056)***	-0.133	(0.081)*	-0.412	(0.269)
Distance to university *(log)*	-0.006	(0.035)	-0.014	(0.038)	-0.029	(0.042)	-0.383	(0.072)***
Distance to Schiphol *(log)*	-0.163	(0.142)	0.159	(0.200)	0.394	(0.234)*	0.082	(0.546)
Distance to ramp *(log)*	0.017	(0.060)	0.074	(0.073)	-0.221	(0.065)***	-0.045	(0.214)
Distance to station *(log)*	-0.088	(0.052)*	0.076	(0.059)	-0.028	(0.059)	0.061	(0.176)
Highway <150m	0.208	(0.097)**	0.146	(0.097)	0.249	(0.112)**	0.302	(0.261)
Railway <150m	-0.202	(0.115)*	-0.01	(0.146)	-0.031	(0.149)	-0.357	(0.484)
Water <150m	0.092	(0.063)	0.225	(0.073)***	0.048	(0.080)	-0.449	(0.225)**
Open space <150m	0.205	(0.060)***	0.055	(0.073)	0.211	(0.072)***	0.249	(0.202)
Green Heart	0.369	(0.238)	-0.497	(0.448)	0.040	(0.423)	0.614	(0.844)
Population density *(log)*	-0.124	(0.019)***	-0.083	(0.024)***	-0.137	(0.022)***	-0.129	(0.066)*
Municipality FE (61)	Yes		Yes		Yes		Yes	
Log-likelihood	-6,557.686		-4,433.235		-4,814.334		-722.314	
Number of locations	13,655		13,655		13,655		13,655	
Number of births	2,585		1,480		1,702		154	

Notes: See Table 5.2. The dependent variables in Specifications (5), (6), (7) and (8) are respectively the number of births in economic services, marketing services, IT services and R&D services.

multinational enterprises is more important, as already suggested by Rodenburg et al. (2010).[111] For Research and Development (Specification (8)), other KIBS are relatively important: doubling the weighted employment in KIBS leads to 38 percent more births. In line with results of Section V.A, it is clear that MNEs do not have a significant impact on the number of entries of R&D services. In contrast to analysis of all KIBS (Specification (2)), we find that proximity to universities is an important driver of R&D births: doubling the distance to a university leads to a decrease in R&D births of 27 percent, suggesting the presence of local university knowledge spillovers, which is in line with Woodward et al. (2006). Note, however, that the number of R&D births is relatively small, so the results are more suggestive than those of other subsectors.

D. Heterogeneity in MNEs and results for survival and deaths

In this subsection, we first investigate whether there are different impacts of MNE-KIBS versus MNEs that are not KIBS at birth. Second, we investigate whether MNE headquarters and MNEs that are subsidiaries have different impacts on the number of KIBS births at a certain location. Results are presented in Table 5.5. Specification (9) shows that, conditional on employment in KIBS, MNEs that are not KIBS have a positive, significant impact while MNEs that are KIBS at the same time do not have any statistically significant impact on KIBS-births. This suggests that proximity to potential customers who

[111] Please note the difference with Table 5.2. In Table 5.2 Technical and IT services as a total population is hardly co-agglomerated with MNEs, whereas Specification (5) shows that MNEs leads to statistically significant increase in entries of Technical and IT services. This may suggest that, although the current population of Technical and IT services is not co-agglomerated MNEs, co-agglomeration between these populations is increasing.

TABLE 5.5 — REGRESSION RESULTS OF THE IMPACT ON KIBS-BIRTHS: DIFFERENT MNES AND SURVIVAL
(Dependent variable: the number of KIBS-births per PC6-location)

	(9) MNE KIBS		(10) MNE HQs		(11) KIBS-survivors		(12) KIBS-deaths	
MNEs KIBS Γ_{KIBS}*(log)*	0.004	(0.021)						
MNEs no KIBS Γ_{noKIBS}*(log)*	0.058	(0.018)***						
MNEs HQ Γ_{HQ}*(log)*			-0.017	(0.019)				
MNEs no HQ Γ_{noHQ}*(log)*			0.077	(0.022)***				
MNEs Γ *(log)*					0.078	(0.027)***	0.038	(0.027)
KIBS Δ *(log)*	0.473	(0.043)***	0.474	(0.041)***	0.461	(0.054)***	0.481	(0.044)***
Other firms Θ *(log)*	-0.268	(0.052)***	-0.264	(0.051)***	-0.346	(0.064)***	-0.181	(0.054)***
Distance to university *(log)*	-0.043	(0.025)*	-0.050	(0.025)**	-0.073	(0.029)**	-0.015	(0.032)
Distance to Schiphol *(log)*	0.087	(0.120)	0.104	(0.122)	0.204	(0.158)	0.037	(0.149)
Distance to ramp *(log)*	-0.047	(0.046)	-0.032	(0.046)	0.061	(0.056)	-0.127	(0.054)**
Distance to station *(log)*	-0.015	(0.039)	-0.012	(0.039)	0.003	(0.045)	-0.028	(0.051)
Highway <150m	0.212	(0.073)***	0.215	(0.073)***	0.112	(0.098)	0.304	(0.082)***
Railway <150m	-0.049	(0.095)	-0.061	(0.096)	0.019	(0.106)	-0.143	(0.119)
Water <150m	0.103	(0.050)**	0.100	(0.050)**	0.139	(0.059)**	0.062	(0.062)
Open space <150m	0.160	(0.047)***	0.165	(0.047)***	0.219	(0.058)***	0.115	(0.056)**
Green Heart	0.068	(0.198)	0.085	(0.197)	-0.268	(0.259)	0.394	(0.284)
Population density *(log)*	-0.124	(0.015)***	-0.128	(0.016)***	-0.093	(0.018)***	-0.149	(0.018)***
Municipality FE (61)	Yes		Yes		Yes		Yes	
Log-likelihood	-11,070.872		-11,069.186		-6,953.482		-7,450.512	
Number of locations	13,655		13,655		13,655		13,655	
Number of births	6,275		6,275		2,873		3,402	

Notes: See Table 5.2. The dependent variable in Specification (11) is the number of KIBS-births that still exist after 5 years, while Specification (12) indicates the number of births that have not survived.

offer complementary activities is more important than the proximity to MNE-KIBS that are likely to offer competing services. Another explanation might be that MNEs outsource certain internal services such as IT, which will be consequently provided by KIBS spin-offs that locate nearby.

In Specification (10), we separate MNEs in headquarters and non-headquarters. We may expect that headquarters are more important for KIBS-births because they are involved in command and control activities and are concentrations of human capital, suggesting that more knowledge is potentially spilled over. On the other hand, headquarters are more likely to still perform some services in house compared to their subsidiaries. Furthermore, in the case that MNE headquarters do contract KIBS, they are more likely to do so further afield or only to large and established KIBS with a global reputation that tend to concentrate near the head offices of clients (Aslesen and Jakobson, 2006). Likewise, the location of MNE headquarters is expected to be associated with higher property values and office rents, creating an entry barrier for start-up firms. This is not to suggest that MNE headquarters are not responsible for the birth of KIBS or for the survival of KIBS start-ups, but only that in most cases these start-ups will probably be located at some comfortable distance to the CBD, as suggested by Shearmur and Alvergne (2002). The results show that only MNEs that do not perform headquarter services have a statistically significant impact on KIBS-births.

An important issue in the identification of agglomeration economies is that already advantageous locations tend to produce more productive firms (which have a greater probability of surviving) (Ottaviano, 2011). It has also been argued that survivors in particular are very important to the stability of a regional economy (Brüderl et al., 1992; Stam, 2010). We therefore investigated the impact of location attributes (of the year 2000) on the births of survivors (which we define as firms that still exist five years later) and deaths (those firms that no longer exist after five years). Specification (11) and (12) present the results of births of survivors and deaths, respectively. Specification (11) shows that the effect of multinational enterprises is larger than in Specification (2). On the other hand, we observe that MNEs do not influence the locational pattern of deaths significantly (Specification (12)). These results indicate that more successful entrepreneurs prefer locations nearby MNEs, ceteris paribus, likely because they expect that MNEs will increase their profits and chance of survival.[112]

5.6 Conclusions and discussion

The relationship between knowledge intensive business services (KIBS) and multinational enterprises (MNEs) within the regional economy has been viewed as favourable for urban and regional dynamics. In this chapter we have analysed the location of new entries of knowledge intensive business services in a regionalised service economy (the Northwing of the Dutch Randstad), by using a continuous space framework. More specifically, we applied the point pattern methodology of Duranton and Overman (2005) and we estimated conditional Logit models. Based on propositions derived from the research literature, we addressed five hypotheses. The first main finding of the analysis is the confirmation of our hypothesis that KIBS have become more spatially concentrated over time. This could be tested accurately with a co-location analysis based on individual KIBS data. The spatial concentration of KIBS is both in city centres (of Amsterdam and Utrecht) and in more suburban locations, near university locations, Schiphol airport and good accessible locations with space for expanding. We secondly hypothesised that KIBS-births are spatially concentrated and co-agglomerated with MNEs. As this was confirmed in our analysis, we further elabourated on two important determinants of KIBS births. We hypothesised, in line with the literature, that the presence of MNEs fosters the births of KIBS (hypothesis 3). KIBS births have a new locational decision to make, as opposed to MNEs that are generally larger and older, already located in the region and embedded in global networks of subsidiaries. We therefore argue that causality runs from MNEs to KIBS births location. We found this relation to be present, although this effect is rather small compared to our fourth hypothesised relation, namely that the existing population of KIBS has an impact on newly created KIBS (births). This relation is found much more profound than the relation of MNEs with KIBS-births. Finally, because our fifth hypothesis stated that firm heterogeneity plays an important role in explaining the existence of agglomeration economies (see Ottaviano, 2011), we tested the relations between MNEs and KIBS births for four different subsectors of KIBS (economic services, marketing and advertising, IT-firms and R&D-oriented firms) and for various sizes and ownership structures of firms. We found that the effect of MNEs is relatively more important for marketing and IT services KIBS births as well as for entries with a larger workforce. R&D-oriented KIBS births (relatively small in number) are more related to proximity to universities (important for the suggested innovative character of these KIBS), while births of KIBS specialised in economic services are more related to the existing KIBS population. These insights in the

[112] Further research could study the importance of nearby MNEs and KIBS on survival rates of KIBS-births more thoroughly, e.g. by estimating Cox-regressions (see e.g. Neffke et al., 2011).

heterogeneity in KIBS location behaviour is important, as has been pointed out already by Shearmur and Alvergne (2002), who found that different sub-sectors of KIBS display combinations of both concentration and dispersal within the Greater Paris metropolitan region. They argued that this depends on the markets served (local, global) and on the internal structure of KIBS establishments. Insights in these aspects are important for policy conclusions.

While our analysis fills a research gap in the field of micro-level co-agglomeration and urban and regional development (in our case of MNEs and KIBS), limitations also apply to our research. In further research, we suggest that a distinction be made between start-ups and spin-offs, which has not been the case in this chapter (mainly because of data limitations). We expect that spin-offs will have a better chance of survival and growth than start-ups because they will likely follow the routines from the parent company (see Klepper and Sleeper, 2005). The sectoral and functional heterogeneity that showed important in our analysis should be sustained in such analyses. Future research should also focus on survival analyses of KIBS and investigate whether the survival rate of KIBS is influenced by the presence of nearby MNEs and other KIBS. An additional line of inquiry might be the conceptualisation and further empirical (causal) analysis of the co-evolutionary dynamics between KIBS and MNEs. The literature on international business economics considers how MNE subsidiaries try to strengthen their position within their own corporate network by studying the processes within local clusters (see Beugelsdijk et al., 2010). The strategic and commercial engagement of the MNE-subsidiary with local based KIBS can result in a change of firms' routines and can increase their dynamic capabilities. Indeed, acquiring competences and functional mandates through strategic partnerships with locally based KIBS might be a relevant strategy of the MNE-subsidiary to strengthen its position within the overall MNE-corporate structure. Another form of co-evolution is the move of KIBS into vertical knowledge domains in which they start to specialise in delivering services to specific industries.

Appendix 5.A Data and descriptives

TABLE 5.A1 — DEFINITION OF KIBS IN TERMS OF NACE INDUSTRY CLASSIFICATION

KIBS category	NACE	Description
Economic services	64.1	Monetary intermediation
	64.2	Activities of holding companies
	64.3	Trusts, funds and similar financial entities
	64.9	Other financial service activities, except insurance and pension funding
	66.1.1	Administration of financial markets
	69.2	Accounting, bookkeeping and auditing activities; tax consultancy
	70.1	Activities of head offices
	70.2	Management consultancy activities
Marketing services	73.1	Advertising
	73.2	Market research and public opinion polling
Technical and IT services	62.0.1	Computer programming activities
	62.0.2	Computer consultancy activities
R&D services	72.1	Research and experimental development on natural sciences and engineering
	72.2	Research and experimental development on social sciences and humanities

TABLE 5.A2 — DESCRIPTIVE STATISTICS

	Mean	Std.Dev.	Min.	Max.
KIBS births	0.442	1.261	0.000	65.000
KIBS births – survivors	0.202	0.680	0.000	43.000
KIBS births – deaths	0.240	0.801	0.000	22.000
MNEs Γ	396.290	866.154	0.000	15,584.258
KIBS Δ	312.621	403.098	0.000	4,787.828
Other firms Θ	7,862.466	8,572.184	0.000	40,993.521
Distance to university *(km)*	9.294	7.705	0.001	32.903
Distance to Schiphol *(km)*	23.943	14.895	0.101	70.529
Distance to ramp *(km)*	2.772	1.895	0.065	12.826
Distance to station *(km)*	2.311	2.082	0.027	12.506
Highway < 150m	0.107	0.310	0.000	1.000
Railway < 150m	0.064	0.244	0.000	1.000
Water < 150m	0.348	0.476	0.000	1.000
Open space <150m	0.427	0.495	0.000	1.000
Green Heart	0.092	0.288	0.000	1.000
Population density *(per km^2)*	5,010.223	5,110.174	1.000	24,568.132
Number of locations		13,655		

TABLE 5.A3 — CORRELATIONS

	MNEs Γ	KIBS Δ	Other firms Θ
MNEs Γ	1.000		
KIBS Δ	0.388	1.000	
Other firms Θ	0.329	0.869	1.000

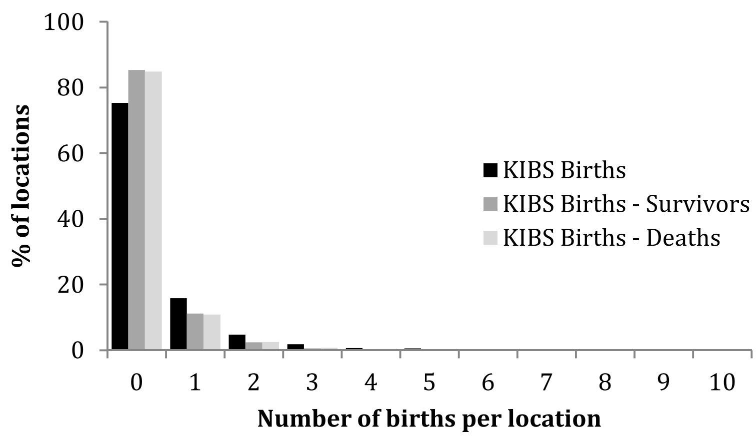


FIGURE 5.A1 — HISTOGRAM OF KIBS BIRTHS PER PC6-LOCATION

Appendix 5.B Robustness checks

In this subsection we provide some robustness checks for the results presented in Section 5.5. The results are presented in Table 5.B2. Specifications (B1) and (B2) provide a robustness check for the choice of the decay parameter δ. When we choose $\delta = 1$, most of the weight of the weighted employment measure is within 2.5 kilometres. The coefficient of KIBS is somewhat higher: doubling Δ leads to an increase in rents of 47 percent, but the effect of MNEs is now statistically insignificant. For higher values of δ, the effects are similar to Specification (2), although the effect of KIBS is somewhat lower. In the preceding analysis, we only include locations that have more than 10 employees in 2000, which is an arbitrary value. In Specification (B3) and (B4) we include locations with more than respectively 5 and 15 employees in 2000. It appears that the results are very comparable to those presented in Table 5.1. The effect of KIBS is slightly higher when we only select locations with more than 15 employees.

In Table 5.A3 it is shown that the correlation between the concentration of KIBS Δ and other firms Θ is reasonably high (0.869). Although potential multicollinearity should not affect the consistency of the estimated coefficients (only the magnitude of the standard errors), we also estimate equations where we include Δ or Θ. In Specification (B5) we exclude Θ. It is shown that the coefficient of MNEs is now only statistically significant at the 20 percent level, because it picks up some of the negative effects of clustering of other firms. The coefficient of KIBS is still strongly positive and an order of magnitude larger than the coefficient of MNEs, which is in line with previous conclusions. In Specification (B6) we exclude Δ. It is then shown that the coefficient of MNEs is somewhat higher and the coefficient of other firms is now positive. This is not too surprising, as both the concentration of MNEs and other firms are positively correlated with the concentration of KIBS, which has a positive impact.

TABLE 5.B1 — REGRESSION RESULTS OF THE IMPACT ON KIBS-BIRTHS: ROBUSTNESS CHECKS
(Dependent variable: the number of KIBS-births per PC6-location)

	(B1)	(B2)	(B3)	(B4)	(B5)	(B6)
	$\delta = 1$	$\delta = 5$	Locations >5 empl.	Locations >15 empl.	Exclude Θ	Exclude Δ
MNEs Γ *(log)*	0.026	0.046	0.048	0.064	0.300	0.124
	(0.039)	(0.014) ***	(0.019) ***	(0.023) ***	(0.021)	(0.020) ***
KIBS Δ *(log)*	0.673	0.409	0.444	0.493	0.341	
	(0.077) ***	(0.027) ***	(0.035) ***	(0.043) ***	(0.031) ***	
Other firms Θ *(log)*	-0.411	-0.123	-0.240	-0.293		0.117
	(0.086) ***	(0.032) ***	(0.040) ***	(0.058) ***		(0.037) ***
Control variables (10)	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE (61)	Yes	Yes	Yes	Yes	Yes	Yes
Log-likelihood	-11,155.068	-10,967.011	-14,784.065	-9,226.403	-11,091.626	-11,177.551
Number of locations	13,655	13,655	19,069	11,014	13,655	13,655
Number of births	6,275	6,275	7,610	5,212	6,275	6,275

Notes: See Table 5.2. In Specification (B1) $\delta = 1$ and in Specification (2) $\delta = 5$. In Specification (B3) and (B4) we select respectively locations that have more than 5 and 15 employees in 2000.