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**On the link between urban location and the involvement of
knowledge intensive business services firms in collaboration
networks**

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ABSTRACT

Knowledge intensive business services firms can play a key role in modern economies by linking localized collaboration networks to global knowledge flows, and by actively serving in support of knowledge diffusion across institutional and sectoral divides. The extent to which they do is dependent on the markets, partners and human resources available locally. This paper uses the unique establishment-level innovation data available in Norway to investigate whether location in urban labour market regions influences the geographical scope of collaborative linkages maintained within and outside the realm of clients. It proceeds to consider whether the diversity of partner types used locally, domestically and abroad differ between locations.

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Keywords: knowledge intensive business services, urban economies, collaboration, internationalization,

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Abstract

Knowledge intensive business services firms can play a key role in modern economies by linking localized collaboration networks to global knowledge flows, and by actively serving in support of knowledge diffusion across institutional and sectoral divides. The extent to which they do is dependent on the markets, partners and human resources available locally. This paper uses the unique establishment-level innovation data available in Norway to investigate whether location in urban labour market regions influences the geographical scope of collaborative linkages maintained within and outside the realm of clients. It proceeds to consider whether the diversity of partner types used locally, domestically and abroad differ between locations.

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Introduction

Knowledge intensive business services firms (hereby referred to only as KIBS) are positioned at the intersection between corporate demand for specialized knowledge, and the supply of this knowledge from various actors, institutions and locations. This means that KIBS can play a key role in modern economies by linking localized networks to global knowledge flows and by supporting knowledge diffusion across institutional and sectoral divides (Desroches & Lepälä, 2011). The extent to which they fulfil this role depends on the number of different business contexts covered by the network linkages they maintain. This can be referred to as the geographical scope of networks (Fernhaber, Gilbert, & McDougall, 2008). It also depends on the diversity of partner types used and thus cognitive domains covered, which can be referred to as their network breadth (Herstad, Bloch, Ebersberger, & van de Velde, 2008; Laursen & Salter, 2006). This paper is inspired by the notion that it is primarily KIBS in certain high-density urban agglomerations which exhibit behaviour conducive to such positioning (Wood, 2006). Hence, the paper seeks to investigate the legitimacy of this claim with particular emphasis on various aspects of internationalisation. In doing so, it addresses not only the question of *whether* urban economies influence the network behaviour of firms, but also *how* and *why*.

Methodologically, it extends the concepts of scope and breadth on the basis of recent contributions which have introduced the concept of network involvement (e.g. Ebersberger & Herstad, 2013, Herstad, Aslesen & Ebersberger, *forthc*). The empirical approach developed has two important advantages. First, this allows different locational impacts on the geographical scope of sales and various forms of innovation collaboration to be distinguished from each other. Second, it allows the breadth of collaborative linkages maintained at several spatial scales - locally, domestically outside own region and abroad - to be understood in relation to the background characteristics of the regional economy.

The empirical analysis uses establishment-level data for Norway, available through the Community Innovation Survey (CIS), to identify and delineate service-providing firms, establish the link between networking behaviour and various urban or non-urban labour market regions, and control for impacts on behaviour attributable to firm-specific characteristics such as size, IPR strategies and investments in innovation.

Conceptual framework & hypotheses

Research on territorial innovation systems has traditionally put a strong emphasis on interactive learning by means of collaborative ties. This study is therefore not the first to consider potential relationships between locations and collaboration in various industries (Cumbers, MacKinnon, & Chapman, 2003; Laursen, Masciarelli, & Prencipe, 2012; Laursen, Reichstein, & Salter, 2011). Yet, prior research is inconclusive with respect to the existence and strength of these relationships. Some studies have found positive associations between the density of related economic activity in an area and patterns of collaboration (Bennett, Robson, & Bratton, 2001). In the context of services, it has been suggested that these linkages are particularly evident in sub-clusters of capital regions (Wood, 2006). Others claim that a direct relationship between urbanization and behaviour is far from apparent (Amin & Thrift, 2002; Fritsch, 2003). Some have even argued that firms located in rural areas (Teirlinck & Spithoven, 2008) or outside the capital region (Herstad, Pålshaugen, & Ebersberger, 2011; Tödtling & Trippl, 2005) may be more 'open' in their innovation processes.

Despite this, no prior study has to our knowledge used large, representative-sample innovation micro data to investigate whether the networking behaviour of services firms differs systematically, and in a manner which reflects the resource conditions prevalent in their locations.

KIBS specialize in the creation, validation and application of specialized knowledge in order to solve client problems. They rely heavily on academic expertise blended with creativity, discretion and pragmatically justified rules of thumb, which reflect prior experiences and occupational norms (Faulconbridge, 2007; Robertson, Scarbrough, & Swan, 2003). This knowledge is often complex and tacit, embodied in the minds of individual experts, and is provided to clients through direct interaction. This translates into 'inseparability' of service development, production and provision. It also generates unique loyalty problems, because proprietary knowledge cannot easily be stored, transported and provided in a disembodied form, separate from the on-going practices of individual experts (Alvesson, 2000; Dougherty, 2004). Knowledge intensive service provision is therefore considered highly localized, expert-dependent and client-oriented, in all aspects of its structure and its strategy.

These characteristics mean that non-local market presence and collaborative linkages of KIBS cannot be understood merely in terms of well-calculated responses to evolving external political-institutional and technological circumstances, such as the inclusion of services in the GATT framework and the availability of modern ICTs (Javalgi, Griffith, & White, 2004; Samiee, 1999). More fundamentally, these issues must be understood within the context of search processes and experience-based learning at the level of the individual expert and establishment. This is because the internationalization process itself leads to learning and subsequent changes in organisational routines and aims; internationalisation increases awareness of further international opportunities, leads to the adaptation of organizational routines conducive to the task of operating abroad, and changes the way risk-reward ratios are evaluated (Johanson & Vahlne, 1977; Reihlen & Apel, 2007).

Prior research on knowledge-intensive services includes the work of Coviello and Munro (1997), which reveals the role of initial contact points in forming the basis for a broader set of informal and formal ties. While more recent contributions disagree on the relative importance of formal business ties versus informal social ties, they do agree that relationships in place prior to the internationalization process are of importance in shaping it. For instance, recent work has found that the internationalization of UK consultancy firms is favourably influenced by founder networks established through prior career paths (Deprey, 2011; Deprey, Lloyd-Reason, & Ibeh, 2011). Reihlen and Apel (2007) propose that internal cognitive diversity – the diversity of experiences among managers and other key employees – facilitates international opportunity identification and operations based on diverse knowledge inputs and market needs. This reflects the more general argument that proximity to a set of diverse, internationalized actors increases the likelihood that any individual firm conceives of operating in a foreign market (Fernhaber, et al., 2008).

The most important mechanisms for competence upgrading in KIBS is recruitment (Keeble & Nachum, 2002). This occurs most intensively through local labour markets. The extent to which experts available in local labour markets have prior experience with international operations and maintain interpersonal networks that extend into foreign business contexts is influenced by the degree of internationalization among actors and institutions from which this recruitment occurs. Similarly, when a diverse set of actors and institutions constitute the recruitment basis, this is

reflected not only in the diversity of experiences among new recruits, but also in the diversity of the external cognitive domains into which their informal network ties extend. Such networks are of vital importance to KIBS opportunity search (Robertson, et al., 2003; Todtling, Lehner, & Tripl, 2006).

Urban economies merit special attention. This is partly due to the diversity of industrial activities, research, education and public administration functions concentrated within them, and partly due to the tendency of these to be simultaneously linked to international industrial, academic and public policy networks and to local service providers (Aslesen & Isaksen, 2007; Aslesen & Jakobsen, 2007; Simmie, 2003). From the perspective of KIBS, location in an urban economy is conducive to securing a broad knowledge supply base and enables demand specialization. Concentrations of KIBS are characterized by high and cluster-specific rates of inter-firm mobility (Aslesen, Isaksen, & Stambøl, 2008; Herstad & Ebersberger, 2012) by which knowledge accumulation becomes linked to regional 'occupational' labour markets (Lam, 2000). Such labour markets provide conditions for the rapid entry and exit of new actors and for intense spillovers between individual firms (Agrawal, Cockburn, & McHale, 2006, Herstad, Sandven & Solberg, 2013). By contrast, firms in peripheral regions face narrower local knowledge supply bases and local markets with less scope for specialization (O'Farrell, Zheng, & Wood, 1996).

Firms in peripheral regions may compensate for these constraints by developing more innovative strategies and by attempting to 'internalize' some of the benefits which are external to firms in urban regions (Doloreux & Shearmur, 2012). This may even out, or even reverse, the productivity differences which would be expected from differences in location characteristics (ibid). However, exposure to information which is valuable because it originates from outside the firm cannot, by definition, be fully replaced by internalization. Thus, the external resource base of urban locations provides location-specific support for the process of identifying and acting on extra-regional market opportunities. This should be reflected in the geographical scope of market presence and client collaboration, leading to the following first two hypothesis regarding KIBS and their locations:

H1: Urban location is positively associated with geographically dispersed sales

H2: Urban location is positively associated with geographically dispersed client collaboration

Client interaction is part and parcel of service provision and the threshold at which it becomes co-production of knowledge is low. A substantial part of the literature has focused primarily on this dimension (Fosstenløykken, Løwendahl, & Revang, 2003; Skjølvik, Løwendahl, Kvålshaugen, & Fosstenløykken, 2007). Yet, it is increasingly recognized that KIBS also engage in external knowledge sourcing beyond their client networks. Notably, the complementarities between demand and supply side linkages suggested by Castellacci (2010) are reflected in the notion of 'innovation value chains', wherein customers inspire new service development while knowledge from non-client actors enables it (Love, Roper, & Bryson, 2011). Such innovation collaboration beyond the client base entails the externalization of individual experts' knowledge from the on-going practice of service provision (Dougherty, 2004). It therefore requires dedicated management attention and comes with distinct risks and opportunity costs. Furthermore, it requires mechanisms that ensure the appropriation of returns from the collaborative work at a later stage. However, management attention is a scarce resource (Ocasio, 1997) and the possibility to appropriate knowledge is often perceived as limited because the loyalty of individual experts cannot be taken for granted (von Nordenflycht, 2011). This increases the costs and the risks of collaboration. Hence, collaboration beyond the client base is

selective and sensitive to the information flows and resources provided by the urban economy. This gives rise to a third hypothesis on the scope of collaboration:

H3: Urban location is positively associated with geographically dispersed non-client innovation collaboration

The sensitivity of collaboration to geographical distance is moderated by the quality and relevance of partners once they are identified (Laursen, et al., 2011). Nonetheless, proximity enables more frequent face-to-face interaction and trust that is conducive to the exploration and exchange of not-yet-stable knowledge (Torre, 2008; Torre & Rallett, 2005). Consequently, the diversity of potential partner firms and institutions available around an urban region firm translate into a locational advantage, which should be reflected in broad local collaboration. From this follows the first hypothesis on the breadth of collaborative linkages maintained:

H4: Urban location is positively associated with broad local innovation collaboration

Compared to firms in other regions, urban region KIBS face less severe trade-offs between quality, relevance, and proximity of collaboration partners. In institutionally thinner regions (Tödtling & Trippel, 2005), KIBS have incentives to establish broader extra-regional collaboration networks (Doloreux & Shearmur, 2012; O'Farrell, et al., 1996) in order to overcome local resource constraints, leading to the second hypothesis on collaboration breadth:

H5: Non-urban location is positively associated with broad extra-regional domestic innovation collaboration

However, the weaker access to specialized human resources and privileged information that is associated with institutional thinness may limit the ability of the firm to implement those strategies through which it compensates for locational constraints. As international involvement is particularly sensitive to information and resource constraints, a final hypothesis follows:

H6: Non-urban location is negatively associated with broad international innovation collaboration

These six hypotheses reflect the two intersections which are fundamental to knowledge intensive business service firms: The intersection between client and non-client actor groups, and the intersection between local and global knowledge networks. The key underlying assumption is that the context or location of a firm influences its positioning. In the following section these six hypotheses are tested in a manner which seeks to isolate locational influences from those influences attributable to individual firm characteristics and strategies.

Empirical analysis

Locations

Previous empirical work using register data on housing and employment has identified 161 Norwegian labour market regions (Jukvam, 2002). These labour market regions are classified on a centrality scale ranging from 5 (capital region), through 4 (large city regions) to 1 (peripheral regions). Based on this, a comparison can be made between location in the capital region ('Capital') or the other three large city labour market regions ('Trondheim', 'Bergen', 'Stavanger') and those in a reference group consisting of labour market regions at centrality levels 1-3. This also allows us to distinguish urban economy influences from specific capital region influences. In order to capture whether these are specific to known services clusters within the capital region (e.g. Isaksen, 2008; Wood, 2006), the capital is split into three sub-regions. 'Capital C' captures locations within the capital city itself, and includes the main Norwegian financial centre. 'Capital N' captures locations in the bordering north-eastern municipalities. 'Capital W' captures locations in the bordering south-western municipalities, in which engineering and communication services are concentrated.

Data, sample selection issues and estimation strategy

The empirical analysis is based on micro-data from the sixth Norwegian Innovation Survey (CIS2008), collected by Statistics Norway in 2008 as an extended version of the harmonized European Community Innovation Survey (Eurostat, 2010; OECD, 2005). CIS data is collected by the national statistical agencies in all European countries on a biannual basis. The survey is based on the definitions of innovation input, behaviour and output laid out in the third edition of OECD's Oslo Manual (OECD, 2005). Innovation survey data is used for generating official innovation statistics for the EU and its member states. It has been used extensively for analysis in economics (e.g. Cassiman & Veugelers, 2006; Cefis & Marsili, 2006), management studies (e.g. Grimpe & Kaiser, 2010; Laursen & Salter, 2006) and economic geography (e.g. Ebersberger & Herstad, 2012; Laursen, et al., 2011; Simmie, 2003).

In contrast to many other European countries, participation in CIS2008 was compulsory for the sampled Norwegian enterprises. This generated a comparatively large data set, which is not plagued by a non-response bias. The data has also been thoroughly reviewed and validated by Statistics Norway. Unique features of the Norwegian Innovation Survey include sampling for representativeness at the level of regions and the provision of basic information on all individual establishments within the surveyed enterprises. This information includes establishment size, sector and location. In total, the data set contains information on the innovation activities of 6,029 enterprises, with supplementary information on their 9,942 individual establishments within manufacturing industries, construction and infrastructure, wholesale trade and logistics, and knowledge-intensive business services. A total of 2,359 KIBS *establishments* are included in the data set. These are split into four sub-sectors: postal and communication services (NACE 64), technical services (NACE 72, 73), financial services (NACE 65-67) and other business services (NACE 74).

Only a sub-sample of observations is defined as innovation active and has provided information on these activities. As this might cause a selection bias (Heckman, 1979), regressions based on CIS are commonly estimated using a two-stage approach in which the second stage includes a control for unobserved determinants of selection estimated in the first stage (Crepon, Duguet, & Mairesse,

1998; Rammer, Czarnitzki, & Spielkamp, 2009). In analysis at the level of regions, an additional sample selection issue arises from the level of sampling. The surveyed legal entity (the ‘enterprise’) may in fact consist of several operational entities (i.e. ‘establishments’) which i) may operate in different sectors and ii) be located in different regions. Consequently, when enterprises include more than one establishment, estimations on specific industries may be biased by the fact that the sectors of interest (e.g. knowledge intensive services) are not properly identified by the sectoral affiliation of the enterprise. Similarly, in estimations comparing regions, biases may result from discrepancies between the regions in which activities are actually conducted (by establishments) and regions in which they are reported (by enterprises). In the approach used here (see Figure 1), both biases have to be accounted for.

Figure 1 approximately here

The analysis uses individual establishment data to i) identify knowledge intensive business service providers through establishment-level sector codes and ii) estimate, by means of a selection equation, whether they are legally independent from other establishments and thus equal to the surveyed enterprise (Single = 1). This stage is estimated by a probit regression on all 2,359 KIBS establishments identified (see figure 1):

Selection step one:

$$\Pr(\text{Single}=1 | {}^1x_i) = \Phi({}^1x_i {}^1\beta)$$

1x_i contains the variables capturing location (Trondheim, Stavanger, Bergen, and Capital), the size and the age of firms (measured in logarithmic scale) and their sub-sector affiliation. Based on this regression the Mills ratio is calculated and this is included in the subsequent regression steps to control for the selection bias.

By restricting this analysis to the 1,144 observations where the establishment equals the enterprise, it is possible to utilize the additional information available on the latter from CIS, to estimate the likelihood of innovation activity. This is necessary, because innovation collaboration can only be observed for those observations that are innovation active.

Selection Step two:

$$\Pr(\text{Active}=1 | {}^2x_i) = \Phi({}^2x_i {}^2\beta)$$

In this step, 2x_i includes characteristics assumed to affect the decision to carry out innovation activities, including location (Trondheim, Stavanger, Bergen, and Capital) and sectoral indicators. Furthermore, weak prior growth should positively influence the propensity to engage in current innovation activity. The log of the average annual percentage growth rate, from start-up (or 2001 at the earliest) until the start of the CIS reference period in 2006, is calculated based on business register data and is included. As affiliation with a foreign corporate group may either enable innovation activity or constrain it (Cantwell & Mudambi, 2005; Frenz & Ietto-Gillies, 2007), a control

for this is included. By the same token, foreign market presence entails larger market size and exposure to more diverse information. Because this may influence the decision to engage in innovation activities (Crepon, et al., 1998), 2x_i includes a dummy variable capturing whether the main market is foreign. Based on this selection regression a second Mills ratio is computed, which will be included in the final outcome regression.

The correction of selection biases by means of the three step model employed here requires two instruments to produce credible estimates. In each stage, at least one variable has to determine selection without affecting any of the subsequent stages (Greene, 2000; Puhani, 2000). Establishment age is used as the instrument in the first step. Age should reduce the likelihood that the focal establishment is legally independent from other establishments, but should not affect the decision to engage in innovation activity or collaborate in various forms (e.g. Wong & He, 2009). In the second stage, the growth rate is included as an additional instrument. It should affect the decision to engage in innovation activities, but should not affect collaborative involvement.

The results of the selection equations are reported in Table A1 in the appendix. Age and size, measured as their respective natural logarithms, significantly reduce the likelihood that the establishment fully equals the enterprise surveyed by CIS. The strong, positive impact of capital region location is notable because no significant impacts are detected from location in any of the other urban labour market regions. Location in the capital region significantly reduces the likelihood of innovation activity, while location in the second largest town of Bergen significantly increases it. This is consistent with the notion that knowledge spillovers between KIBS in the capital region are reducing their individual incentive to engage in systematic development work due to appropriability problems and the option of 'learning-by-hiring' provided by the strong regional labour markets for expertise (e.g. Herstad, et al., 2011, Herstad & Ebersberger, 2012).

Outcome regressions

Scope and breadth of collaborative involvement

The innovation survey specifies four geographical levels at which the firm can have a market presence (locally and non-locally in Norway, in EU or EFTA countries, and elsewhere). Furthermore, it specifies a total of eight potential collaboration partner groups, which range from downstream customers through suppliers and competitors, into research institutes and universities upstream. For each partner group, the firm indicates whether a collaborative interaction has taken place in its own region (subjectively defined by the firm itself), elsewhere in Norway or in either one of five world regions specified (Nordic countries, EU excl. Nordic countries, North America, Asia, other).

Based on this, a set of indicators can be constructed which capture the geographical scope of involvement in sales, client collaboration and non-client collaboration. An additional set of indicators captures the breadth of collaborative involvement locally, domestically outside own region, and abroad. To estimate the scope of involvement the information available on the geographical location of the given types of collaboration partners (clients or non-client actor groups specified in the questionnaire) was used. The breadth of involvement was calculated using the information available on the different types of collaboration partners at the three main spatial levels specified. The raw

involvement indexes developed in this study are constructed in accordance with the work of Bozeman, Gaughan and Corley (Bozeman & Gaughan, 2011; Gaughan & Corley, 2010) as weighted additive indices. The weights are the inverse of the relative frequency of the activity in the NACE 2-digit sectorⁱ. All involvement indexes are log transformed prior to estimations.

Estimation

It cannot be assumed that the decision to engage along one dimension is independent of activities along other dimensions. Two sets of seemingly unrelated regressions with three dependent variables each are therefore estimated (Zellner, 1962):

$$v_{1i} = \beta_1 x_i + u_{1i}$$

$$v_{2i} = \beta_2 x_i + u_{2i}$$

$$v_{3i} = \beta_3 x_i + u_{3i}$$

where $u = (u_1', u_2', u_3')'$ and $E(u)=0$, $E(uu')=\Sigma$.

The first set of regressions estimates involvement in geographically dispersed sales (v_1) client collaboration (v_2) and non-client collaboration (v_3), whereas the second set of regressions estimates the breadth of involvement in regional collaboration (v_1), domestic collaboration (v_2) and international collaboration (v_3). The Breusch-Pagan Chi2 Lagrange multiplier test (Breusch & Pagan, 1980) is implemented to capture interdependencies between the outcome variables revealed by the correlation of their error terms (Arora, 1996). All outcome regressions are reported in a base form, which includes only locations, selection controls and instruments; and in a full form which includes all exogenous variables.

Control variables

CIS data allows a number of control variables to be implemented in order to isolate the impact of firm-specific characteristics from the impact of the location itself. First, increasing firm size typically entails more diverse competences, stronger management capabilities and better developed organizational systems (e.g. Gilbert, McDougall, & Audretsch, 2006). On the other hand, firms of a smaller size may exhibit increased organizational flexibility and dependence on resources in their external environments (Fernhaber, et al., 2008). Consequently, size may either increase the propensity of the firm to collaborate, due to management learning and organizational absorptive capacity effects, or may reduce this propensity due to less flexibility and the lower dependence on external resources which follow from stronger internal capabilities. As this suggests a certain non-linearity, enterprise size is controlled for by comparing small establishments (< 26 employees) and large establishments (>99 employees) to a reference group consisting of medium sized establishments.

Innovation expenditures (R&D and non-R&D) measured in NOK 100 000 per employee are used to capture the firm's emphasis on systematic new knowledge development (Ebersberger, Herstad, Iversen, Som, & Kirner, 2011; Tether, 2002). A strong emphasis on innovation strengthens internal knowledge resources and routines and in this way can increase the capacity to engage in collaborative work (Cohen & Levinthal, 1989, 1990), in particular over long distances (de Jong & Freel, 2009). A control for innovation intensity is included, in order to capture these effects. The

networks of foreign enterprise groups may serve as a channel for international sales and collaboration partner search, in a manner not attributable to the location of the individual firm (Asheim, Ebersberger, & Herstad, 2012; Kafourous, Buckley, & Clegg, 2012). However, such affiliation also requires attention, potentially at the expense of attention towards collaborative knowledge development (Blanc & Sierra, 1999; Ebersberger & Herstad, 2012). A control is therefore included which captures foreign group affiliation. Public innovation funding schemes often aim to achieve behavioural additionally (Czarnitzki, Ebersberger, & Fier, 2007). This effect is controlled for by a dummy variable on the receipt of domestic or EU funding. Lastly, because collaborative work involves exposure of proprietary knowledge, willingness to engage is likely to be contingent on the availability of relevant IPR protection measures. The control for IPR breadth (Herstad, et al., 2008) captures the fraction of specified IPR protection mechanisms (patents, industrial designs, trademarks, copyright, secrecy, complexity of goods and services and lead time advantages) which the establishment reports using.

In the last set of regressions, each equation includes a control for the market presence, which corresponds to the level of involvement captured by the dependent variable. This procedure is applied to specifically capture the strength of the linkage between KIBS market presence at a certain geographical level, and their involvement at the same level. Bivariate correlations and descriptive statistics for all variables are reported in Table A2 in the appendix.

Results

Table 1 below shows the results of the regressions on the geographical scope of involvement in sales, client collaboration and non-client collaboration. The base model detects a more dispersed market presence among KIBS located in the fourth largest labour market region of Stavanger, compared to the more peripheral reference regions (centrality 1-3). This effect loses significance when the control variables are included. By contrast, the full model finds that KIBS in the second and third largest labour market regions (Bergen and Trondheim) are less involved in geographically dispersed sales than KIBS located outside the large city regions. Thus, peripherality rather than urban location is associated with broader market presence.

Table 1 approximately here

Neither an urban location in general, nor a capital region location in particular, increases the scope of demand side involvement. The fact that neither hypothesis H1 nor hypothesis H2 is supported suggests that the outward push to reach extra-regional markets experienced by KIBS in peripheral regions is as strong as the enabling effect of resources specific to urban regions. In contrast, the base and full models estimating involvement in geographically dispersed non-client collaboration yield highly significant coefficients for all three capital region sub-clusters (Capital C, Capital N, and Capital W). The negative impacts of location in the other large city regions on both non-client and client side involvement are not significant, either individually or jointly. Thus, the support for Hypothesis H3 is specific to the capital region.

The Breusch-Pagan test reveals that independence of the three forms of involvement can be rejected ($\chi^2=237, 18; p=0,000$). Notable control variable impacts include positive and highly significant parameter estimates for innovation intensity in all three equations. Furthermore, foreign group affiliation increases involvement in geographically dispersed sales, but has negative, although insignificant, effects on involvement in collaboration. As expected, public funding is positively associated with collaborative involvement. Supplementary Wald tests reveal that the impact of public funding on non-client involvement is not significantly stronger than any individual capital region variable impact. At the outset, this means that merely 'being there' in the capital has an impact on collaboration, which is approximately equal to the behavioural additionality of public funding. Lastly, neither small nor large KIBS are more involved than medium-sized KIBS establishments (the reference group); nor are the coefficients for small and large size, according to Walds tests, significantly different from each other.

The regressions on the breadth of involvement at different geographical levels are reported in Table 2. In the full model, it is only capital region location which is associated with stronger involvement locally and abroad. Notably, this holds even after controlling for whether or not the firm is present in local and international markets respectively. It is only the breadth of foreign involvement which is influenced significantly by market presence at the same spatial level. Thus, the conditional (on capital region location) support for Hypothesis H4 suggests that while KIBS in this region actively draw on a broad range of local collaboration partners, KIBS in other urban labour market regions do not do so to the same extent. Similarly, the conditional (on capital region location) support for Hypothesis H6 is consistent with the findings on the scope of non-client linkages: Capital region KIBS actively use the

local resource base while searching for and collaborating with international partners. In fact, supplementary Wald's tests reveal that breadth of foreign involvement is significantly more strongly influenced by merely 'being there' in the central or western services clusters of the capital, than it is influenced by foreign market presence ($\chi^2=3.52$ and 4.56 , $p=0.065$ and 0.032 respectively).

The full model that estimates the breadth of non-local domestic collaboration yields significantly negative coefficient estimates for all urban locations, except for the capital. This provides support for Hypothesis H5, which predicts broader non-local domestic involvement outside urban regions due to local resource constraints. The fact that it takes the form of significant differences between peripheral regions and non-capital urban regions only points to the dominant position of the capital region economy in the national innovation system as a whole. It also raises the question of whether domestic collaboration networks of KIBS in peripheral regions by and large converge on the capital.

Table 2 approximately here

The Breusch-Pagan test again finds that independence can be rejected ($\chi^2=328,543$; $p=0,000$). Furthermore, the analysis finds small KIBS to be more involved abroad than medium-sized KIBS and a negative coefficient for large KIBS. While the latter is not significant, this does suggest that internationalization is influenced by receptiveness to external opportunities. This receptiveness exerts a stronger influence than the managerial capabilities and broader internal competences which typically are associated with size.

Conclusion

This paper has investigated whether the resources available to KIBS in urban locations influence the scope and breadth of their collaborative involvement. In doing so, it has also analysed the role played by services in linking localized collaboration networks to global knowledge flows, and in contributing to knowledge diffusion across institutional and sectoral divides. The provision of advanced business services is fundamentally a process of knowledge coproduction with clients. Consequently, the geographical scope of client collaboration is closely linked to the geographical scope of market presence, and to the overall emphasis put on innovation by the individual firm. Resources available to KIBS in urban regions may make it easier for them to identify and pursue extra-regional market opportunities, as suggested in the theoretical discussion, but these effects are overshadowed by the stronger external market dependence of KIBS outside these regions.

Partnerships which extend beyond the realm of clients are also closely associated with firm-specific investments in innovation. However, compared to demand side relationships, they are much more selective and subjected to stronger partner search, opportunity cost and human resource constraints. These constraints are mediated by competences and contact points to informal networks provided by individual experts, or those accessed through pre-existing collaborative ties (Johanson and Vahlne, 2009). The result is significantly stronger non-client involvement amongst KIBS in those capital region locations which offer the greatest direct access to human resources and the most diverse local partner base.

In other words, the commitment of capital region KIBS to local collaboration reflects the place-specific availability of resources which also support broader, and more far-reaching, international involvement. This underscores how network linkages internal and external to locations may be complementary to each other (Bathelt, Malmberg & Maskell, 2004) rather than contradictory (e.g. Fitjar & Rodríguez-Pose, 2012) in their impact on territorial industrial dynamics: Strong international involvement amongst individual firms and public sector institutions translates into broad local economy contact points to non-local networks, and the build-up of experience with international operations amongst potential partner firms and professionals mobile in occupational labour markets. This allows technology and market opportunities external to the region to be identified and pursued by firms which, at the outset, primarily focus on search and client collaboration within it. The diverse and internationalized industrial base of the capital region thus enables service providers to continuously emerge, reflect on and redefine their own positioning at the intersection between knowledge supply and knowledge demand, the global and the local (Wood, 2006). As they do so, they collectively expand the local resource base available to other firms to support their establishment of broad and far-reaching network linkages.

The self-reinforcing advantageous position of the capital as a breeding ground for internationalized services raises questions concerning the need for policy intervention. In non-urban Norwegian labour market regions, it is apparent that weak local resource bases translate into a strong dependence on domestic collaboration networks which, to unknown degrees, converge on the capital. To the extent that governmental initiatives should target KIBS in these regions, they should focus on supporting the build-up of internal competences and on strengthening their international linkages (Herstad, Bloch, Ebersberger & van De Velde, 2010). Both these aspects of KIBS activity are constrained by occupational labour markets which reflect comparatively weak industrial bases and brain drain towards the capital (Aslesen et. al., 2008). Nonetheless, the inherent dependence of KIBS on surrounding *local* conditions suggests that the potential for growth in peripheral regions is limited, and is more dependent on effective regional innovation policies as a whole than on initiatives aimed specifically at services.

A need for targeted intervention is more evident in the non-capital urban regions, where colocation with advanced industrial organizations and knowledge institutions does not trigger significantly broader local commitment than that found in peripheral regions. This merits attention in the form of local mobilization and networking initiatives (Tödtling & Trippl, 2005), because the KIBS sector appears unable to exploit the diverse knowledge assets and capabilities which are present. Even more importantly, it entails that the sector does not live up to its potential for actively contributing to cross-fertilization between them.

Certain important limitations to the study must be acknowledged. First, cross-sectional data cannot be used to determine whether innovation policies and associated funding schemes actively influence the positioning of KIBS within the nexuses of global-local and demand-supply, or merely follow up with funding once such positions are already established. A second limitation is that the data does not allow analyses of the purpose and content of various collaborative linkages, nor how they evolve over time. This means that the analyses cannot describe the nature of demand side linkages maintained at various spatial scales, nor capture the relationship between demand and supply side involvement. It also cannot describe what is likely to be a distinct division of labour between local linkages, motivated by the resources available in the capital, and international collaboration, motivated

by a need to access resources which are not. This underscores how further quantitative and qualitative analyses is needed to capture the evolutionary dynamics of new service firm formation and network positioning, and how innovation policies may directly or indirectly influence these dynamics under different regional conditions.

Third, the empirical analysis has assumed that the use of public funding schemes, the overall emphasis put by KIBS on innovation and their implementation of IPR protection strategies are micro-level characteristics determined independently of locations. This assumption is not trivial. Access to public innovation schemes may, due to the incorporation of regional development objectives, be contingent on the location of the firm. Furthermore, innovation intensity and IPR strategies may, like the decision to engage in innovation activity, be influenced by regional economy characteristics and by the local appropriability regimes these characteristics give rise to (Herstad & Ebersberger, 2012, Herstad et. al., 2011).

The Norwegian capital region is, by international standards, small and peripheral. Despite this, it does exhibit the concentration of knowledge workers, private sector R&D and business services which is typical of such regions. Limitations attributable to the use of data from a single, small, open economy should therefore not overshadow the fact that the analysis provided herein has, as the first of its kind, pin-pointed the types of collaborative linkages that are sensitive to influences from high-density urban locations. This is an important contribution in its own right, which also allows for an improved understanding of how the concentration of services in such locations both expresses and expands their role as 'melting pots' for information and knowledge originating in various institutional and geographical domains. It follows that the growth of internationally oriented services may not so much be a general urban economy phenomenon, as a phenomenon which is, and likely will remain, contained within the very limited number of locations positioned for such growth at the outset.

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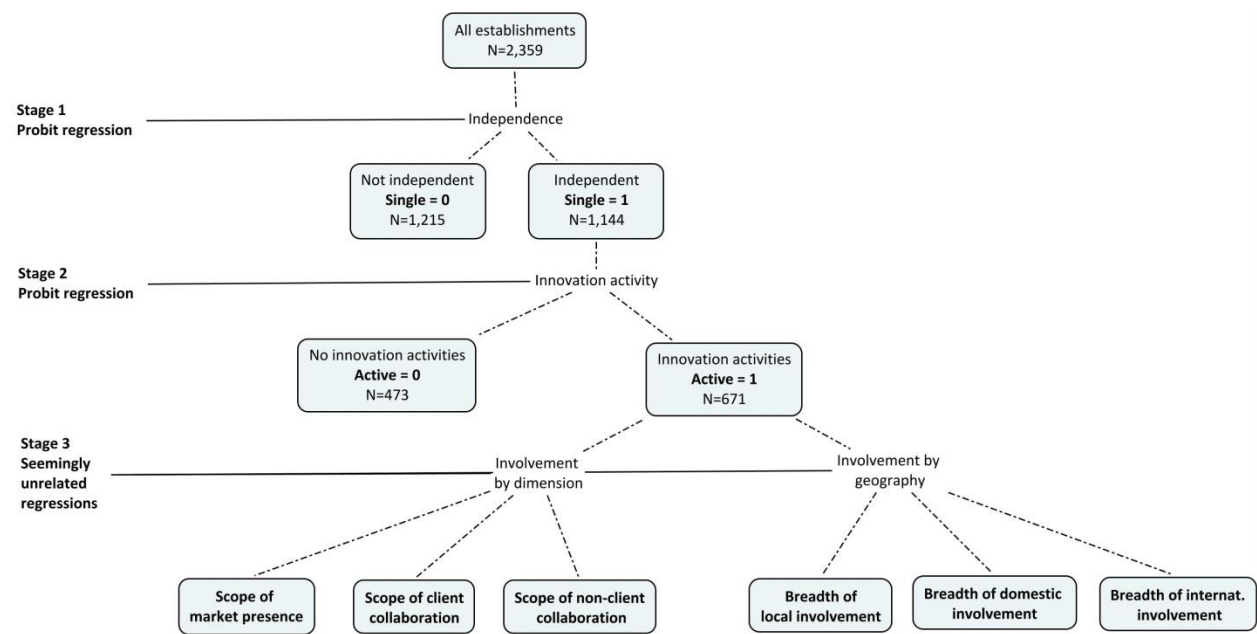
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Appendix

Tables A1 and A2 here

Figures



Tables

Table 1: Involvement by dimension

	Model 3: Involvement by dimension											
	Equation A: Scope of market presence (lnSales)				Equation B: Scope of client collaboration (lnCust)				Equation C: Scope of non- client collaboration (lnSupp)			
	Base model		Full model		Base model		Full model		Base model		Full model	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Labour market regions	Reference		Reference		Reference		Reference		Reference		Reference	
Centrality 1-3												
Trondheim	-0,023	0,044	-0,080	0,043*	0,071	0,046	-0,004	0,045	0,097	0,056	-0,011	0,052
Stavanger	0,089	0,041**	0,045	0,041	-0,026	0,043	-0,046	0,043	0,017	0,052	-0,031	0,050
Bergen	-0,031	0,040	-0,117	0,044***	-0,080	0,041*	-0,072	0,046	-0,065	0,050	-0,095	0,053
Capital N	-0,049	0,061	-0,078	0,069	-0,021	0,064	0,074	0,072	0,003	0,077	0,183	0,084**
Capital W	0,038	0,041	0,010	0,052	0,035	0,043	0,066	0,055	0,152	0,051***	0,232	0,064***
Capital C	-0,005	0,029	-0,036	0,044	0,017	0,030	0,057	0,046	0,087	0,036**	0,189	0,053***
Firm characteristics												
Medium (26-99 employees)			Reference				Reference				Reference	
Small (<26 employees)			0,004	0,034			-0,002	0,035			0,036	0,041
Large (>99 employees)			-0,001	0,068			-0,094	0,072			-0,102	0,083
Part of foreign corporate group			0,109	0,039***			-0,015	0,041			-0,066	0,048
Firm strategy												
Innovation intensity			0,019	0,048***			0,015	0,051***			0,015	0,059**
IPR breadth			0,108	0,049**			0,211	0,052***			0,307	0,060***
Public funding			0,014	0,035			0,126	0,036***			0,219	0,042***
Selection instruments												
Age (log)	-0,008	0,013	0,000	0,013	0,009	0,014	0,004	0,014	-0,010	0,017	-0,022	0,016
Growth (log)	0,000	0,026	0,030	0,026	0,034	0,028	0,030	0,027	0,037	0,033	0,040	0,032
Pseudo R2	0,0355		0,1491		0,0202		0,1304		0,0366		0,2113	
Chi2	27,73		117,61		13,84		100,59		25,49		179,76	
Prob>Chi2	0,006		0,000		0,180		0,000		0,004		0,000	
Note: Coefficient estimates and standard errors from seemingly unrelated regressions. Breusch-Pagan test of independence: Chi2 (3) =308,888, prob>Chi2=0,000. ***, ** and * indicate significance at 1, 5 and 10 per cent levels respectively. Inverse Mills ratios calculated on the basis for model 1 and 2 are included in all regressions. The full regression models include three subsector controls, which are jointly significant.												

Table 2: Involvement by geography

	Model 4: Involvement by geography											
	Equation A:				Equation B:				Equation C:			
	Breadth of local involvement				Breadth of domestic (nonlocal) involvement				Breadth of foreign involvement			
	(InReg)				(InDom)				(InFor)			
	Base model		Full model		Base model		Full model		Base model		Full model	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Labour market regions												
Centrality 1-3	Reference		Reference		Reference		Reference		Reference		Reference	
Trondheim	0,120	0,059**	0,038	0,057	-0,013	0,053	-0,111	0,051**	0,074	0,053	-0,026	0,050
Stavanger	-0,048	0,056	-0,074	0,054	-0,065	0,050	-0,105	0,049**	-0,020	0,050	-0,053	0,048
Bergen	-0,051	0,053	-0,069	0,058	-0,088	0,047*	-0,094	0,052*	-0,083	0,048*	-0,082	0,052
Capital N	-0,006	0,082	0,152	0,092*	-0,069	0,073	0,065	0,081	0,012	0,074	0,144	0,081*
Capital W	0,139	0,054**	0,194	0,070***	-0,013	0,049	0,021	0,062	0,114	0,049**	0,183	0,062***
Capital C	0,037	0,038	0,121	0,059**	-0,063	0,034*	-0,010	0,052	0,073	0,034**	0,148	0,052***
Firm characteristics												
Medium (26-99 employees)			Reference				Reference				Reference	
Small (<26 employees)			-0,019	0,045			0,004	0,040			0,067	0,040*
Large (>99 employees)			-0,093	0,091			0,017	0,081			-0,053	0,081
Foreign corporate group			-0,059	0,053			-0,019	0,047			-0,011	0,047
Firm strategy												
Innovation intensity			0,014	0,064**			0,014	0,057**			0,020	0,058***
IPR breadth			0,179	0,066***			0,242	0,058***			0,261	0,059***
Public funding			0,240	0,046***			0,167	0,041***			0,156	0,041***
Market presence												
Local			0,034	0,029								
Domestic							0,037	0,023				
Foreign											0,040	0,023*
Selection instruments												
Age (log)	-0,009	0,018	-0,018	0,018	0,019	0,016	0,010	0,016	0,011	0,016	0,005	0,016
Growth (log)	0,021	0,035	0,026	0,035	0,017	0,032	0,018	0,031	0,058	0,032*	0,052	0,031*
Pseudo R2	0,025		0,151		0,026		0,163		0,033		0,177	
Chi2	17,52		118,78		17,88		129,24		22,79		144,20	
Prob>Chi2	0,063		0,000		0,057		0,000		0,011		0,000	

Note: N=671. Coefficient estimates and standard errors from seemingly unrelated regressions. Breusch-Pagan test of independence: Chi2 (3) =328,543, prob>Chi2=0,000. ***, ** and * indicate significance at 1, 5 and 10 per cent levels respectively. Inverse Mills ratios calculated on the basis for model 1 and 2 are included in all regressions. The full regression models include three subsector controls, which are jointly significant.

Table A1: Selection models

	Model 1: Single=1		Model 2: Active=1	
	Marg.eff	SE	Marg.eff	SE
Centrality 1-4		<i>Reference</i>		<i>Reference</i>
Trondheim	-0,006	0,041	0,013	0,077
Stavanger	-0,003	0,036	0,107	0,072
Bergen	-0,013	0,040	0,207	0,069***
Capital	0,250	0,022***	-0,220	0,104**
Part of foreign corporate group			-0,114	0,071
Foreign market orientation			0,216	0,047***
Size (log)	-0,117	0,009***	0,138	0,051***
Age (log)	-0,029	0,012**	0,023	0,024
Growth (log)			-0,080	0,042*
N	2359		1144	
Wald Chi2(9)	375,24		143,32	
Prob>Chi2	0,000		0,000	
Pseudo R2	0,179		0,121	

Note: Marginal effects and robust standard errors from probit regression model. ***, ** and * indicate significance at 1, 5 and 10 per cent levels respectively. Both models include three subsector controls, which are jointly significant. Model 2 include the inverse Mills ratio calculated on the basis of Model 1.

Table A2: Descriptive statistics and correlations

	Mean	SD	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1 Sales inv. (log)	0,55	0,27	1,30	1																										
2 Client inv. (log)	0,09	0,28	1,91	0,19	1																									
3 Non-cl inv. (log)	0,15	0,34	1,71	0,17	0,63	1																								
4 Regional inv. (log)	0,13	0,35	2,03	0,10	0,62	0,69	1																							
5 Domestic inv. (log)	0,10	0,32	2,02	0,15	0,59	0,63	0,45	1																						
6 Foreign inv. (log)	0,10	0,32	1,90	0,19	0,69	0,83	0,46	0,53	1																					
7 Trondheim	0,06	0,24	1	-0,02	0,07	0,06	0,08	0,04	0,05	1																				
8 Stavanger	0,08	0,27	1	0,13	-0,01	0,01	-0,04	-0,01	-0,02	-0,08	1																			
9 Bergen	0,09	0,29	1	-0,01	-0,07	-0,07	-0,04	-0,03	-0,08	-0,08	-0,09	1																		
10 Capital N	0,03	0,18	1	-0,06	-0,03	-0,06	-0,04	-0,03	-0,04	-0,05	-0,05	-0,06	1																	
11 Capital W	0,10	0,29	1	0,03	0,02	0,06	0,08	0,00	0,05	-0,08	-0,09	-0,10	-0,06	1																
12 Capital C	0,34	0,47	1	-0,05	0,00	0,02	-0,02	-0,09	0,04	-0,19	-0,21	-0,23	-0,13	-0,23	1															
13 Postal & Com. Serv.	0,06	0,24	1	0,01	-0,08	-0,05	-0,06	-0,07	-0,04	-0,04	-0,05	-0,03	0,06	-0,02	-0,04	1														
14 Financial services	0,09	0,28	1	-0,07	-0,05	-0,05	-0,05	-0,09	-0,05	-0,04	-0,08	-0,05	0,12	-0,06	0,10	-0,08	1													
15 Technical services	0,41	0,49	1	-0,03	0,00	-0,04	-0,04	-0,04	0,00	0,00	0,02	-0,07	-0,08	0,00	0,12	-0,21	-0,26	1												
16 Other services	0,44	0,50	1	0,07	0,06	0,09	0,09	0,12	0,04	0,04	0,05	0,11	-0,02	0,05	-0,16	-0,22	-0,27	-0,74	1											
17 Local market	0,24	0,43	1	0,30	0,00	-0,01	0,01	0,01	-0,02	-0,07	0,00	0,04	-0,04	-0,05	-0,14	0,06	0,04	-0,07	0,02	1										
18 Domestic market	0,75	0,44	1	-0,03	0,11	0,06	0,04	0,07	0,06	0,03	0,05	0,02	-0,02	0,02	0,09	0,03	-0,09	0,06	-0,03	-0,55	1									
19 Foreign market	0,53	0,50	1	0,70	0,18	0,16	0,08	0,14	0,20	0,02	0,08	-0,04	-0,04	0,07	0,08	-0,08	-0,15	0,13	0,00	-0,30	0,19	1								
20 Small (< 26 emp)	0,73	0,44	1	-0,07	-0,08	-0,14	-0,14	-0,10	-0,08	0,02	0,02	0,09	0,09	-0,13	-0,13	-0,05	-0,07	0,04	0,03	0,09	-0,09	-0,12	1							
21 Medium (26-99 emp)	0,24	0,43	1	0,06	0,08	0,12	0,13	0,07	0,06	-0,02	-0,02	-0,09	-0,09	0,13	0,10	0,05	0,04	-0,03	-0,02	-0,08	0,08	0,11	-0,93	1						
22 Large (>99 emp)	0,03	0,17	1	0,03	0,01	0,07	0,04	0,08	0,06	0,01	0,02	-0,02	-0,01	0,01	0,08	0,00	0,07	-0,01	-0,03	-0,03	0,03	0,04	-0,29	-0,10	1					
23 Foreign corp. Group	0,07	0,26	1	0,07	0,01	-0,01	0,00	0,02	0,03	0,01	-0,05	-0,07	-0,02	0,08	0,09	-0,04	0,01	-0,01	0,02	-0,07	-0,01	0,11	-0,24	0,18	0,19	1				
24 Innovation intensity	163,71	233,18	773,69	0,22	0,21	0,21	0,18	0,16	0,25	0,15	-0,04	-0,08	-0,02	-0,05	0,10	-0,08	-0,17	0,22	-0,08	-0,12	-0,02	0,30	0,11	-0,10	-0,04	-0,01	1			
25 IPR breadth	0,15	0,22	1	0,22	0,25	0,32	0,22	0,24	0,30	0,10	0,11	-0,04	-0,10	0,03	0,07	-0,06	-0,10	0,09	0,00	-0,08	0,00	0,27	-0,16	0,13	0,09	0,06	0,29	1		
26 Public funding	0,10	0,30	1	0,09	0,20	0,26	0,26	0,22	0,22	0,10	-0,06	0,04	-0,06	0,04	-0,08	-0,06	-0,10	0,00	0,09	-0,09	0,09	0,13	0,00	0,01	-0,02	-0,04	0,31	0,11	1	
27 Age (log)	2,16	0,84	3,81	-0,03	0,02	-0,01	-0,01	0,06	0,02	0,07	-0,04	-0,04	0,07	-0,07	0,00	-0,03	0,06	-0,07	0,05	0,09	0,00	-0,08	-0,08	0,05	0,09	0,09	-0,13	0,01	-0,06	1
28 Growth (log)	0,61	0,41	3,38	-0,01	0,02	0,03	0,01	-0,01	0,04	-0,06	0,02	0,02	-0,04	0,00	0,01	0,06	-0,01	0,00	-0,02	0,01	-0,07	0,00	0,06	-0,04	-0,06	-0,05	0,03	0,00	0,00	-0,32

Note: Bivariate correlations and descriptive statistics, innovation active establishments (N=671). The minimum value of all variables is zero. Innovation intensity is reported in NOK 1000.

ⁱ As an example of how involvement indexes are constructed, consider a firm engaged in client collaboration only in the Nordic countries and in Asia. In the NACE 2-digit sector of this firm, collaboration with customers within the Nordic countries is rather common as 80% of the firms maintain such. Collaboration with customers in the EU is maintained by 65%, in North America by 60%, in Asia by 25% and elsewhere by 30%. Before logarithmic transformation, the *scope of client involvement* would be:

$$(1*(1-0.80)) + (0*(1-0.65)) + (0*(1-0.60)) + (1*(1-0.25)) + (0*(1-0.30)) = 0.95$$

Similarly, consider a firm in a sector where 50% collaborate with clients locally; 15 % do so with suppliers locally and 7 % with research institutes locally. The average for local collaboration with universities, competitors, consultancy firms and private R&D labs is 1 % in all cases. If this single firm maintains local client collaboration, supplier collaboration and university collaboration, the *breadth of local involvement* would be 2.34 before log transformation. If the same firm also collaborates with a local research institute, the involvement score would increase by $1*(1-0.07)$, i.e. by 0.93.

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