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The Impact of Functional Integration and Spatial Proximity on the Post-entry Performance of Knowledge Intensive Business Service Firms

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The impact of functional integration and spatial proximity on the post-entry performance of knowledge intensive business service firms

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Abstract

Knowledge intensive business service firms (KIBS) are an important element of modern economies and thus attracting increasing interest in scientific research. In the existing literature it is argued that due to the important role of knowledge, innovation and user-producer interaction in the KIBS sector, functional integration and spatial proximity are particularly decisive for a firm's development. Nevertheless, due to the absence of suitable micro data there is a lack of studies *empirically* analysing the impact of functional integration and regional proximity using micro firm data. Based upon newly-conducted firm micro data in three German metropolitan regions, this paper supplements the literature by giving a multivariate empirical analysis of the determinants of post-entry performance of KIBS. The results of the estimation of firm growth equations show that functional linkages to knowledge providers, customers and co-operation partners indeed matter for the performance of young KIBS. Regarding spatial proximity, however, especially a high diversification of geographical reach is proved to be crucial.

1 Introduction

During the past decades, there has been a large dissemination and growth of producer and business services. The reasons for that phenomenon are manifold, but they are mostly appraised to be the outcome of an increasing division of labour, specialisation, and need for flexibility within production processes. Both in policy and in scientific research, special attention is paid to the so called knowledge intensive business services (KIBS). These are believed to play an outstanding role concerning innovation, technological change, and economic progress (Czarnitzki/Spielkamp, 2003, Koch/Stahlecker, 2005, Miles et al., 1995, Muller/Zenker, 2001).

As the KIBS-sector is a highly dynamic field of economic activity, large numbers of firm foundations and closures are symptomatic. In Germany, for example, firm foundations in this sector accounted for more than 14% of all new firms in 2002 (ZEW, 2004).[1] Studies about KIBS are, for example, concerned with the role of these firms for economic development and change (Czarnitzki/Spielkamp, 2003, Muller/Zenker 2001), with the nature and significance of innovation processes in the service sector (Gallouj/Weinstein, 1997, Miles et al., 1995, Nählinder/Hommen, 2002) or with the inter-firm relationships of KIBS (Illeris, 1994). The majority of the existing empirical research is either based on highly aggregated data or on qualitative, rather anecdotal material (for an overview see Koch/Stahlecker, 2005). Entrepreneurship in the KIBS sector in general and the question of the determinants of post-entry growth of KIBS in particular, in contrast, have hardly ever been discussed so far. However, considering the importance of firm foundation and the relevance of KIBS for economic development and the economic importance, it seems necessary to provide deeper insights into processes of firm foundations and their development in this sector.

Due to a better availability of micro firm data for the manufacturing sector there is a large bias in existing empirical entrepreneurship research towards manufacturing (e.g. Honjo, 2004, Strotmann, 2002, 2003, Wagner, 1994). Corresponding studies for the service sector as a whole and the KIBS sector in particular are missing. The few existing studies examining the service sector explicitly (e.g. Almus et al., 2001,

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[1]   These high foundation rates are accompanied also by above-average failure rates (Brixy/Grotz 2004).

Audretsch/Klomp/Thurik, 1999, Santarelli/Piergiovanni, 1995) are all based on aggregate regional data. Aggregate information as e.g. about sectoral or regional industrial concentration are at best a proxy for the concrete functional integration and the spatial proximity of single KIBS.

This paper therefore aims to supplement existing literature by analysing for the first time a possible impact of functional integration and spatial proximity on the post-entry performance of KIBS empirically based on a newly created firm micro-level dataset. In autumn 2003, 547 firm founders in three German metropolitan regions were asked about various aspects of the process of their firm's foundation, the development of their firm, as well as co-operation, market and knowledge. As will be outlined below, the data set allows to examine the role of linkages, networks and spatial proximity on the firm-level, not on an aggregate regional level.

This paper is organized as follows: In section 2, a brief survey on possible determinants of the post-entry performance of KIBS will be given. Dataset and methodology will be outlined in section 3 before empirical results are presented in section 4. Section 5 concludes.

2   Conceptual framework: The post-entry performance of KIBS

A vast majority of contributions examining the post-entry performance of firms is classifying the determinants of growth into entrepreneur-specific, firm-specific and environmental-specific factors (e.g. Autio, 2000, Brüderl et al., 1996, Honjo, 2004, Okamuro, 2004). Environmental-specific factors may be further distinguished into industry-specific factors, factors concerning the regional environment of a firm and macroeconomic factors.

As will be argued in the next section, functional integration of the founder and the firm and spatial proximity are believed to be of particular importance for the success of KIBS start-ups due to sector-specific characteristics in the KIBS sector. Therefore, due to these sectoral specifics our analyses will focus on a possible role of existing linkages and networks of the entrepreneur and on a possible impact of spatial proximity, i.e. a distinct integration with partners within a region, on a firm's post-entry growth. Further

more conventional entrepreneur-specific and firm-specific variables as e.g. firm size, firm age, age or sex of the founder are additionally used as control variables.

To understand the specifics of the KIBS sector, we will first outline the characteristics of the KIBS sector in section 2.1 – which will be done both along an analysis of the existing literature as well as along the results of own previous and more qualitative studies (Koch/Stahlecker, 2005). In sections 2.2 and 2.3 hypotheses on factors relevant for the post-entry growth of young firms in this sector with respect to functional integration and spatial proximity are theoretically deduced. Section 2.4 briefly informs about further general entrepreneur-specific, firm-specific and industry-specific determinants which will be included in our empirical analysis.

2.1 Basic characteristics of KIBS

KIBS are characterized by their knowledge intensity[2] and the orientation of their services towards other firms or organisations, and not to private households (Almus et al., 2001). They provide non-material, intangible, and highly customized services like specialized expert knowledge, competencies in research and development or applied problem solving. KIBS act, on the one hand, as external knowledge sources for their client firms and, on the other hand, they are increasingly becoming independent innovation creators (Gallouj/Weinstein, 1997, Muller/Zenker, 2001). As in most branches of the service sector, scale economies play a minor role in the KIBS sector (Audretsch/Klomp/Thurik, 1999). Most firms are small or medium sized and the average size of firms is smaller than in manufacturing.

At least most *quantitative* studies dealing with KIBS apply the Standard Industry Classification for identifying the relevant sub-sectors of the economy. Generally, it is differentiated between *Technical KIBS* (T-KIBS), for instance software providers, engineering consultants, and architects, and *Professional KIBS* (P-KIBS) like accountants, lawyers, and business consultants (Nählinder/Hommen, 2002) (see table 1).

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[2] The knowledge intensity can be measured by input factors (e.g. the qualification structure of the employees or the R&D expenditures) or by output factors like innovations or patents (Haas/Lindemann 2003).

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Table 1: KIBS in the Standard Industry Classification

	Technical KIBS
72.1	Hardware consultancy
72.2	Software consultancy and supply
72.3	Data processing
72.4	Data base activities
72.5	Maintenance and repair of office, accounting and computing machinery
72.6	Other computer related activities
73.1	Research and experimental development on natural sciences and engineering
74.2	Architectural and engineering activities and related technical consultancy
74.3	Technical testing and analysis
	Professional KIBS
73.2	Research and experimental development on social sciences and humanities
74.1	Legal, accounting, book-keeping and auditing activities / tax consultancy / market research etc.
74.4	Advertising

The provision of knowledge intensive services requires specialized knowledge and cumulative learning processes, which can mainly be realized by intense interaction between service supplier and client (Johannisson, 1998, Strambach, 2002).[3] As KIBS provide highly application-oriented services, implicit knowledge is important. For the acquisition of this type of knowledge, co-operation, trust, communication, and face-to face contacts play a crucial role (Howells 2002). Thus, it has often been stated that KIBS are primarily located in close spatial proximity to their customers (Illeris, 1994, Vaessen/Wever, 1999). Indeed, at least in Germany, most firms and firm foundations in the KIBS sector occur in the major urban agglomeration areas (Brixy/Grotz, 2004), where also important potential clients are located. However, the impact of proximity may vary not only from firm to firm, but also between different sub-sectors of the KIBS-sector (Czarnitzki/Spielkamp, 2003).

These factors – knowledge intensity, business orientation, interactive innovation processes and spatial proximity – can also be decisive for the success and the growth of a newly founded KIBS firm. In the following, we refer to these bundles of factors as

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[3]   These interactions are further explained by the nature of innovation processes in the modern economy. Since the emergence of evolutionary concepts explaining technological change, innovation is no longer seen as a linear sequence from invention to commercialisation, but rather as an interactive process involving interaction and feedback loops between various actors (Nelson/Winter, 1982). Garnsey (1998: 533) furthermore states that firms might require intense interaction due to the fact that *"potential users may need to be encouraged to realize that their needs could be met in new ways"*.

"functional integration" and *"spatial proximity"*.[4] It will be argued that functional integration and spatial proximity at first root in the pre-entry stage of a new firm (e.g. *opportunity identification, resource access*), as *"[e]arly choices shape future options and can lock out alternatives"* (Garnsey, 1998: 531f).[5] But, in later stages of a firm's development (*resource mobilisation, organization buildin*g), they evolve and change continuously (Garnsey, 1998, Sorenson, 2003).

Knowing about the basic characteristics of KIBS, the following sections will now state more precisely how functional integration and spatial proximity might stimulate the growth prospects of KIBS and thereby formulate the hypotheses to be tested in our empirical analyses.

2.2   Functional integration

Most assets and resources of a newly founded firm are closely bound to its founders (Johannisson, 1998, Okamuro, 2004). Their personal experiences, routines, networks and knowledge can therefore be supposed to have a profound influence on the early development of the firm (Sorenson, 2003). The founders of a new firm are thus pivotal objects when analysing its development.

Before starting a new firm, an opportunity has to be identified and resources (e.g. knowledge, financing, personnel) have to be mobilized. Founders perceiving the most promising opportunities and mobilising the most valuable and adequate resources are most likely to run a successful business (Klepper, 2001, LeBrasseur et al., 2003). For both opportunity identification and resource mobilization the disposability of information and knowledge are crucial (Klepper, 2001). This is even more important in industries where knowledge and interaction with clients are decisive. It can thus be supposed that especially experienced people with detailed insights and connections into their clients' sector have good success and growth prospects. The founders having the most adequate routines and networks at the time of the foundation of their firm can be

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[4]   With Kevin Morgan (2004), we might also term these phenomena as *'organizational or relational proximity'* on the one hand and *'physical or geographical proximity'* on the other.
[5]   This idea is in line with Stinchcombe's (1965) approach of organisational imprinting, which refers to the fact that initial structural characteristics of a firm are fairly persistent and thus partially determine the further development of that firm.

expected to perform best. They are most probable to anticipate their clients' needs, to be aware of the chances and problems of their services.

Functional integration does not evolve from a vacuum. It is based on (prior) social relations of the founder(s), but it also is mutually dependent on the development of the new firm (Yli-Renko et al., 2001). Entrepreneurs importing customer relationships into their new firms should have better growth prospects in the early years due to the fact that they are more likely to overcome the liability of newness with the help of these relationships (Lechner/Dowling, 2003). In contrast, improper or obsolete resources can hamper improvements or innovations and may thus be contra-productive for a firm's performance.

Functional integration does not only serve to identify opportunities and to mobilize resources in a pre-entry stage, but also to reduce uncertainties which are most striking in innovative businesses as well as during the early development of a new venture (Sawyerr et al., 2003). The more uncertainties exist in a given sector of the economy, the more important is the role of networking and interaction (Garnsey, 1998). Networks can be seen *"as a kind of vehicle that enables the transfer of knowledge in a world full of uncertainty"* (Boschma/Weterings, 2004: 5). In the KIBS sector, networking activities may thus have a crucial influence on a firm's development.

As particularly newly founded firms in the KIBS sector heavily depend on interactions in order to promote learning processes and innovation, the quantity and the intensity of co-operation with *customers* (market) and *partners* (knowledge, innovation) can be decisive for their development. The closer a newly founded firm is integrated into the innovation processes of its customer, the more secure and positive its early development will be due to the mutual interdependence.[6] Informal contacts with other persons in the same industry and contacts with suppliers can also be regarded as important factors for competitiveness (Isaksen, 2003).

However, integration and intense interaction are a two-edged sword. On the one hand, close networking may guarantee access to new ideas via communication and knowledge

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[6]   However, later on a high intensity of interaction with few clients may hamper the development of the young firm as lock-ins can occur.

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exchange; on the other hand, it may foster obsolete routines and thus hamper innovation processes (Koster/van Wissen, 2004). Therefore, from a theoretical point of view one might expect a positive impact of networking and functional integration an a firm's development, but there are also arguments in favour of a negative relationship. Hence, this question has to be analysed empirically. Although a large strand of management literature is examining the role of network integration for entrepreneurship formation and the success of new businesses (for recent overviews see Autio, 2000 or Witt, 2004), most of these empirical studies are based upon qualitative case studies or upon quantitative studies with a small number of cases resulting in a lack of comparability. Moreover, the post-entry growth of firms has hardly ever been discussed in this context.

2.3   Spatial proximity

Notwithstanding the rapid development of transport facilities and information and communication technologies, many economists and regional scientists do not agree on Cairncross' (1997) buzzword of the *"Death of Distance"*. They claim that spatial proximity still matters in economic processes and state that because *"information diffuses rapidly across organisational and territorial borders, it is wrongly assumed that understanding does, too"* (Morgan, 2004: 3).[7]

Especially in processes of knowledge transfer and innovation, short distances between actors are still considered to be important (e.g. Boschma/Weterings, 2004, Howells, 2002).[8] It is argued that particularly uncodified, tacit knowledge and its organisation is tied to personal capabilities and information (know-how, know-who) and thus has a spatial component (Howells, 2002, Morgan, 2004). Localized knowledge spillovers as the basis for innovation are more likely to be realized in spatial proximity (Audretsch et al., 2004). It is believed that, due to the role of trust, face-to-face contacts, common understanding and culture, communication and interaction are favoured by spatial

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[7]   Anyhow, one should beware of spatial fetishism. Spatial proximity should always be conceived as a result of an underlying relational proximity (Boschma/Weterings, 2004, Johannisson, 1998). Or, as Morgan (2004: 3) terms it, one should be aware of the problem of *"conflating spatial reach with social depth"*.

[8]   The most common concepts to explain the role of spatial proximity are those of agglomeration and localisation economies. Simply put, they state that it can be advantageous for a new firm to locate in spatial proximity to other firms, organisations or actors due to the benefits from cost reductions (e.g. transportation, labour market, specialized supply, knowledge spillovers). Due to the design of our data we will not account for agglomeration affects in our analyses.

proximity. Through learning-by-interacting, information and knowledge for innovations develop and can be transmitted and implemented (Howells, 2002).

As described in section 2.1 in the KIBS sector, an important role of spatial proximity can be assumed due to the pivotal role of knowledge, innovation, and particularly because of the high significance of interaction between service providers and clients. In the early development of newly founded firms, spatial proximity might also play a prominent role. As most new firms are small in the beginning and only have limited resources, proximity can reduce costs and uncertainties. Thus, falling back on relations in close geographical distance in the early stages of development may foster growth (Illeris, 1994). Founders originating from the region of their new venture can be supposed to experience faster growth in the early stages of their firm's development. Johannisson (1998: 306) claims that the local area may serve as a *"springboard for global business"*. Audretsch et al. (2004) point out that localized knowledge spillovers may be more important for young firms because they depend to a greater extent on external knowledge produced by other firms or universities. It can be assumed that spatial distance can be important as well during the stage of opportunity identification and resource access as in the stage of resource mobilization and organisation building.

Due to the existence of personal and social networks, firm founders are more likely to fall back on information sources and partners in close spatial proximity (Johannisson, 1998). This hypothesis is supported by various studies stating that the big majority of firm founders establish their venture in the region where they had lived and worked before (e.g. Cooper, 1985). A potential firm founder knows the actors living and working in spatial proximity, thus face-to-face contacts prevail and trust as a base of effective knowledge exchange is more probable (Illeris, 1994). These facts are of special importance in knowledge intensive sectors of the economy.

Likewise, spatial proximity can foster the development of the firm during the subsequent stages of a new firm's development, as *"easy access to customers is crucial to generating rapid growth"* (Vaessen/Wever, 1993, 127). In the KIBS sector, access to customers takes place mainly via interaction and personal networks of the founder. As the establishment and continuity of these relations is facilitated by spatial proximity,

locally embedded firms may have better prospects for growth (Boschma/Weterings, 2004).

However, the significance of spatial proximity for the performance of a new venture may also have its limits or even hamper the growth of newly-founded KIBS, e.g. due to regional lock-in effects. For the expansion of a firm's activities in subsequent stages of development, a broader spatial reach may become more advantageous. The reasons for that are, first, the simple assumption that a bigger number of potential clients and partners increases the chances of successful contacts, and, second, that by an expansion of spatial reach, new and different knowledge can enter the firm and potential lock-ins can be more probably avoided.

2.4   Further entrepreneur-specific, firm-specific and industry-specific determinants

In the beginning of section 2 we already pointed towards the fact that it is common in empirical analyses of post-entry development of firms to distinguish between entrepreneur-specific, firm-specific and environmental-specific factor, the latter comprising industry-specific, regional-specific and macroeconomic factors. Though the focus of this paper is on an analysis of a possible impact of functional integration of the founder and the team and spatial proximity on the post-entry growth of newly-founded KIBS we have to be aware that there are important further determinants which have to be considered when explaining the growth of a firm.

In our empirical analyses we will therefore include further variables into the growth equations as proxies for more general entrepreneur-specific (e.g. age, sex, team foundation), firm-specific (e.g. firm size, firm age, human capital of employees) and industry-specific determinants. We will briefly discuss their possible impact on growth when presenting the model and the measurement issues in section 3.2.

3 Data, economic model and measurement issues

3.1 *Data*

As suitable firm micro data for an analysis of the impact of regional and functional integration on the post-entry performance of KIBS is missing, this paper is based upon a newly created dataset. In three German agglomeration regions (Bremen, Munich, Stuttgart) a telephone survey with founders of start-ups in the KIBS sector was conducted.

The KIBS sector is defined according to the mainstream of relevant publications (for an overview and discussion of different definitions see Stahlecker/Koch, 2005) and includes firms classified under the NACE-Codes 72, 73 and 741-744[9]. Furthermore, the population was restricted to firms founded between 1996 and 2003. Additionally, we only considered genuine foundations listed in the trade registers. This means that subsidiaries, branch offices, firms arising from mergers & acquisitions and firm reformations have been excluded from the survey.

Based on these definitions, the population size was 7,714 firms. A random sample, stratified by the 3-digit sectoral attribution, of 2,108 firms was drawn[10]. Based upon that sample, 547 successful interviews could finally be conducted resulting in a quite satisfactory rate of return of almost 26%. The survey was carried out in October and November 2003. In principle, the founder of the firm was interviewed. In case of firms founded by more than one person, one of these founders was interviewed.

For the interviews, a standardized questionnaire covering a large variety of detailed questions was developed. The first part of the interview concerned individual attributes of the founder (e.g. context of business idea, former occupation and location of workplace, skills, etc.), whereas the second part dealt with start-up characteristics of the firm and its development over time.

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[9] Some sub-sectors of 744 have been excluded. For example, a significant proportion (up to nearly 40%) of firms was classified as "Management Activities of Holding Companies" (7415) which we did not consider as KIBS.

[10] The sectoral distribution of the firms included in our dataset corresponds by and large with the data provided in the "Mannheim Foundation Panel" of the Centre for European Economic Research (ZEW) which can be regarded as the most reliable and detailed data source for firm foundations in Germany.

Thereby, we are able to specify the role of functional integration and spatial proximity for a new KIBS' post-entry growth in a more profound manner than existing studies which rely upon aggregated regional data. Before presenting the results of the empirical estimation, the following section will describe the economic model and the methodology.

3.2   Economic model and measurement issues

Following the majority of existing studies, a firm's growth is measured by the average annual growth rate of employment from period one to period t.

$$w_i^t = \frac{\ln E_i^t - \ln E_i^1}{t}$$

To be able to analyse the growth of firms, we retrospectively asked the founders about the development of their firms from the foundation till the day of interrogation with respect to turnover, number of employees and the number of free-lancers (which constitute an important element in service firms).[11] In this paper, we focus on the analysis of employment growth. We will extend our analyses to turnover growth and other growth indicators in future research.

In our model a firm's employment growth is explained by a vector of explaining covariates x_i', β is the vector of coefficients to be estimated. ε_i is a random error, which captures all determinants not explicitly modelled, and which is assumed to be i.i.d. (see e.g. Greene 2003, or Wooldridge, 2002).

$$w_i^t = \frac{\ln E_i^t - \ln E_i^1}{t} = x_i'\beta + \varepsilon_i$$

Firstly, we estimate the model by simple OLS estimation. To account for heteroscedasticity of unknown form, standard errors will be estimated heteroscedasticity consistent using White's (1980) method. As it is well known that the results of OLS

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[11]   This is not without problems (rather short period and the not reliably recalled number of employees in the year of firm foundation), but usual in empirical research (see also, for example, Brüderl et al., 1996). To be more precise one would have to create a suitable panel dataset tracking the development of single firms over time.

estimation might be influenced by outliers, we also applied robust regression methods to test the stability of the results in this respect. The basic idea of robust regression methods is to reduce the influence of outliers by a suitable weighting scheme (see e.g. Rousseeuw/Leroy, 1987 for a general description of the issues and methods. A description of the method of robust regression we applied is given in Hamilton 2002).[12]

Based on the theoretical considerations in section 2, determinants related to the founder, the firm, and the environment of the KIBS' employment growth will be included in our economic model (for a similar model, see e.g. Brüderl et al., 1996, Honjo, 2004). In contrast to existing studies based on firm data a special emphasis is met on the impact of functional integration and spatial proximity on a firm's post-entry performance.

We measure the **functional integration** of a newly founded firm by a set of different variables. At first, the *professional background of a founder* is an important aspect (Klepper, 2001): a set of dummy variables controls for the fact whether the founder worked at a university or a similar scientific institution, in the private economy or whether the founder was self-employed or a free-lance worker before the firm's foundation. To account for the transfer of knowledge and resources, an additional dummy variable measures whether the *concrete idea of foundation* has its origin in the former occupation.

The *firm's share of turnover generated by customers from the manufacturing sector* indicates the importance of demand from the manufacturing sector on the growth performance of KIBS. A further variable measures how close the KIBS' services are integrated into their customer's innovation processes. One might expect that a closer *integration in the R&D-process* might strengthen the growth possibilities in early years. Furthermore, the *form and intensity of cooperation* (cooperation contracts, joint projects, mission oriented research or informal contacts) might also stimulate the post-entry growth.

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[12]   We also applied median regressions minimizing the sum of the absolute errors instead of the sum of squared errors as in OLS. As the results are rather similar we abstained from presenting these results as well.

To account for a possible impact of **spatial proximity** on post-entry growth, the following variables are included into the model. The role of regional demand for a firm's growth and its embeddedness in regional networks is at first measured by the *share of turnover earned within the region.*[13] In contrast to the hypothesis of a positive impact of local regional demand on a firm's growth one might instead expect that a strategy of *regional diversification* might be more promising. We therefore additionally include an index of regional diversification of turnover into the model which has its maximum value of one if a firm earns equal shares of turnover on each regional level (region, rest of the Federal State, rest of Germany, foreign country). Its minimum value is zero if total turnover is earned within one single regional level.

Moreover, we control for a possible impact of the *existence of a regional lead customer* who played – according to the founder – a decisive role for the foundation. To consider whether a firm receives *access to new knowledge and new technologies* by cooperation partners, several variables have been tested. In case of partners, we can distinguish whether *the partners primarily stem from the region of the firm itself or from outside* the region and – which is a more functional aspect – whether the cooperation *partners are from the public sector or from the private economy*.

The *development of the spatial range* of a firm's market is also used as an explaining variable. The founders were asked whether they geographically expanded their relevant market since the foundation or whether they had a shrinking spatial reach. One could expect that a regional expansion coincides with a higher employment growth.

In addition to the variables controlling for a possible impact of functional integration and spatial proximity, further variables are added to control for entrepreneur-specific, firm-specific and industry-specific effects.

As general *entrepreneur-specific determinants* the sex and the age of the founder(s) are considered. Furthermore, information is included about whether the KIBS was founded by a single founder or by a team of founders (binary dummy variable). Concerning *firm-specific determinants* of firm growth, there is quite a lot of evidence in empirical

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[13]   By the term "region" the questionnaire referred to the planning region in which the respective firm was located.

research – particularly for the manufacturing sector (see e.g. Evans, 1987 or Strotmann, 2003 and 2002) – that there is a higher risk of death for smaller firms *("liability of smallness")*, while surviving small firms grow faster than their larger counterparts (see section 2). To allow for a possible impact of firm size on the growth of KIBS, the logarithm of start-up employment is included in the model. To account for non-linearities its square is also used.

Following the basic idea of Jovanovic's (1982) selection theory there might also exist a *"liability of newness"* or a *"liability of adolescence"*. This means that the risk of death is higher for young firms, which enter the market and have to learn that they are not viable.[14] With respect to both hypotheses one could expect that young surviving firms might grow faster than older firms (see e.g. for the manufacturing sector Evans, 1987, Hall, 1987 or Harhoff et al., 1998). The firm's age can be either approximated by a set of year dummies or a variable measuring the firm's age in years. As the results do not depend on the concrete specification only the results including the firm's age in years are considered. The *qualification structure of a firm's employees* is represented by a dummy variable which is one if all employees are academics.[15]

Industry-specific effects are measured either by a single binary variable (T-KIBS versus P-KIBS, see section 2.1) or, in a more detailed way, by including a set of sectoral dummy variables (software, other activities related to data processing, technical services, consultancy services, advertisement). As the results do not depend on the concrete specification only the results for the five dummy variables are presented in this paper.

A problem we cannot address in our analyses is the problem of a possible *survivor bias* (for an early discussion e.g. Mansfield, 1962). As we can only rely upon the response of firms which had survived until the day of interrogation, information about the ones

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[14] While the liability of newness hypothesis forecasts the highest risk of market exit immediately after start-up, the thesis of a liability of adolescence claims that the risk of death increases after start-up and decreases if the firm survived a certain period. We also accounted for non-linearities, but the results have not been significant and therefore will not be presented.

[15] We additionally included the knowledge intensity of a firm approximated by its *qualification structure* (share of employees with university degree) and the amount of its *R&D expenditures* (relation of R&D expenditures to turnover) as explaining variables. As they did not help explaining the growth of employment we abstained from their inclusion in our preferred model versions.

which had to exit the market in the meantime could not be obtained. This might lead to an inconsistent estimation of the 'real' growth equation when only referring to surviving firms. However, as we do not have panel data or information about existing firms, we cannot control for a potential selection bias by applying bivariate tobit estimation or the Heckman two-step estimation (see e.g. Greene, 2003).

Therefore, our estimation results can only explain the growth of surviving KIBS. But as the vast majority of existing studies (see e.g. Evans, 1987, Hall, 1987 or Strotmann, 2002) show that though there often exists a statistically significant attrition bias it does rarely influence the estimation results of the growth equation, this might be a minor problem. Geroski (1998) for example named in his analyses of Gibrat's law the missing empirical relevance of the selection bias a 'stylized fact'.[16] Anyhow, we cannot state for sure that selection problems do not influence our results.

4   Empirical results

4.1   Descriptive statistics

After excluding all firms with missing values in any of the relevant variables, a set of 446 firms remains for our further multivariate analyses. With respect to the firm's employment, the average annual rate of growth is – according to our definition – 11.9% per year.[17]

The majority of the surviving start-ups managed to grow since their foundation. Almost 60% of the 446 firms dispose of a larger number of employees at the time of interrogation than at the end of the start-up year. 135 firms (about 30%) did not change their employment, while 45 firms (10%) had to shrink since their start-up. Table 4-1 gives the descriptive statistics of all variables included in our model estimation.

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[16] *"Attrition bias does not seem to be a major problem, and inferences made about firm performance using data on survivors is often robust to the inclusion of data on non-survivors"* (Geroski, 1998, p. 17).

[17] As for the total sample the corresponding rate of employment growth is rather similar, we do not have selection effects with respect to the dependent variable.

The surveyed firms are distributed rather equally over the five sectors software (16.4%), technical services (23.5%), consultancy services (21.7%), advertisement (17%) and other activities related to data processing (21.3%). In more than 50% of the KIBS start-ups, the founder(s) have their professional background in the private economy, 13.5% of all founders stem from academic institutions and 35.2% were self-employed or did free-lance work before the foundation. 78.3% of the founders started their new venture in the region they have been living and working before.

Table 2: Descriptive statistics

	N	Mean	Std. dev.	Min	Max
Growth rate of employment (annual average)	446	0.165	0.285	-0.805	2.442
Entrepreneur-specific effects					
Age of the founder (in years)	446	37.726	8.626	16	64
Sex of the founder (1=female)	446	0.123	0.329	0	1
Team foundation (1=yes)	446	0.630	0.483	0	1
Firm-specific effects					
Age of the firm in years	446	3.865	1.854	1	7
Start-up employment (log.)	446	1.008	0.750	0	3.219
Start-up employment_ (log.)	446	1.577	1.964	0	10.361
Firm employs 100% academics (1=yes, 0 = no)	446	0.289	0.454	0	1
Industry-specific effects[18]					
Software (72.2) (reference)	446	0.164	0.370	0	1
Other activities related to data processing (72.1, 72.3-72.6)	446	0.213	0.410	0	1
Technical Services (73.1, 74.2 & 74.3)	446	0,235	0.425	0	1
Consultancy Services (73.2 & 74.1)	446	0.217	0.413	0	1
Advertisement (74.4)	446	0.170	0.376	0	1
Functional integration					
Professional background: private economy (reference)	446	0.513	0.500	0	1
Professional background: scientific research	446	0.135	0.342	0	1
Professional background: self-employed	446	0.352	0.478	0	1
Concrete idea from an earlier occupation led to foundation (1=yes, 0=no)	446	0.854	0.353	0	1
Share of turnover with clients from manufacturing sector	446	0.515	0.363	0	1
Close integration into the customers' innovation processes (1=yes, 0=no)	446	0.735	0.442	0	1
Intensity of cooperation with partners (0=none or informal, 1=formal cooperation)	446	0.493	0.500	0	1
Spatial proximity					
Founder stems from the region (1=yes, 0=no)	446	0.783	0.413	0	1
Regional lead-customer with crucial influence on foundation (1=yes, 0=no)	446	0.321	0.467	0	1
Share of regional turnover (%)	446	0.460	0.393	0	1
Regional dispersion of turnover (1=max. of dispersion, 0=min. of dispersion)	446	0.395	0.310	0	1
Broader regional expansion of market (1=yes)	446	0.383	0.487	0	1
No change in expansion of market (1=yes)	446	0.531	0.500	0	1
Smaller regional expansion of market (1=yes)	446	0.085	0.279	0	1
Access to new knowledge/technologies primarily by partners from outside the region (1=yes)	446	0.460	0.499	0	1
Access to new knowledge/technologies primarily by partners from inside the region (1=yes)	446	0.386	0.483	0	1
No partners (1=yes)	446	0.155	0.362	0	1

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[18] Numbers in parentheses represent the respective NACE-codes of the included branches (see annex).

4.2   Results of the multivariate analyses

Different models have been estimated to gain an impression of the validity and the sensitivity of the results. It can be summarized in general that the results remain rather stable and do not strongly depend on the type of model. The presentation of our estimation results is therefore limited to our preferred models. OLS estimation and robust regression reducing the impact of outliers lead without a single exception to the same results as far as it concerns the signs of the estimated coefficients, but differ in some cases with respect to their statistical significance.

Generally speaking, the estimation results underline that functional integration and spatial proximity of new KIBS indeed play a key role in explaining their post-entry growth. To be precise, however, we find that – in spite of large interdependencies between functional integration and spatial proximity–, the former seems to be particularly important for a KIBS post-entry growth.

Regarding **functional integration**, it is particularly the professional/institutional background of the founder that proves to be highly significant for a new KIBS post-entry performance: firms whose founders come from scientific institutions (university, professional formation) grow significantly faster than those of founders who were employed in private firms before. Although this result is in line with qualitative studies or corresponding studies for other sectors, it has not been expected to be so articulated in the KIBS sector. One could instead have expected that service firms could depend more upon relations to customers than upon formal knowledge. Therefore, it seems to be especially the access to knowledge causing success and not a closer integration into the market (which might be expected for founders from firms and even more from those who were self-employed). KIBS of founders who were self-employed or owned a firm before grew, in contrast, significantly slower than those of founders who were employed in private firms before. It might be supposed that formerly self-employed persons already dispose of some day-by-day business and therefore have no need to grow in the early stages of their firm's development.

The "import" of business ideas, services, or technologies from a former occupation has a positive, but insignificant impact on the firm's post-entry growth. Close interactions

with customers in innovation processes have a positive influence on the employment growth of young KIBS. The more deeply the KIBS are involved into the innovation processes of their customers, the more likely they are to grow. And, secondly, also the intensity of co-operation has an at least weakly significant positive impact on the KIBS development: the more formalized the co-operation process was, the more likely was the firm to grow. If the services new KIBS deliver to their clients are closely integrated in their clients' innovation processes (e.g. in the R&D process, in the process of production or in the process of (re-) organisation), these KIBS can expect a higher employment growth. Considering a possible impact of the diversification of customers, we found no significant effects on the KIBS' development.[19] In contrast, the highly significant positive impact of the share of turnover earned with customers from the manufacturing sector rather seems to point to the primordial importance of traditional manufacturing as clients in the KIBS sector. Close interaction of customers has significant effects on the post-entry performance of the KIBS, while diversification of customers has not. This supports the assumption of the outstanding importance of user-producer interaction in the KIBS sector.

Considering **spatial proximity**, several observations can be made: whether a founder stems from the region or not does not have a statistically significant impact on the post-entry growth of newly founded KIBS. The existence of a regional lead client who plays a crucial role for the foundation and early development of the firm (in the eyes of the founder) can be shown to have a weakly significant negative influence on the post-entry growth of the new firm. This may indicate that the existence of such a lead client hampers the growth of the new company due to a strong dependency of the new firm from this client. This orientation towards the lead client may lock up the access to other clients in the early stages of the firm's development and may thus hamper growth.

With respect to regional demand a strategy of **regional diversification** seems to be more promising than focusing on a single regional area: the higher the dispersion index of regional turnover is, i.e. the more a firm is present on different regional levels at the same time, the better are its growth prospects. At the same time, the share of turnover earned within the firm's region has no significant impact on the employment growth.

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[19] This variable has not been included in the presented models as it proved to be insignificant throughout all models.

Table 3: **Determinants of employment growth of newly-founded KIBS, Results from OLS estimation and robust regression, P-values in parentheses**

	Model 1		Model 2	
	OLS estimation	Robust regression	OLS estimation	Robust regression
Entrepreneur-specific effects				
Age of the founder (in years)	-0.001	-0.003	-0.001	-0.003
	(0.538)	(0.018)**	(0.535)	(0.021)**
Sex of the founder (1=female)	-0.069	-0.035	-0.069	-0.034
	(0.024)**	(0.211)	(0.024)**	(0.216)
Team foundation (1=Yes)	0.035	0.015	0.035	0.014
	(0.218)	(0.480)	(0.226)	(0.498)
Firm-specific effects				
Age of the firm (in years)	-0.033	-0.010	-0.033	-0.010
	(0.000)***	(0.042)**	(0.000)***	(0.040)**
Start-up employment (log.)	-0.149	-0.086	-0.149	-0.086
	(0.000)***	(0.010)**	(0.000)***	(0.010)**
Start-up employment_ (log.)	0.011	0.003	0.011	0.003
	(0.422)	(0.825)	(0.418)	(0.836)
Firm employs 100% academics (1=yes, 0=no)	-0.130	-0.122	-0.130	-0.123
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Industry-specific effects[20]				
Other activities related to data processing (ref.: software)	0.039	0.056	0.039	0.053
72.1, 72.3-72.6	(0.251)	(0.062)*	(0.264)	(0.075)*
Technical Services (ref.: software)	0.036	0.048	0.036	0.048
73.1, 74.2 & 74.3	(0.267)	(0.107)	(0.267)	(0.114)
Consultancy (ref.: software)	0.119	0.072	0.119	0.071
73.2 & 74.1	(0.005)***	(0.016)**	(0.005)***	(0.018)**
Advertisement (ref.: software)	0.044	-0.009	0.044	-0.010
74.4	(0.287)	(0.779)	(0.292)	(0.758)
Functional integration				
Professional background: scientific research (ref.: priv. econ.)	0.109	0.054	0.109	0.054
	(0.061)*	(0.067)*	(0.063)*	(0.068)*
Professional background: self-employed (ref.: priv. econ.)	-0.060	-0.041	-0.060	-0.041
	(0.024)**	(0.039)**	(0.024)**	(0.038)**
Concrete idea from an earlier occupation led to foundation	0.052	0.037	0.052	0.038
(1=yes, 0=no)	(0.100)	(0.156)	(0.101)	(0.152)
Share of turnover with clients from manufacturing (%)	0.001	0.000	0.001	0.000
	(0.089)*	(0.080)*	(0.084)*	(0.073)*
Close integration in the customers' innovation processes	0.049	0.028	0.049	0.027
(1=yes, 0=no)	(0.090)*	(0.197)	(0.092)*	(0.207)
Intensity of cooperation with partners	0.026	0.038	0.026	0.039
(0=none or informal, 1=formal cooperation)	(0.283)	(0.046)**	(0.288)	(0.043)**
Spatial proximity				
Founder stems from the region (1=yes, 0=no)	-0.014	-0.005	-0.013	-0.007
	(0.651)	(0.811)	(0.642)	(0.753)
Regional lead-customer with crucial influence on foundation	-0.048	-0.021	-0.048	-0.025
(1=yes)	(0.055)*	(0.285)	(0.076)*	(0.232)
Share of regional turnover (%)			-0.000	0.000
			(0.992)	(0.591)
Regional dispersion of turnover	0.048	0.060	0.048	0.066
(1=max. of dispersion, 0=min. of dispersion)	(0.217)	(0.051)*	(0.264)	(0.042)**
Broader regional expansion of the market (ref.: no change)	0.074	0.045	0.074	0.045
	(0.007)***	(0.024)**	(0.007)***	(0.023)**
Smaller regional expansion of the market (ref.: no change)	-0.118	-0.090	-0.118	-0.091
	(0.001)***	(0.007)***	(0.001)***	(0.006)***
Access to new knowledge/technologies primarily by partners from outside the region (ref.: no partners)	0.065	0.040	0.065	0.043
	(0.025)**	(0.052)*	(0.031)**	(0.044)**
Access to new knowledge/technologies primarily by partners from inside the region (ref.: no partners)	0.015	0.013	0.015	0.014
	(0.624)	(0.655)	(0.625)	(0.626)
Constant	0.280	0.231	0.281	0.221
	(0.008)***	(0.001)***	(0.008)***	(0.003)***
Observations	446	446	446	446
R-squared	0.295	0.277	0.295	0.278
Wald, F-statistic	6.36	6.72	6.09	6.48
	(0.000)***	(0.000)***	(0.000)***	(0.000)***

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[20] Numbers in parentheses represent the respective NACE-codes of the included branches.

The results for the development of the spatial range of the market are highly significant: firms which managed to expand their market geographically are significantly more likely to grow than those who had no changes in their spatial market orientation. Those with a shrinking reach grow slower in a statistically significant manner.

Last but not least, we regarded the spatial characteristics of knowledge access. It turned out in our empirical model that start-up KIBS who have more partners from outside the region than from within the region are significantly more successful in post-entry growth than new KIBS whose cooperation partners are mainly from within the region. Whether the partners can be found in the private or in the public sector, however, does not play a crucial role for new-firm growth. We therefore did not include those variables in our preferred models. Comprising, it can be stated that the local linkages of the KIBS' founders deriving from their provenance have no significant impact on a firm's development. Contrarily, spatial diversification has positive impacts on a firm's performance.

The results for our further 'control variables' measuring general entrepreneur- and firm-specific effects and industry-specific effects on the growth of the new firm are rather plausible. With respect to firm size and firm age newly founded KIBS do not seem to be different from most other firm foundations. When surviving small and young KIBS grow faster than their larger and older counterparts. A statistical significance of the impact of firm age, however, is only given in OLS estimation. Team foundations seem to have higher rates of employment growth than foundations of single founders, but the difference is not statistically significant. If the employees of a firm are only academics firm employment growth is significantly less than in the case of a more diversified qualification structure. Considering a possible influence of a founder's age and sex on employment growth the results indicate that employment growth is slightly larger if the firm founder is male and if he/she is younger. Industry-specific effects were measured by a set of dummy variables. Moreover, our estimation results indicate that there are significant differences between industries whereby firm growth is largest for consultancy firms.

5 Conclusions

This paper supplements existing literature by using a newly created firm micro-level data to analyse for the first time the determinants of post-entry growth of firms in the sector of knowledge intensive business services. A special focus is met on the importance of functional integration and spatial proximity on a KIBS' performance. Both factors are appraised to be of particular interest in the KIBS sector, as interaction with clients and partners as well as information exchange and knowledge transfer play a crucial role for the successful accomplishment of innovative activities in this sector. However, in spite of the large importance of the KIBS sector for employment creation and economic development the relationship between functional integration, spatial proximity and firm growth have not been analysed so far using *firm micro data*, mainly due to lack of suitable micro data.

Our empirical analyses clearly underline the theoretical argumentation that functional integration and spatial proximity of young KIBS can be conducive to their post-entry growth in various ways. Concerning the provenance of the founder(s), their institutional background matters, while purely regional linkages, i.e. starting a firm in the region one has been living or working before, does not lead to statistically significant benefits with respect to the early growth of the firms. Even in the KIBS sector, which is believed to be quite application-oriented and which is based to a considerable extent upon tacit knowledge, founders who have been working in universities or scientific research institutions have eminent advantages in post-entry growth compared to founders with a more applied background.

In the day-to-day business of the KIBS – in generating and processing knowledge and innovations for and with their clients, functional integration *and* spatial proximity matter. But our results give some hints that, while it is *close functional* integration which is conducive to post-entry growth, it is rather *diversified spatial* reach fostering a positive development. Those firms having partners outside their location and those firms succeeding to extend their market spatially are most likely to increase their employment.

Though our study helps reducing the lack of empirical micro data studies dealing with the growth performance of KIBS, there is of course still considerable need for further research. Intra-sectoral differences seem to be of relevance, especially the sub-sector of consulting activities is outstanding in this regard. The KIBS sector is a highly heterogeneous entity and the determinants of post-entry growth, the relevance of functional integration and spatial proximity might significantly differ between different *types* of KIBS (Illeris, 1994). It is conceivable that firms with a more technical profile might rely more upon regional linkages than others due to closer co-operation and a higher importance of face-to-face contacts. It would thus be desirable for future research to account for these intra-sectoral differences in a more profound manner as we did by sectoral dummy variables in this study. Furthermore, it could be an interesting task to also account for regional differences, which was not possible in the present study. From existing research (Almus et al., 2001, Santarelli/Piergiovanni, 1995) it is known that the sectoral structure of firm foundations in the KIBS sector partly depends upon regional industry structure. However, it remains unknown whether in different regions these regional characteristics are really assessed by the young firms.

Even if it can be assumed that employment growth is an important instrument to secure a KIBS' survival in the early stages of its development, it has to be pointed out that scale economies do not play such a prominent role in services like in manufacturing (Audretsch/Klomp/Thurik, 1999). Service firms do not have to grow as much as manufacturing firms in order to survive. We also do not conceal the fact that we do not have information about the growth prospects or motivations of the examined firms (this problem is also addressed by LeBrasseur et al., 2003). The fact that 32.8% of the firms in our sample had no changes in employment at all (42.9% did not grow) may also be explained by the fact that no growth was intended.[21] Similarly, the reasons for growth may differ between the firms. While some firms may grow because of an intrinsic motivation of their founder, other firms may grow rather because of outside pressures (Garnsey, 1998). This may have further implications on the growth determining factors and cannot be addressed by our data.

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[21] Similarly, Garnsey (1998: 537) presumes that this is the reason why, after the first six years of their existence, about 40% of the surviving firms in the US did not show any employment growth.

Further studies should also consider the fact that, though the founder of a new venture might be the most important actor regarding the transfer of contacts, knowledge, and networks, there are certainly other actors like co-founders and also the employees – which are mostly highly qualified – who also matter for the development of a new firm: *"In the long run, corporate success will depend more on the network and the networking activities of the whole organization than that of an individual entrepreneur"* (Witt, 2004: 403). In our study we controlled for team foundation and different backgrounds of the founders, but one should do this in future research in more detail.

This study made a first step in reducing the lack of detailed micro information concerning KIBS when analysing the determinants of growth using a newly created cross-sectional firm-level data base. To be able to really follow up the development of single KIBS firms over time and to analyse growth and in particular survival in a more profound manner, suitable panel data should be created in the future.

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