CIRCLE

LUND UNIVERSITY

Paper no. 2013/12

MNC affiliation, knowledge bases and involvement in global innovation networks

Sverre J. Herstad (sverre.herstad@nifu.no)
Nordic Institute for Studies in Innovation, Research and Education (NIFU), Oslo
CIRCLE, Lund University

Bernd Ebersberger (bernd.ebersberger@mci.edu)
MCI Management Center Innsbruck

Bjørn Asheim (bjorn.asheim @circle.lu.se)
CIRCLE, Lund University

This version: March 2013

Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE)
Lund University
P.O. Box 117, Sölvegatan 16, S-221 00 Lund, SWEDEN
http://www.circle.lu.se/publications

WP 2013/12
MNC affiliation, knowledge bases and involvement in global innovation networks

Sverre J. Herstad, Bernd Ebersberger, Bjørn Asheim

ABSTRACT

Innovation collaboration is subjected to partner search and selection constraints. These constraints are reinforced by geographical distance, and mediated by privileged information accessed through pre-existing formal and informal ties to foreign business contexts. Multinational corporations may therefore influence the collaborative linkages maintained by their affiliates abroad, outside the group network. This paper shows that the sensitivity of foreign collaboration to resources provided by the parent group is dependent on whether affiliates of the multinational are engaged in developing cross-disciplinary, application-specific technological knowledge with a strong tacit content (e.g. systems engineering), knowledge with a strong aesthetic of cultural content (e.g. media or fashion) or knowledge dominated by specific scientific disciplines (e.g. biotechnology).

JEL Code: F23, L24, O32

Keywords: Multinational corporations, industrial knowledge bases, innovation collaboration, globalization

MNC affiliation, knowledge bases and involvement in global innovation networks

Sverre J. Herstad[1]
CIRCLE, Lund University & NIFU, Oslo

Bernd Ebersberger
MCI Management Center Innsbruck

Bjørn Asheim
CIRCLE, Lund University

March 2013

[1] CIRCLE (Centre for Innovation, Research and Competence in the Learning Economy), Lund University, and NIFU (Nordic Institute for Studies in Innovation, Research and Education), Oslo.
Corresponding author. Address: NIFU, P.O. Box 5183 Majorstuen, N-0302 Oslo, Norway. E-mail: sverre.herstad@nifu.no

Abstract

Innovation collaboration is subjected to partner search and selection constraints. These constraints are reinforced by geographical distance, and mediated by privileged information accessed through pre-existing formal and informal ties to foreign business contexts. Multinational corporations may therefore influence the collaborative linkages maintained by their affiliates abroad, outside the group network. This paper shows that the sensitivity of foreign collaboration to resources provided by the parent group is dependent on whether affiliates of the multinational are engaged in developing cross-disciplinary, application-specific technological knowledge with a strong tacit content (e.g. systems engineering), knowledge with a strong aesthetic of cultural content (e.g. media or fashion) or knowledge dominated by specific scientific disciplines (e.g. biotechnology).

Keywords: Multinational corporations, industrial knowledge bases, innovation collaboration, globalization

JEL: F23, L24, O32

Acknowledgements: Research for this paper was partially funded the Swedish Research Council (Linnaeus Grant No. 349200680) and Vinnova (Grant agreement 2010-07370.

Introduction

The ability to access, transfer, recombine and exploit resources across multiple contexts is the rationale for the existence of multinational enterprises (Meyer, Mudambi, & Narula, 2011). The literature on the internationalization of innovation has therefore put a strong emphasis on the strategies and localization decisions of MNCs, their embeddedness in the networks of host economies (Barba Navarett & Venables, 2004; Ebersberger & Herstad, 2012; Smarzynska Javorcik, 2004) and the exchanges of information, technology and knowledge between territorial economies which may occur as a result (Balsvik, 2011; Meyer & Sinani, 2009). The focus of this research has been largely on the MNC as such and the challenges it faces in managing multiple network linkages (Meyer, et al., 2011), and on the relationships between subsidiaries and their local contexts (Asheim & Herstad, 2005; Blanc & Sierra, 1999; Dachs, Ebersberger, & Lööf, 2008). Little if any research attention has yet been devoted to whether the spatially dispersed system of control, coordination and communication operated by the MNC assist individual subsidiaries in establishing collaborative linkages outside the realm of the parent and their immediate business environment. This is a notable shortcoming of the literature, in particular within the context of advanced economies and knowledge-intensive industrial activity which increasingly depends on broader access to external competences and capabilities than those the parent can be expected to provide.

This paper uses the concept of network breadth as its point of departure (Herstad & Ebersberger, forthc.), and studies the collaborative linkages of Norwegian corporate group affiliates abroad. It considers first how the composition of the knowledge bases of firms influences the breadth of collaborative involvement in various world regions (Herstad, Aslesen, & Ebersberger, 2012). It proceeds to consider whether broader extra-group networks are established when a parent group contact point to the region is present. Last, it considers whether the facilitating roles of these contact points are contingent on the composition of the knowledge base of the focal firm. In this way, it avoids the common pitfalls of neglecting heterogeneity at the micro-level altogether; or reducing fundamental properties of learning processes to a question of R&D intensity and patent profiles.

International innovation collaboration

The process of growth is associated with specialization, which generates an ever-expanding range of differentiated markets, products and technologies (Knell, 2008). As a result, the stock of knowledge available for recombination continuously grows, diversifies (Grossman & Helpman, 1991) and becomes more and more distributed on numerous locations and actor groups. The resulting need to identify and harness complementarities between market demand and resources controlled by different firms in different business contexts is driving the development towards globally distributed innovation networks.

Alliances and other forms of collaborative linkages have the capacity to transfer knowledge which is disembodided, tacit and evolving - even over long distances (Adams, 2002; Bathelt, Malmberg, & Maskell, 2004; Torre, 2008). The litterature has established how different actor groups contribute different forms of knowledge (Ebersberger & Herstad, 2011; Jensen, Johnson, Lorenz, & Lundvall, 2007), and serve different functions at various stages in the innovation process (Kessler, Bierly, & Gopalakrishnan, 2000; Roper, Du, & Love, 2008). The collaboration networks of firms are therefore increasingly captured in terms of their breadth (Grimpe & Kaiser, 2010); i.e. in terms of the diversity of actors groups and cognitive domains covered (Ebersberger, Bloch, Herstad, & van de Velde, 2011; Laursen & Salter, 2006). The breadth of knowledge sourcing on an international scale has been found to influence productivity (Kafouros, Buckley, & Clegg, 2012), innovativeness (Ebersberger & Herstad, 2013; Fitjar & Rodríguez-Pose, 2012; Laursen & Salter, 2006) and financial performance (Goerzen & Beamish, 2003).

Certain collaborative linkages are more or less given by the specific activity in question and the value chain position of the firm (Herstad & Ebersberger, 2012). Other forms reflect attempts at strategic repositioning through new knowledge development and require management attention dedicated to the task of identifying partners with complementary competencies, evaluating their trustworthiness and establishing the legal and organizational framework around the venture. When firms extend their network into foreign regions, they cannot in advance define a universe of ideas and potential partners to select discretely from. Rather, they are left to rely on those information flows which they are exposed to through pre-existing network ties, routine and accident (Ellis, 2000; Herstad & Ebersberger, forthc.). Peripheral positions in such webs of formal and informal ties reinforce the uncertainty with which identification of new partners and evaluation of risk-reward ratios is associated, while central positions contribute to reducing it (Johanson & Vahlne, 2009). The interpersonal networks maintained by key employees and established as a result of labor market mobility and social interaction intimately tied to places are important sources of new ideas, information and initail contact points into new domains (Agrawal, Cockburn, & McHale, 2006; Oettl & Agrawal, 2008; Rosenkopf & Almeida, 2003). Thus, search occurs most effectively in those regions where one is present, and within those value chains and labor markets to which one is already linked. This tendency to search domains which are already known (Rosenkopf & Almeida, 2003) and to focus excessively on established collaborative linkages (Narula, 2002) translate, to degrees depending partly on knowledge and technologies involved, into constraints on network involvement abroad.

Broad collaboration networks entail contact with diverse organizational systems (Lane & Lubatkin, 1998; Laursen & Salter, 2006). They require a broad range of internal competences to be engaged, and organizational routines able to effectively coordinate them. Substantial management attention is necessary to monitor progress, adjust project group composition and ensure integration of results into the organizational knowledge base (Grant, 1996). Essentially, distributed interactive learning requires organizational routines dedicated to this particular task (Ebersberger & Herstad, 2011; Schmidt, 2010). These routines evolve cumulatively, through experience. Engaging in collaborative knowledge development furthermore entails exposure of proprietary knowledge and may come with uncertainty concerning the control of the knowledge assets which are developed. This translates into a risk of uncontrolled spillovers and partner opportunism. Mediators of this risk may be present in the form of conventional-relational assets which are either developed through past collaborative interaction or linked to the social capital (Laursen, Masciarelli, & Prencipe, 2012) and interpersonal networks of places (Agrawal, et al., 2006; Bouty, 2000). When a firm considers extending its network to include new partners in unknown business contexts, such mediators are rarely present. This increases the sensitivity of involvement to prior management experiences with evaluating partners, the availability of IPR protection measures and to corporate group backing.

The internationalisation of innovation must therefore be understood within the context of how specific (to the knowledge base and organisational rotuines in question) constraints on search and collaboration combine with privileged access to information to allow foreign partners to be identified and evaluated, and how the subsequent process of embedding in foreign business contexts broadens the search space of the focal firm to include the context in question, and leads to the adaption of new organizational routines as well as changes the way in which risk-reward ratios are interpreted by those involved (Johanson & Vahlne, 2009; Reihlen & Apel, 2007). Hence, various forms and geographies of internationalisation may be interwoven with each other in a manner by which activities along either one dimension influence – necessitate, enable or constrain – activities along the other dimension, indivisibly and cumulatively determining the direction, scope and breadth of network linkages maintained abroad.

Differentiated knowledge bases

The interlinked processes of international search, collaboration network expansion and management learning are conditioned by the extent to which presence is required for efficient search, and the extent to which proximity is required for effective collaboration. This is to a large extent determined by the characteristics of underlying knowledge resources. Knowledge can be tacit, hard to observe, complex and system-dependent (Winter, 1987); that is, usable primarily when applied within a given social context (Brown & Duguid, 1991) and associated with information signals subjected to strong distance decay effects. Knowledge can also be easy to articulate, applicable independently of specific contexts (Birkinshaw, Nobel, & Ridderstråle, 2002; Robertson, Scarbrough, & Swan, 2003) and associated with information signals which travel ligthtly between them. These dimensions determine the sensitivity of search to privileged information access (Johanson & Vahlne, 2009), and translate into differences in outward communicability which in turn condition the dependence on proximity during interaction.

In innovaton studies it is common to characterize the strength and composition of knowledge bases in terms of R&D intensity (Castellacci & Zheng, 2010; Cohen & Levinthal, 1990; Grimpe & Kaiser, 2010), by technological profiles revealed by patent data (Nooteboom, Van Haverbeke, Duysters, Gilsing, & van den Oord, 2007) and by the composition of scientific inputs used (Breschi, Malerba, & Orsenigo, 2000). Yet, such defintions only rarely capture the intrinsic qualities of the learning process itself and the organizational routines through which knowledge is expressed. By contrast, work within management studies which build on the resource-based theories conceptualizes firms as complex 'bundles' of internal and externally oriented activities which are expressed by organizational routines and work in tandem to explore and exploit knowledge which is specific to the firm. As a middle-ground between crude defintions based on R&D activity and the focus on idiosyncratic micro-level organisational characteristics we apply the distinction between 'synthetic', 'analytical' and 'symbolic' types of knowledge bases which is gaining increasing attention (Asheim & Coenen, 2005; Asheim and Gertler, 2005; Asheim et al., 2011).

In the philosophy of science, an epistemological distinction is made between two parallel forms of knowledge creation: natural science and engineering science (Laestadius, 2000). Johnson et al. (2002) refer to the Aristotelian distinction between on the one hand 'epistèmè: knowledge that is universal and theoretical, [and] technè: knowledge that is instrumental, context specific and practice related' (Johnson et al, 2002, p. 250). The former corresponds with the rationale for 'analysis' referring to understanding and explaining features of the (natural) world (natural science/know-why). In line with this, an analytical knowledge base refers to economic activities where knowledge development is based on systematic R&D and formal models where knowledge inputs and outputs are often codified in scientific articles , electronic files or patent descriptions. These activities tend to be less sensitive to distance-decay effects, because commonly accepted professional languages and criteria for justification are available (Nonaka, 1994; von Krogh & Grand, 2000). The process of identifying opportunities and potential collaboration partners is enabled by the flow of information in the global 'epistemic' communities (Moodysson, Coenen, & Asheim, 2008), which form around relatively distinct disciplines (e.g. chemistry or biology).

'Technè' corresponds with 'synthesis' (or integrative knowledge creation) referring to designing or constructing something to attain functional goals and corresponds to a synthetic knowledge base. Innovation takes place mainly through the application or novel combination of existing knowledge from various scientific and non-scientific sources, often in response to the need to solve problems that arise when customers and suppliers interact. Knowledge is created more often in an inductive process of testing, experimentation and other forms of 'situated' practical work (Dougherty, 2004). Tacit knowledge is more important due to the fact that knowledge often results from experience gained at the workplace. Industries dominated by synthetic knowledge have a tendency to be relatively stickier and the geographical scope of their external networks tend to be lower (Asheim, Ebersberger, & Herstad, 2012; Herstad, et al., 2012).The cross-disciplinary, situated and often system-embedded nature (Bassanini & Ernst, 2002) of synthetic knowledge base makes the process of partner search far less straightforward; and a stronger reliance on frequent face-to-face contact in innovation processes follow from the hands-on, inductive approach to problem-solving.

Symbolic knowledge is related to the creation of meaning and desire as well as aesthetic attributes of products, such as designs, images and symbols, and to its economic use. The increasing significance of this type of knowledge is indicated by the dynamic development of cultural production such as media (film making, publishing, and music), advertising, design, brands and fashion. In cultural production the input is aesthetic rather than cognitive in quality. This demands rather specialized abilities in symbol interpretation and creativity. This type of knowledge is often narrowly tied to a deep understanding of the habits and norms and 'everyday culture' of specific social groupings. Due to the cultural embeddedness of interpretations, this type of knowledge base is characterized by a distinctive tacit component and is usually highly context-specific. The acquisition of essential creative, imaginative and interpretive skills is less tied to formal qualifications and university degrees than to practice in various stages of the creative process.

Scope, breadth and absorptive capacity

Organizations function by translating individual competences into collective capabilities. This means that knowledge is expressed in a manner which reflect underlying organizational structures and routines, the alingnment of which between partner firms determine their *relative* absorptive capacities (Lane & Lubatkin, 1998; Schmidt, 2010). Routines, in turn, reflect past experiences and evolve with the domiant contact points maintained with the external partners (Bosch, Volberda, & Boer, 1999). Different knowledge bases are therefore asociated with different search spaces, due to the composition of the knowledge base as such, and different relative absorptive capacities (Lane & Lubatkin, 1998; Schmidt, 2010) due to differences in the routines which govern them.

Firms operating based on analytical knowledge base are dominated by highly educated employees, who maintain informal network linkages to national and international academic communities. As organizations, they continously and cumulatively refine their ability to identify, assimilate and transform external scientific inputs, and do so very effectively even at a global scale (Herstad, et al., 2012). Broad collaboration entails the identification, mobilization and continuous assimilation of knowledge which is distributed over numerous partner groups, experience-based and often communicated in codes specific to those who are involved. This requires organizational routines dedicated to the task of identifying, selecting and interacting with a wide range of partners (Ebersberger & Herstad, 2011). Firms operating based on synthetic and symbolic knowledge bases are by their very nature adapted to this task. At the same time, the diversity of cognitive domains which are to be covered by their search spaces, the higher uncertainty which follow from this and the need for more frequent face-to-face interaction during knowledge exchanges also entail that the geographical scope of their networks will be narrower than is the case for firms operating based on an analytical knowledge base (Herstad, et al., 2012).

Multinational corporations

MNC networks represent organizational search spaces (Katila, 2002; Katila & Ahuja, 2002) which are enriched by the diversity of contexts they span (Ebersberger & Herstad, 2012; Frenz & Ietto-Gillies, 2007). By operating affiliates in foreign countries, the MNC establishes physical presences which enable it to tap localized information flows. However, the MNC units present in a given region or the headquarters with which they communicate directly are not necessarily the units which recognize opportunities from the localized resources accessed in this region. The extent to which opportunities are recognizes is therefore contingent on the diffusion of localized information within the MNC, i.e. on its communicative capacity (Ghoshal, Korine, & Szulanski, 1994; Hansen, 2002). As a result, it is commonly claimed that the individual MNC subsidiary is characterized by a tension between 'internal proximity' (i.e. to processes of information signaling and interpretation occurring within the group network) and 'external proximity' (i.e. to resources available in its local environment). At the level of the group, diversity of business contexts and the need to internalize external resources available in them translate a challenge of managing 'multiple embeddedness' (Blanc & Sierra, 1999; Meyer, et al., 2011) and of building the communicative capacity necessary to harness tecnological or operational synergies across these diverse contexts.

The post-war MNC attempted to keep these tensions at bay by developing formalized systems of control and monitoring (Bartlett & Ghoshal, 1998; Geppert, Williams, & Matten, 2003) which essentially reduced the need for communicative capacity by limiting the amount of information to be processed (Granstrand, 1999). Due to a shift towards knowledge seeking strategies, many MNCs are now focusing on the creation of such capacity by linking formal integrative mechanisms to the formation of interpersonal networks across different subsidiaries, located in different contexts (Hedlund, 1986; Björkman, Barner-Rasmussen, & Li, 2004; Ivarsson, 2002). Efforts include the establishment of meeting places and cross-unit organizational labor markets, and the institutionalization of shared values, objectives and belief systems across MNC units (Björkman et al 2004:447). Many MNCs are in this way attempting to nurture those inter-unit personal ties (Szulanski, 1996) which are critical to the ability of the corporate system to absorb, interpret, translate and diffuse information between units on a broader basis than allowed for by formalized systems and management design (Persaud, 2005).

The internal networks of multinational corporate groups are used more intensively for innovation search by affiliates than the internal networks of uninational corporate groups (Ebersberger & Herstad, 2012). Yet, the extent to which information originating in a specific foreign context is conveyed to an affiliate located elsewhere is dependent, first, on the position of the MNC within the foreign context in question and the type of information which is (most easily) conveyed. Second, it is dependent on the position of the individual affiliate within the MNC network and the mandate which it has been assigned as part of parent group efforts at managing environmental and organizational complexity (Cantwell & Mudambi, 2005; Meyer, et al., 2011). With an increase in the number of ties through which information must diffuse follows reduced accuracy (Hansen, 2002). This means that units with close linkages to other units with a knowledge creation mandate can be assumed to be exposed to richer, and more accurate, information flows than those units which at best access this information through several layers of ties. Direct relationships with corporate units abroad, headquarters or subsidiaries, should therefore serve as particularly strong platforms for partner search and extra-group collaboration in the region where they are located.

Data & variables

The analysis is based on Norwegian firm-level data from the Sixth wave of the European Community Innovation Survey (CIS2010), covering the years 2008–2010. CIS collects data on innovation based on the definitions brought forth by the Oslo Manual (OECD, Eurostat 2005). Participation in the Norwegian CIS2010 was compulsory for surveyed firms, and the data has been thoroughly reviewed by Statistics Norway prior to release for research purposes. CIS data in general provides an excellent coverage of innovation input, innovation output, and innovation strategy, and has been extensively used in management research (e.g., Belderbos et al., 2004; Cassiman & Veugelers, 2006; Grimpe & Kaiser, 2010; Laursen & Salter, 2006; Leiponen & Helfat, 2010), in economics (e.g., Cassiman & Veugelers, 2002; Czarnitzki, Ebersberger, & Fier, 2007;) and in economic geography (Ebersberger & Herstad, 2012; Herstad & Ebersberger, forthc.).

Dependent Variables

Innovation collaboration is in CIS strictly defined (OECD, 2010) to include only linkages where partners are actively involved in development work conducted by the focal firm. Pure contractual R&D sourcing is explicitly excluded from the definition. Although the data does not contain information about the intensity of collaboration and the actual number of partners involved, it states the geographical distribution (Norway, Nordic Countries, Europe, US/Canada, India/China, other) of actively involved external partner groups (customers, suppliers, consultants, competitors, R&D laboratories, universities and higher education institutions). This information is used to capture the breath of within-region collaborative involvement in Norway, other Nordic Countries and in other European countries. Due to their size and lack of internal political-institutional coherence, we do not attempt to consider how group contact points in the regions specified only as 'US/Canada', 'China/India', and 'other' influences involvement within them.

Our involvement indexes are constructed in the tradition of Bozeman, Gaughan and Corley (Bozeman & Gaughan, 2011; Gaugan & Corley, 2010) as weighted additive indices. The weights are the inverse of the relative frequency of the activity in the NACE 2-digit sector (Ebersberger & Herstad, 2013). To calculate the breadth of involvement we utilize the information available on the different types of collaboration partners used within the different regions specified.

As an example, consider a firm in an industry where 50% collaborate with clients in other Nordic countries; 15 % do so with suppliers and 7 % with research institutes. The average for collaboration with universities, competitors, consultancy firms and private R&D labs in other Nordic countries is 1 % in all cases. If this single firm maintains client collaboration, supplier collaboration and university collaboration in this region, the breadth of involvement in other Nordic countries would be 2.34. If the same firm ads a Nordic research institute to its network, the involvement score for would increase by 1*(1-0.07), i.e. by 0.93.

Independent Variables

Knowledge bases

In order to operationalize knowledge bases we build on the literature on absorptive capacity (Lane and Lubatkin, 1998; Nooteboom et al., 2007) and assume that the use and stated importance of any specific information source to innovation activities specifically reflect either the existence of internal competences conducive to such use, or attempts at building these competences. Consequently, external search reflects the composition of the internal knowledge base. Information sources are assessed on a four-level scale (3 =“high importance”, 2 =“medium importance”, 1 =“low importance”, 0 = “not relevant”), which refers explicitly to impacts on the innovation activities of the focal firm. Observations which report a higher (average) valuation of information originating from scientific sources than of information from industrial sources are classified as relying on an analytical knowledge base (KB_ANA).

Companies reporting a higher (average) valuation of non-science knowledge sources (customers, suppliers, competitors) are classified as relying either on a synthetic knowledge base or a symbolic knowledge base. In order to distinguish truly ‘synthetic’ knowledge bases, we draw on the information provided on internal competences. A synthetic knowledge base is assumed when firms state that they have in-house engineering or applied science competences (KB_SYN). Symbolic knowledge bases are assumed when firms state that they have in-house competences in graphical design, web design or multimedia, but no internal engineering or applied science competences (KB_SYMB). Observations which do not meet the specified criteria for analytical, synthetic or symbolic knowledge bases are excluded from the analysis. Note that the distinction between synthetic and symbolic knowledge bases refers only to whether engineering competences are present (synthetic) or not (symbolic). In this way, synthetic knowledge bases are allowed to have a strong symbolic content (e.g. Manniche, 2012). The distribution of knowledge base groups is given in Table 1 below.

Table 1 approximately here

Parent group contact point

The Community Innovation Survey explicitly captures innovation collaboration involving parent corporate group units (headquarter or subsidiary) located in the specified world regions. A corporate group contact point (CONTACT_XX) in world region XX is considered to be present only when a collaborative relationship between the Norwegian focal firm and a parent group unit in this region is stated. This definition captures i) organizational proximity between the two units, which is conducive to information sharing on a broad basis. Furthermore, the strict definition of collaborative linkages applied in the Community innovation entail that ii) only Norwegian subsidiaries assigned a knowledge-creation mandate by the parent are, by our definition, considered linked to the different regions by the parent (cf. Cantwell & Mudambi, 2005).

Table 2 approximately here

Control Variables

Headquarter location

CIS data does not directly specify whether the intra-group collaborative linkages which constitute contact points involve other subsidiaries of the parent group or group headquarters. The latter often serve as particularly strong points of gravitation in domestic collaboration networks and labor markets. Because we want to capture the impact of contact points irrespective of specific headquarter location effects, each of the regression equations include a binary variable which capture whether the parent group is headquartered in the foreign region for which involvement is estimated (HQ_xx). Similarly, all regressions include a binary variable which captures specifically whether the multinational parent group is headquartered in Norway (ORG_DM). This is because the data does not allow us to observe whether the focal firm is in fact the group headquarters. Findings may therefore be biased by the information gravitation role of headquarters within the international group network (cf. in particular Ebersberger & Herstad, 2012).

Affiliate size, R&D intensity and external technology sourcing

Larger size entails stronger management capabilities and more diverse internal competencies. As this raises the latent absorptive capacity of the firm (Czarnitzki, Ebersberger, & Fier, 2007; Nooteboom, et al., 2007) and supports internationalization more broadly (e.g. Knight and Cavusgil 2004), we include size measured as the natural logarithm of number of employees in all regressions (LEMP). R&D intensity is measured as the share of turnover spent on research and development, and included to capture emphasis on innovation (RDINT) R&D activities may strengthen absorptive capacity (Cohen and Levinthal, 1990; Grimpe and Kaiser, 2010) and increase the geographical reach of collaboration (e.g. de Jong & Freel, 2009).Contractual R&D sourcing may serve to back up collaborative activities, or be applied as a substitute for such. Hence, we include separate controls for whether firms engage in external R&D with domestic (RDEX_NAT) or international (RDEX_INT) partners (Maskell, Pedersen, Petersen, & Dick-Nielsen, 2007). Last, controls are included to capture the behavioral additionality of domestic (FP_NAT) and EU (FP_INT) public innovation funding.

Table 3 approximately here

Market orientation

All regressions control for whether the firm is present on a local or domestic Norwegian market (MARLOC and MARNAT), on a European market (MAREUR) or on other markets (MAROTH).

Protection strategy

Prior empirical work has distinguished between formal and strategic means of IPR protection (Castellacci & Zheng, 2010). The distinctiveness of these two strategies is confirmed by factor analysis on all IPR protection measures stated in the CIS questionnaire (cf. Table A1 in the Appendix). The two factors are included as controls to capture formal versus strategic IPR protection.

Innovation strategy

Different objectives of innovative work are associated with different requirements on the input side, and will therefore influence collaborative involvement. Process innovations refer to the development and implementation of production and delivery methods, which involve new or significant improvements of techniques and equipment used (OECD, 2005:49). These are not exposed directly to market selection and should therefore be less contingent on knowledge related to the demand side. At the same time, they can be assumed highly contingent on knowledge developed through ‘doing-using-interacting’ (Jensen, et al., 2007) in contexts of application (Zahra & Nielsen, 2002) and thus prone to rigidities and lock-in effects which require external inputs to be avoided. The factor analysis objectives of innovation activity (cf. Table A2 in the Appendix) confirm that product innovation is a distinct strategy which as such could influence collaborative behavior.

Product innovation, as defined here in accordance with the OECD Oslo Manual (OECD, 2005), involve the development and introduction of a good or service which is new or has significantly improved technical specifications or functional characteristics. It entails direct expose to the market, and requires dedicated efforts at linking a wide range of technological opportunities and resources to market demand (Danneels, 2002; Ebersberger & Herstad, 2011). Consequently, the distinct product innovation strategy revealed by the factor analysis can be assumed associated with broader collaborative involvement.

Methodology

It cannot be assumed that collaborative involvement in Norway (NO), in the Nordic Countries outside Norway (ND) or in the European Union (EU) outside the Nordic countries are mutually independent. Hence, seemingly unrelated regressions with three dependent variables are estimated (Zellner, 1962):

$NETWORK_{\mathrm{NO}}$=

$\mathrm{CONTACT}_{NO}\ \beta_{1,\mathrm{NO}} + KB_{SYMB}\ \beta_{2,\mathrm{NO}} + KB_{SYN}\ \beta_{3,\mathrm{NO}} + KB_{ANA}\ \beta_{4,\mathrm{NO}} +$

$\mathrm{CONTACT}_{\mathrm{NO}} * KB_{SYMB}\ \beta_{12,\mathrm{NO}} + \mathrm{CONTACT}_{\mathrm{NO}} * KB_{SYN}\ \beta_{13,\mathrm{NO}} + \mathrm{CONTACT}_{\mathrm{NO}} * KB_{ANA}\ \beta_{14,\mathrm{NO}}$

$+$

$X\ \beta_{\mathrm{NO}} + u_{\mathrm{NO}}$

$NETWORK_{\mathrm{ND}}$=

$\mathrm{CONTACT}_{ND}\ \beta_{1,\mathrm{ND}} + KB_{SYMB}\ \beta_{2,\mathrm{ND}} + KB_{SYN}\ \beta_{3,\mathrm{ND}} + KB_{ANA}\ \beta_{4,\mathrm{ND}} +$

$\mathrm{CONTACT}_{\mathrm{ND}} * KB_{SYMB}\ \beta_{12,\mathrm{ND}} + \mathrm{CONTACT}_{\mathrm{ND}} * KB_{SYN}\ \beta_{13,\mathrm{ND}} + \mathrm{CONTACT}_{\mathrm{ND}} * KB_{ANA}\ \beta_{14,\mathrm{ND}}$

$+$

$X\ \beta_{\mathrm{ND}} + u_{\mathrm{ND}}$

$NETWORK_{\mathrm{EU}}$=

$\mathrm{CONTACT}_{EU}\ \beta_{1,\mathrm{EU}} + KB_{SYMB}\ \beta_{2,\mathrm{EU}} + KB_{SYN}\ \beta_{3,\mathrm{EU}} + KB_{ANA}\ \beta_{4,\mathrm{EU}} +$

$\mathrm{CONTACT}_{\mathrm{EU}} * KB_{SYMB}\ \beta_{12,\mathrm{EU}} + \mathrm{CONTACT}_{\mathrm{EU}} * KB_{SYN}\ \beta_{13,\mathrm{EU}} + \mathrm{CONTACT}_{\mathrm{EU}} * KB_{ANA}\ \beta_{14,\mathrm{EU}}$

$+$

$X\ \beta_{\mathrm{EU}} + u_{\mathrm{EU}}$

where $u = (u_{\mathrm{NO}}', u_{\mathrm{ND}}', u_{\mathrm{EU}}'')'$ and $E(u)=0$, $E(uu')=\Sigma$. *NETWORK* is the breadth of the network in the respective world regions. CONTACT captures a collaborative linkage maintained with another group unit (parent HQ or subsidiary) in the given region. *KB* is the indicator for the symbolic (*SYMB*), the synthetic (*SYN*) and the analytical (*ANA*) knowledge base. The regression equations also contain the interaction between the presence and the knowledge bases. β are the parameters to be estimated. *X* contains the control variables.

The availability of information needed to estimate involvement is contingent on the decision to engage in innovation activities (Cassiman & Veugelers, 2006). This translates into a potential sample selection bias, because unobserved determinants of innovation activity may also determine involvement. To test whether findings may be biased by sample selection, the inverse Mills ratio (IMR) has been estimated (Greene, 2000; Heckman, 1979) on the basis of a probit regression on the decision to engage[2]. When included in the regressions on involvement, IMR does not yield significant parameter estimates. We have therefore not implemented sample selection models in the tradition of Heckman (1979).

[2] This regression model is not reported here. The parameter estimates, however, can be obtained from the authors upon request.

RESULTS

As a point of departure, Table 4 below compares average involvement scores in the three different regions by knowledge bases. Companies operating based on an analytical knowledge base show the highest average involvement scores, whereas companies operating based on a symbolic knowledge base show the lowest involvement scores. Within Norway and the Nordic countries, it is only the average involvement of firms operating based on symbolic knowledge which is significantly different from any other knowledge base average. By contrast, average involvement in Europe is significantly lower for symbolic knowledge base firms than for synthetic knowledge base firms; which in turn is significantly lower than average involvement in the group of firms operating based on analytical knowledge.

Table 4 approximately here

Table 5 report average involvement scores for the three different regions, conditional on whether a parent group contact point to the region is present or not. It shows that average scores for extra-group involvement within the different regions are significantly higher when a relationship to the region is established through the parent group.

Table 5 approximately here

The baseline regression findings are reported in Table A3 in the appendix. Notable control variable impacts include the lack of clear-cut relationships between market presence and collaborative involvement. Furthermore, given the other firm characteristics accounted for by the model, neither size nor R&D intensity yield consistently significant parameter estimates. However, external R&D contracting abroad positively associated with the breadth of involvement. This is consistent with the notion that arms-length sourcing of R&D services from foreign partners may be a first step towards stronger, and more direct, collaborative ties (e.g. Maskell, Pedersen, Petersen, & Dick-Nielsen, 2007). It is notable that headquarter location per se does not significantly influence involvement. Given this, the positive impacts from the variable indicating that the headquarters of the *multinational* parent group is located in Norway (ORG_DM) are highly notable. They illustrate how being the MNC headquarters, or being located within the same economy as the headquarters, is associated with unique positions within the information-conveying network of the group and thus highly conducive to collaborative involvement abroad (Ebersberger & Herstad, 2012; van Pottelsberghe de la Potterie & Lichtenberg, 2001).

In order to consider whether impacts of MNC affiliations and knowledge bases on collaborative involvement are contingent on each other, we calculate and report the combined marginal effects of knowledge bases, group linkage to the region, and their interaction. The upper parts of Tables 6 and 7 report marginal effects, and the extent to which these are significantly different from zero. The bottom parts of both tables report whether marginal effects are significantly different from each other.

Table 6 approximately here

Table 6 report marginal effects for all firms, calculated based on the full regression model reported in Table A3 in the appendix. It shows that intra-group linkages within Norway has a significantly stronger impact on external involvement in Norway for firms operating based on a symbolic knowledge base, than for any other type of firm. Domestic intra-group linkages, essentially, reinforce what are already highly contextual knowledge development activities. By contrast, involvement in foreign regions is significantly more sensitive to the existence of a corporate group contact point when firms operate based on a synthetic knowledge base, than is the case for firms operating based on symbolic or analytical knowledge bases. In fact, a corporate group linkage to Europe does not significantly influence involvement amongst firms operating based on either analytical or symbolic knowledge.

Table 7 approximately here

The sensitivity of involvement to intra-group linkages and knowledge bases can be assumed dependent on the diversity of internal knowledge resources and distinctiveness of organizational routines, i.e. on the size of the firm. An additional seemingly unrelated regression has therefore been run on SMEs only. Table 7 report the marginal effects of the model reported in the appendix. The results for involvement in EU are consistent with those found for all firms, while the effect for synthetic knowledge bases is no longer significantly stronger than the effects for symbolic and analytical on involvement within Nordic countries.

Conclusion

The increased knowledge intensity of economic activity entails that distributed knowledge networks are growing in importance to the innovativeness of firms and competitiveness of economies. They transcend industries, regions and the common taxonomies of high or low tech. Multinational companies are key actors in this because they internalize localized information available in different contexts and diffuse it to affiliates in others. Once a knowledge creation mandate is present and the positions of the different entities involved within the corporate group network is accounted for, the basic characteristics of knowledge bases determine the sensitivity of the focal firms external network involvement to these internal corporate group information flows. Engineering-based ‘synthetic’ knowledge development comes with an inherent need to actively integrate knowledge from a broad range of specialized external knowledge providers (Grant, 1996). Because the range of potential knowledge sources available domestically is limited, the need for broad access to specialized knowledge and capabilities translates into a need for broad international contact points. This does not necessarily materialize as such, because the identification and selection of potential partner firms is highly dependent on privileged information accessed through pre-existing network ties. Interaction effects between synthetic knowledge bases and corporate group contact points are therefore particularly strong. These contact points mediate the search constraints inherent to the identification of specialized partner capabilities and allow the broad collaborative linkages required by this form of knowledge development to materialize.

Symbolic knowledge development and application is highly context-dependent. Thus, while firms operating based on synthetic knowledge bases are forced to search internationally for specialized technological capabilities which are complementary to their own, firms operating based on symbolic knowledge bases must continuously relate to evolving place-specific socio-cultural conditions in order for these to be reflected in the goods and services they provide. Consequently, they are less dependent on and therefore involved in international collaboration than any other firm type. The fact that corporate group linkages to world regions outside the Nordic countries have no triggering effect on this collaborative involvement underscores this point. At a cultural and institutional distance, i.e. in the EU, the parent group network is incapable of absorbing, translating and diffusing the highly contextual information which could trigger such involvement. Within the Norwegian economy itself and the larger yet homogenous group of Nordic countries, the direct linkage to another corporate group unit does impact their involvement to a significantly stronger degree than is the case for synthetic and analytical knowledge base firms. This is because less information is lost through translation within the corporate network, and because the information actually conveyed is easier to interpret and relate to the specific requirements and strategies of the symbolic knowledge base firm when it reflects cultural and institutional conditions similar to those prevalent at home.

While symbolic knowledge production is particularly sensitive to contextual information, the opposite is the case for firms relying on an analytical knowledge base. Due to their internal concentration of innovative capacity amongst a limited number of scientific experts (Tzabbar, 2009), and external dependence on knowledge developed, codified and signaled in accordance with the standards of scientific communities, they embed easily in formal and informal networks. Information relevant to analytical knowledge development travels easily within global epistemic communities and subsequent communication with providers of scientific inputs can be based on commonly accepted languages and criteria for justification (Herstad, et al., 2012; Asheim et al., 2012).

While highly dependent on complementary capabilities accessed on a global scale, the innovative capacity of analytical knowledge base firms is, by definition, less dependent on the active *integration* of cross-disciplinary technological knowledge or cultural codes that are tacit, experience-based and contextual. This allows for less intense interaction with collaboration partners around evolving, tacit knowledge; higher degrees of pre-specification and modularity in development work and production and less long-term dependence on specific partners. As a result, firms operating based on an analytical knowledge base enter more easily in and out of different collaborative arrangements and can maintain broad international networks without encountering the search challenges and constraints from investments in relation-specific assets involved in the development of synthetic knowledge. Thus, as in the case of symbolic knowledge but for diametrically opposing reasons, the extra-group involvement of firms operating based on an analytical knowledge base in specific world regions is not sensitive to within-region search facilitated by group contact points.

The growing complexity of technologies, products and markets which characterizes the contemporary industrial landscape is mirrored within the MNC as growing complexity in webs of internal and external network ties (Ebersberger & Herstad, 2012; Meyer, et al., 2011). With an increasing emphasis on the side of the MNC on knowledge-seeking strategies, and the exponential growth in external network linkages which follow, it cannot be assumed to successfully develop and implement formal systems of coordination and control through which the flow of intangible resources are systematically managed in a manner conducive to innovation. Rather, it is forced to focus on the internal 'creation of space' through socialization efforts in order for information to diffuse on a broad basis between different affiliates, without necessarily entering through headquarters or requiring headquarter consent to be acted on. This perspective on the modern multinational aligns well with Hedlunds (1986) original notion of heterarchy. Our study is therefore important to the evolving theory of the MNC, because it reveals how the challenges associated with building this communicative capacity and its potential impact on the technological positioning of the MNC is dependent on the specific configuration of geographical contexts and firm knowledge bases in question.

What has traditionally been viewed as 'liabilities of foreignness' (Johanson & Vahlne, 1977) may be transforming into advantages of multiple network 'insideness' (Johanson & Vahlne, 2009). It is evident from our analysis that these are not necessarily only at play at the aggregate group level. Rather, the distinct multi-locational communicative and integrative capacity on which these advantages rest is a resource attributed to and thus controlled within decentralized, intra-subsidiary relationships. This perspective on the modern multinational aligns well with emerging network-based theories of internationalization (Coviello, 2006; Coviello & Munro, 1997; Reihlen & Apel, 2007) because it points to how privileged information exposure resulting from established network ties, collectively established by a set of actors, continuously changes individual actor behavior and thus redefines not only their individual network positions but also the characteristics of the network as a whole. To network-based theories of internationalization our study thus contribute the important insight that intrinsic qualities of knowledge development and application – as separate from the R&D intensity of the firm and the technology intensity of the sector - differentiate firms by their sensitivity to the resources provided. Consequently, knowledge bases also differentiate the cumulative dynamics which result.

Last, our findings are relevant to the literature on local impacts of MNC presence. They raise the question of the extent to which observed 'decoupling' between firms and their local environment in the wake of MNC integration is a negative byproduct of the attention required by the administrative system of the new parent group (e.g. Asheim & Herstad, 2005; Ebersberger & Herstad, 2012), or, alternatively, reflect the far more positive role of this parent in reducing 'systemic lock-in' to localized collaboration networks by facilitating broader linkages to business contexts abroad. This is an important issue for future research. They answer, which is likely to be conditional on involved knowledge bases and business contexts, has a strong bearing on how local decoupling specifically and MNC presence more generally influences the position of the larger regional economy in global innovation networks.

As firms gradually embed in global innovation networks, they adapt their routines and change the way risk-reward ratios are evaluated in a manner whereby lock-in to established network ties and business contexts is loosened and the search constraints inherent to the knowledge base in question are gradually overcome. The importance of the multinational parent group in initiating processes of internationalization which eventually become self-sustaining and extend well beyond internal group resources and locations may very likely be growing with the increasing importance of access to global innovation networks, and most distinctively so for firms operating based on complex, engineering-based synthetic knowledge bases.

Acknowledgements

Research for this article was partly conducted through the project 'Economic Development Paths in Norwegian Regions' coordinated by NIFU, Oslo, and funded by the Research Council of Norway under the program 'Democracy and Governance in Regional Contexts'. The authors are grateful for the comments received on an earlier version of the paper from participants at the Conference in Memory of Lennart Hjalmarsson, held at University of Gothenburg on December 7th – 8th, 2012, and from Torben Schubert. Yet, the usual disclaimers apply.

References

Adams, J. D. (2002). Comparative localization of academic and industrial spillovers. *Journal of Economic Geography, 2 (3)* 253-278.

Agrawal, A., Cockburn, I., & McHale, J. (2006). Gone but not forgotten: knowledge flows, labor mobility, and enduring social relationships. *Journal of Economic Geography, 6*(5), 571-591.

Asheim, B. T., & Coenen, L. (2005). Knowledge Bases and Regional Innovation Systems: Comparing Nordic Clusters. *Research Policy*, *34 8*, 1173-1190.

Asheim, B. T. and Gertler, M. (2005): The Geography of Innovation: Regional Innovation Systems, in Fagerberg, J., Mowery, D., and Nelson, R. (eds.), The Oxford Handbook of Innovation. Oxford University Press, Oxford, 2005, 291-317.

Asheim, B. T., Boschma, R. and Cooke, P. (2011): Constructing Regional Advantage: Platform policies based on related variety and differentiated knowledge bases. Regional Studies, 893-904.

Asheim, B. T., & Herstad, S. (2005). Regional innovation systems, varieties of capitalisms and non-local relations: Challenges from the globalising economy. In R. A. Boschma & R. C. Kloosterman (Eds.), *Learning from Clusters: A critical Asessment for an Economic-Geographical Perspective*. Dordrecth: Springer.

Asheim, B. T., Ebersberger, B., & Herstad, S. (2012). MNCs between the global and the local: Knowledge bases, proximity and distributed knowledge networks. In M. Heidenreich (Ed.), *Innovation and institutional embeddedness of multinational companies* (pp. 77-104). Cheltenham: Edward Elgar.

Balsvik, R. (2011). Is labor mobility a channel for spillovers from multinationals? Evidence from Norwegian manufacturing. *Review of Economics and Statistics 93*(1), 285-297.

Barba Navarett, G., & Venables, A. J. (2004). *Multinational firms in the world economy*. Princeton: Princeton University Press.

Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and Knowledge: Local Buzz, Global Pipelines and the Process of Knowledge Creation. *Progress in Human Geography*, *28*(1), 31-56.

Bellak, C. (2004). How domestic and foreign firms differ and why does it matter? *Journal of Economic Surveys*, *18*(4), 483-514.

Birkinshaw, J., Nobel, R., & Ridderstråle, J. (2002). Knowledge as a contingency variable: Do the characteristics of knowledge predict organization structure? *Organization Science*, *13*(3), 274-289.

Björkman, I., Barner-Rasmussen, W., & Li, L. (2004). Managing knowledge transfer in MNCs: The impact of headquarter control mechanisms. *Journal of International Business Studies*, 35, 443-455.

Blanc, H., & Sierra, C. (1999). The internationalisation of R&D by multinationals: A trade-off between external and internal proximity. *Cambridge Journal of Economics, 23 (2)* 187-206.

Bosch, F. A. J. V. d., Volberda, H. W., & Boer, M. d. (1999). Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. *Organization Science*, *10*(5), 551-568.

Bouty, I. (2000). Interpersonal and interaction influences on informal resource exchanges between R&D researchers across organizational boundaries. *The Academy of Management Journal*, *43*(1), 50-65.

Breschi, S., Malerba, F., & Orsenigo, L. (2000). Technological regimes and schumpeterian patterns of innovation. *The Economic Journal*, *110*(April), 388-410.

Brown, J. S., & Duguid, P. (1991). Organizational Learning and Communities of Practice: Toward a Unified View of Working, Learning and Innovation. *Organization Science, 2*(1), 40-57.
Cantwell, J., & Mudambi, R. (2005). MNE Competence-Creating Subsidiary Mandates. *Strategic Management Journal, 26*(12), 1109-1128.
Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge aquisition. *Management Science, 52*(1), 68-82.
Castellacci, F., & Zheng, J. H. (2010). Technological regimes, Schumpeterian patterns of innovation and firm-level productivity growth. *Industrial and Corporate Change, 19*(6), 1829-1865.
Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity - a new perspective on learning and innovation. *Administrative Science Quarterly, 35*(1), 128-152.
Coviello, N. E. (2006). The Network Dynamics of International New Ventures. *Journal of international Business Studies, 37*(5), 713-731.
Coviello, N. E., & Munro, H. J. (1997). Network relationships and the internationalization process of small software firms. *International Business Review, 6*(4), 361-386.
Czarnitzki, D., Ebersberger, B., & Fier, A. (2007). The relationship between R&D collaboration, subsidies and R&D performance: Empirical evidence from Finland and Germany. *Journal of Applied Econometrics, 22*, 1347-1366.
Dachs, B., Ebersberger, B., & Lööf, H. (2008). The innovative performance of foreign-owned enterprises in small open economies. *Journal of Technology Transfer, 33*(4), 393-406.
Danneels, E. (2002). The dynamic of product innovation and firm competencies. *Strategic Management Journal, 23*, 1095-1121.
de Jong, J. P. J., & Freel, M. (2009). Absorptive capacity and the reach of collaboration in high technology small firms. *Research Policy, 39*(1), 47-54.
Dougherty, D. (2004). Organizing practices in services: Capturing practice-based knowledge for innovation. *Strategic Organization, 2*(1), 35-64.
Ebersberger, B., Bloch, C., Herstad, S., & van de Velde, E. (2011). Open innovation practices and their effect on innovation performance. *International Journal of Innovation and Technology Management, forthcoming.*
Ebersberger, B., & Herstad, S. (2011). Product innovation and the complementarities of external interfaces. *European Management Review, 8*(3), 117-135.
Ebersberger, B., & Herstad, S. (2012). Go abroad or have strangers visit? On organizational search spaces and local linkages *Journal or Economic Geography 12*(1), 273-295.
Ebersberger, B., & Herstad, S. (2013). The relationship between international innovation collaboration, intramural R&D and SME's innovation performance: A quantile regression approach. *Applied Economic Letters, 20*(7), 626-630.
Ebersberger, B., & Lööf, H. (2004). Corporate innovation activities: Does ownership matter? *Nordic Innovation Centre report*.
Ellis, P. (2000). Social Ties and Foreign Market Entry. *Journal of international Business Studies, 31*(3), 443-469.
Fitjar, R. D., & Rodríguez-Pose, A. (2012). Firm collaboration and modes of innovation in Norway. *Research Policy*.
Frenz, M., & Ietto-Gillies, G. (2007). Does multinationality affect the propensity to innovative? An analysis of the Third Community Innovation Survey *International Review of Applied Economics, 21*(1), 99-117.
Goerzen, A., & Beamish, P. W. (2003). Geographic scope and multinational enterprise performance. *Strategic Management Journal, 24*, 1289-1306.
Grant, R. (1996). Prospering in dynamically-competitive environments: organizational capability as knowledge integration. *Organization Science, 7*, 375-387.

Greene, W. H. (2000). *Econometric Analysis (4 ed.)*. Upper Saddle River: Prentice Hall

Grimpe, C., & Kaiser, U. (2010). Balancing Internal and External Knowledge Acquisition: The Gains and Pains from R&D Outsourcing. *Journal of Management Studies, 47*(8), 1483-1509.

Grossman, G. M., & Helpman, E. (1991). Quality ladders in the theory of growth. *Review of Economic Studies, 58*(1), 43-61.

Hansen, M. T. (2002). Knowledge networks: Explaining effective knowledge sharing in multiunit companies. *Organisation Science, 13*, 232-248.

Hedlund, G. (1986). The Hypermodern MNC – A Heterarchy? *Human Resource Management*, 25(1), 9-35.

Herstad, S., Aslesen, H. W., & Ebersberger, B. (2012). On industrial knowledge bases, technological opportunities and global innovation network linkages. *Research Policy, under review*. .

Herstad, S., & Ebersberger, B. (2012). The impacts of urban location on the involvement of knowledge-intensive services in international innovation collaboration *Paper presented at the 52nd European Regional Studies Association Conference, Bratislava, August 21st-23rd*.

Heckman, J. J. (1979). Sample selection bias as a specifcation error. *Econometrica, 47*(1), 153-161.

Ivarsson, I. (2002). Transnational corporations and the geographical transfer of localised technology: A multi-industry study of foreign affiliates in Sweden. *Journal of Economic Geography*, 2, 221-247.

Jensen, M. B., Johnson, B., Lorenz, E., & Lundvall, B. A. (2007). Forms of knowledge and modes of innovation. *Research Policy, 36*, 680-693.

Johanson, J., & Vahlne, J. E. (1977). The internationalization process of the firm: A model of knowledge development and increasing foreign market commitments. *Journal of International Business Studies, 8*(1), 23-32.

Johanson, J., & Vahlne, J. E. (2009). The Uppsala internationalization process model revisited: From liability of foreigness to liability of outsidership. *Journal of international Business Studies, 40*, 1411-1431.

Kafouros, M. I., Buckley, P. J., & Clegg, J. (2012). The effects of global knowlege reservoirs on the productivity of multinational enterprises: The role of international breadth and depth. *Research Policy, 41*, 848-861.

Katila, R., & Ahuja, G. (2002). Something Old, Something New: A Longitudinal Study of Search Behavior and New Product Introduction. *The Academy of Management Journal, 45*(6), 1183-1194.

Kessler, E. H., Bierly, P. E., & Gopalakrishnan, S. (2000). Internal vs. external learning in new product development: effects on speed, costs and competitive advantage. *R & D Management, 30*(3), 213-223.

Knell, M. (2008). Heterogeneity in economic thought: Foundations and modern methods. In E. Carayannis, A. Kaloudis & Å. Mariussen (Eds.), *Diversity in the knowledge economy and society* (pp. 35-54). Cheltenham: Edward Elgar.

Laestadius, S. (2000). Biotechnology and the Potential for a Radical Shift of Technology in Forest Industry. *Technology Analysis & Strategic Management, 12*(2), 193-212.

Lane, P. J., & Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal, 19*(5), 461-477.

Laursen, K., Masciarelli, F., & Prencipe, A. (2012). Regions matter: How localized social capital affects innovation and external knowledge aquisition. *Organization Science, 23*(1), 177-193.

Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal, 27 (2)* 131-150.

Manniche, J. (2012). Combinatorial knowledge dynamics: On the usefulness of the differentiated knowledge bases model. *European Planning Studies, 20*(11), 1823--1841.

Maskell, P., Pedersen, T., Petersen, B., & Dick-Nielsen, J. (2007). Learning Paths to Offshore Outsourcing: From Cost Reduction to Knowledge Seeking. *Industry and Innovation, 14*(3), 239-257.

Meyer, K., & Sinani, E. (2009). Where and When Does Foreign Direct Investment Generate Positive Spillovers? A Meta Analysis. . *Journal of international Business Studies, 40*(7), 1075-1094.

Meyer, K., Mudambi, R., & Narula, R. (2011). Multinational enterprises and local contexts: The opportunities and challenges of multple embeddedness. *Journal of Management Studies, 48*(2), 235-252.

Moodysson, J., Coenen, L., & Asheim, B. (2008). Explaining Spatial Patterns of Innovation: Analytical and Synthetic Modes of Knowledge Creation in the Medicon Valley Life Science Cluster. *Environment and Planning A, 40*, 1040-1056.

Narula, R. (2002). Innovation systems and 'intertia' in R&D location: Norwegian firms and the role of systemic lock-in. *Research Policy, 31*(5), 795-816.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5*, 14-37.

Nooteboom, B., Van Haverbeke, W., Duysters, G., Gilsing, V., & van den Oord, A. (2007). Optimal cognitive distance and absorptive capacity. *Research Policy, 36*(7), 1016-1034.

OECD. (2005). *Oslo Manual: Guidelines for collecting and interpreting innovation data*. Paris: OECD & Eurostat.

Oettl, A., & Agrawal, A. (2008). International Labor Mobility and Knowledge Flow Externalities. *Journal of international Business Studies, 39*(8), 1242-1260.

Pennings, J. M., & Wezel, F. C. (2007). *Human Capital, Inter-Firm Mobility And Organizational Evolution*. Cheltenham: Edward Elgar.

Reihlen, M., & Apel, B. A. (2007). Internationalization of professional services firms as learning: A constructivist approach. *International Journal of Service Industry Management, 18*(2), 140-151.

Robertson, M., Scarbrough, H., & Swan, J. (2003). Knowledge creation in professional service firms: Institutional effects. *Organization Studies, 24*(6), 831-857.

Roper, S., Du, J., & Love, J. H. (2008). Modelling the innovation value chain. *Research Policy, 37*(6-7), 961-977.

Rosenkopf, L., & Almeida, P. (2003). Overcoming local search through alliances and mobility. *Management Science, 49*(6), 751-766.

Schmidt, T. (2010). Absorptive Capacity – One size fits all? *Managerial and Decision Economics, 31*(1), 1-18.

Smarzynska Javorcik, B. (2004). Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages. *American Economic Review, 94*, 605-627.

Torre, A. (2008). On the role played by temporary geographical proximity in knowledge transmission. *Regional Studies, 42*(6), 869-889.

Tzabbar, D. (2009). When does scientist recruitment affect technological repositioning? . *Academy of Management Journal, 52*(5), 873-896.

van Pottelsberghe de la Potterie, B., & Lichtenberg, F. (2001). Does foreign direct investment transfer technology across borders? *The review of Economics and Statistics*, *83*(3), 490-497.
von Krogh, G., & Grand, S. (2000). Justification in knowledge creation: The basic propositions. In G. von Krogh, I. Nonaka & T. Nishiguchi (Eds.), *Knowledge creation - a new source of value* (pp. 13-35). Basingstoke: MacMillan Press.
Winter, S. G. (1987). Knowledge and competences as strategic assets. In D. Teece (Ed.), *The competitive challenge - Strategies for industrial innovation and renewal* (pp. 159-184). Cambridge MA: Ballinger.
Zahra, S. A., & Nielsen, A. P. (2002). Sources of capabilities, integration and technology commercialization. *Strategic Management Journal, 23*(5), 377-398.
Zellner, A. (1962). An efficient meothod for estimating seemingly unrelated regressions and tests for aggregation bias. *Journal of the American Statistical Association, 57*, 348-368.

Appendix

Table A1 – A4

Tables

Table 1: Distribution of knowledge bases across industrial sectors (Innovation active companies that are part of a corporate group)

	KNOWLEGE BASE (N=959)		
	_SYM	_SYN	_ANA
Natural resource extraction	29.73%	45.95%	24.32%
Food, Beverages & Tabacco	53.85%	30.77%	15.38%
Textiles, Leather, Wood & Paper	58.75%	33.75%	7.5%
Chemicals, Rubber & Plastic	24.42%	67.44%	8.14%
Basic Metal	19.3%	71.93%	8.77%
Machinery & Equipment	16.95%	77.97%	5.08%
Electronics & Instruments	19.77%	76.74%	3.49%
Manufacturing nec.	27.5%	72.5%	0%
KI Services	47.89%	44.91%	7.2%
Total	37.43%	54.95%	7.61%

Table 2: Summary of independent and dependent variables (Innovation active companies that are part of a corporate group)

	All (N=959)				SMEs (N=850)			
	Mean	Std	Min	Max	Mean	Std	Min	Max
INVOLVEMENT								
_NO	0.807	1.391	0.000	6.385	0.726	1.313	0.000	6.385
_ND	0.247	0.753	0.000	6.263	0.199	0.625	0.000	5.047
_EU	0.360	0.897	0.000	6.583	0.311	0.827	0.000	6.583
CONTACT POINT								
_NO	0.152	0.359	0	1	0.140	0.347	0	1
_ND	0.055	0.229	0	1	0.036	0.188	0	1
_EU	0.082	0.275	0	1	0.065	0.246	0	1
KNOWLEDGE BASE								
_SYMB	0.374	0.484	0	1	0.385	0.487	0	1
_SYN	0.550	0.498	0	1	0.547	0.498	0	1
_ANA	0.076	0.265	0	1	0.068	0.252	0	1

Table 3: Summary of control variables (Innovation active companies that are part of a corporate group)

	All (N=959)				SMEs (N=850)			
	mean	std	min	max	mean	std	min	max
CONTROLS								
LEMP	3.921	1.377	1.609	8.880	3.587	1.039	1.609	5.521
RDINT	0.055	0.151	0.000	1.000	0.058	0.155	0.000	1.000
RDEX_NAT	0.231	0.422	0	1	0.200	0.400	0	1
RDEX_INT	0.099	0.299	0	1	0.078	0.268	0	1
ORG_DM	0.070	0.255	0	1	0.058	0.233	0	1
FP_NAT	0.399	0.490	0	1	0.404	0.491	0	1
FP_INT	0.016	0.124	0	1	0.012	0.108	0	1
MARLOC	0.758	0.428	0	1	0.758	0.429	0	1
MARNAT	0.833	0.373	0	1	0.835	0.371	0	1
MAREUR	0.658	0.475	0	1	0.656	0.475	0	1
MAROTH	0.513	0.500	0	1	0.508	0.500	0	1
PROFORM	0.100	1.003	-0.970	3.430	0.067	0.973	-0.970	3.430
PROSTRAT	0.091	0.945	-1.555	1.716	0.084	0.937	-1.555	1.716
EFFPCS	0.049	0.960	-2.186	2.280	-0.003	0.959	-2.186	2.280
EFFPDT	0.074	0.897	-3.796	1.677	0.083	0.898	-3.796	1.677

Table 4: Average breadth of involvement by geography — all firms (N=959)

Knowledge base	Norway	Nordic	EU
I – Symbolic	0.521	0.109	0.166
II – Synthetic	0.942	0.308	0.446
III - Analytical	1.235	0.485	0.686
Difference between knowledge bases			
I vs II	0.421***	-0.200***	-0.280***
I vs III	-0.713***	-0.376***	-0.521***
II vs III	-0.292	-0.177	-0.249*

Note: ***, **, * indicate significance on the 1%, 5%, 10% level. Bonferroni correction applied for multiple testing.

Table 5: Average breadth of extra-group involvement by world region and parent group contact points to the region — all firms (N=959)

Contact point in region	Norway	Nordic	EU
No	0.501	0.169	0.257
Yes	2.510***	1.581***	1.498***

Table 6: The effect of a parent group contact point in the world region on extra-group collaborative involvement within it — all firms (N=959)

Knowledge base	Norway	Nordic	EU
I – Symbolic	1.870***	0.634***	0.242
II - Synthetic	1.281***	1,160***	0.723***
III - Analytical	1.083***	0.414	0.073
Significance of difference in impact between knowledge bases			
I vs II	7.87***	7.18***	4.32**
I vs III	5.74**	0.45	0.29
II vs III	0.41	6.06**	6.54**

Note: ***, **, * indicate significance on the 1%, 5%, 10% level.

Table 7: The effect of a parent group contact point in the world region on extra-group collaborative involvement within it — SMEs only (N=850)

Knowledge base	Norway	Nordic	EU
I – Symbolic	1.794 ***	0.618***	-0.051
II - Synthetic	1.336***	0,669***	0.838***
III - Analytical	1.547***	0.057	-0.453
Significance of difference in impact between knowledge bases			
I vs II	4.55**	0.07	14.30***
I vs III	0.46	0.45	0.29
II vs III	0.36	2.45	15.04***

Note: ***, **, * indicate significance on the 1%, 5%, 10% level.

Table A1: Factor analysis of protection strategies

	PROFORM	PROSTRAT
Patent application	**0.5911**	0.2124
Registry of design pattern	**0.7717**	0.0393
Trademark	**0.7836**	0.1207
Copyright	**0.6651**	0.1691
Secrecy	0.1600	**0.7629**
Complexity of design	0.0640	**0.7915**
Lead-time advantage	0.1011	**0.8014**

Note: Rotated factor loadings above 0.4 in bold.

Table A2: Factor analysis of innovation objectives

	EFFPCS	EFFPDT
Development of new products	0.0052	**0.7707**
Replacement of outdated products	0.3972	**0.4160**
New market entry or increased market share	0.0466	**0.7978**
Increased product quality	0.3545	**0.6054**
Increased flexibility in production	**0.6688**	0.3452
Increased production capacity	**0.7474**	0.2216
Reduced unit costs	**0.8333**	0.0818
Reduced material & energy consumption	**0.8399**	0.0045
Improved health & safety	**0.7367**	-0.0070

Note: Rotated factor loadings above 0.4 in bold.

Table A3: Baseline regressions

	All firms (N=959)			SMEs (N=850)		
Dep Var inv_xx	xx=NO	xx=ND	xx=EU	xx=NO	xx=ND	xx=EU
	b/se	b/se	b/se	b/se	b/se	b/se
CONTACT_xx	1.861***	0.657***	0.263	1.792***	0.610***	-0.036
	0.169	*0.17*	*0.213*	*0.168*	*0.16*	*0.213*
KB_ANA	0.178	0.12	0.223**	0.244	0.171*	0.241**
	0.164	*0.09*	*0.108*	*0.171*	*0.087*	*0.109*
CONTACT_xx * KB_ANA	-0.810**	-0.015	-0.452	-0.32	-0.702**	-0.640*
	0.33	*0.283*	*0.296*	*0.364*	*0.343*	*0.35*
KB_SYN	0.109	-0.017	-0.055	0.084	-0.03	-0.063
	0.089	*0.05*	*0.059*	*0.092*	*0.049*	*0.06*
CONTACT_xx * KB_SYN	-0.572***	0.506***	0.454**	-0.454**	0.055	0.896***
	0.211	*0.194*	*0.231*	*0.216*	*0.2*	*0.234*
HEADQUARTER_XX	-0.245***	0.007	-0.1	-0.182*	0.048	-0.075
	0.09	*0.074*	*0.081*	*0.095*	*0.074*	*0.083*
LEMP	0.042	0.027	0.006	0	0.041*	-0.016
	0.029	*0.017*	*0.02*	*0.04*	*0.022*	*0.026*
RDINT	0.372	0.267*	0.159	0.37	0.219	0.064
	0.251	*0.148*	*0.174*	*0.251*	*0.137*	*0.168*
RDEX_NAT	0.722***	0.138**	0.231***	0.666***	0.047	0.171**
	0.099	*0.058*	*0.069*	*0.104*	*0.057*	*0.07*
RDEX_INT	-0.107	0.186**	0.349***	-0.023	0.251***	0.482***
	0.133	*0.078*	*0.092*	*0.149*	*0.081*	*0.1*
ORG_DM	0.664***	0.144	0.531***	0.653***	0.168*	0.350***
	0.159	*0.094*	*0.107*	*0.175*	*0.095*	*0.115*
FP_NAT	0.280***	0.068	0.136**	0.232***	0.103**	0.139***
	0.078	*0.046*	*0.054*	*0.08*	*0.044*	*0.053*
FP_INT	0.023	0.510***	0.198	0.116	0.046	-0.282
	0.291	*0.172*	*0.204*	*0.341*	*0.186*	*0.232*
MARLOC	0.169*	0.085*	-0.073	0.134	0.105**	-0.041
	0.086	*0.051*	*0.059*	*0.088*	*0.048*	*0.059*
MARNAT	0.174*	0.123**	-0.006	0.222**	0.094*	-0.06
	0.099	*0.058*	*0.068*	*0.102*	*0.056*	*0.068*
MAREUR	-0.098	0.046	0.067	-0.134	0.05	0.081
	0.089	*0.053*	*0.062*	*0.092*	*0.05*	*0.062*
MAROTH	0.084	0.072	0.201***	0.104	0.067	0.213***
	0.086	*0.051*	*0.06*	*0.087*	*0.048*	*0.059*
PROFORM	-0.037	0.067***	0.101***	-0.046	0.047**	0.104***
	0.036	*0.021*	*0.025*	*0.038*	*0.021*	*0.026*
PROSTRAT	0.054	0.018	0.017	0.045	0.007	0.023
	0.039	*0.023*	*0.027*	*0.041*	*0.022*	*0.028*
EFFPCS	0.091**	0.03	0.053*	0.100**	0.036	0.066**
	0.041	*0.024*	*0.028*	*0.042*	*0.023*	*0.028*
EFFPDT	0.061	0.003	0.015	0.071*	0.004	0.017
	0.041	*0.024*	*0.028*	*0.042*	*0.023*	*0.028*
N	959			850		
ll	-3281.994			-2733.684		
r2	0.405	0.294	0.316	0.378	0.175	0.294
chi2	616.073	388.858	432.713	488.297	183.929	349.579
p	0.000	0.000	0.000	0.000	0.000	0.000

Note: *** (**, *) indicate significance at the 1 per cent, (5 per cent, 10 per cent) level. Standard errors in italics. All regressions include the industry group mean involvement in the respective regions as a control for industry characteristics.

Table A4: Bivariate correlations

,		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	KB_ANA	1.000																				
2	KB_SYN	-0.317	1.000																			
3	CONTACT_NO	0.075	0.028	1.000																		
4	CONTACT_ND	0.051	0.036	-	1.000																	
5	CONTACT_EU	0.100	0.088	-	-	1.000																
6	HQ_NOD	-0.068	-0.107	-0.068	-	-	1.000															
7	HQ_ND	0.004	-0.002	-	0.202	-	-	1.000														
8	HQ_EU	0.084	0.051	-	-	0.205	-	-	1.000													
9	LEMP	0.083	0.221	0.096	0.268	0.221	-0.313	0.176	0.147	1.000												
10	RDINT	0.087	0.100	0.057	-0.021	-0.010	0.032	-0.055	-0.029	-0.089	1.000											
11	RDEX_NAT	0.206	0.119	0.180	0.149	0.222	-0.163	0.006	0.055	0.282	0.155	1.000										
12	RDEX_INT	0.050	0.125	0.044	0.134	0.205	-0.184	0.033	0.050	0.229	0.122	0.406	1.000									
13	FP_NAT	0.071	0.152	0.099	0.073	0.104	0.011	-0.063	-0.063	-0.035	0.224	0.229	0.136	1.000								
14	FP_INT	0.091	0.047	0.040	0.117	0.207	-0.110	-0.005	0.076	0.099	0.154	0.110	0.127	0.137	1.000							
15	MARLOC	-0.022	-0.110	-0.011	0.019	-0.061	0.074	0.019	-0.088	0.046	-0.023	-0.175	-0.131	-0.042	-0.066	1.000						
16	MARNAT	-0.061	0.073	0.050	0.023	-0.008	0.004	0.005	-0.040	0.063	-0.072	-0.026	-0.039	-0.012	-0.056	0.120	1.000					
17	MAREUR	0.050	0.204	0.018	0.049	0.144	-0.098	-0.044	0.072	0.081	0.038	0.146	0.129	0.193	0.091	-0.104	0.243	1.000				
18	MAROTH	0.028	0.275	0.053	0.062	0.171	-0.142	-0.081	0.125	0.116	0.089	0.164	0.149	0.207	0.072	-0.156	0.118	0.511	1.000			
19	PROFORM	0.027	0.050	0.088	0.065	0.083	-0.150	-0.005	0.075	0.112	0.039	0.073	0.075	0.011	0.030	0.003	0.046	0.140	0.162	1.000		
20	PROSTRAT	-0.036	0.199	0.050	0.023	0.083	-0.014	-0.056	-0.023	0.034	0.108	0.129	0.123	0.185	0.075	-0.080	0.068	0.174	0.229	-0.041	1.000	
21	EFFPCS	0.004	0.131	0.122	0.144	0.161	-0.157	0.018	0.066	0.192	-0.118	0.169	0.077	-0.010	0.042	-0.032	0.027	0.035	0.088	0.091	0.096	1.000
22	EFFPDT	-0.138	0.123	0.056	0.087	0.058	-0.008	-0.015	-0.046	0.011	0.017	0.015	0.039	0.126	-0.010	0.036	0.134	0.069	0.087	0.075	0.164	-0.005

Note: Correlations above 0.650 are significant at the 5% level. – indicates that variables are not used in regressions together.

CIRCLE ELECTRONIC WORKING PAPERS SERIES (EWP)

CIRCLE (Centre for Innovation, Research and Competence in the Learning Economy) is a multidisciplinary research centre set off by several faculties at Lund University and Blekinge Institute of Technology. CIRCLE has a mandate to conduct multidisciplinary research and education on the following issues: Long-term perspectives on innovation, structural change and economic growth, Entrepreneurship and venture capital formation with a special focus on new ventures, The dynamics of R&D systems and technological systems, including their impact on entrepreneurship and growth, Regional innovation systems in different national and international contexts and International comparative analyses of national innovation systems. Special emphasis is done on innovation policies and research policies. 10 nationalities and 14 disciplines are represented among the CIRCLE staff.

The CIRCLE Electronic Working Paper Series are intended to be an instrument for early dissemination of the research undertaken by CIRCLE researchers, associates and visiting scholars and stimulate discussion and critical comment.

The working papers present research results that in whole or in part are suitable for submission to a refereed journal or to the editor of a book or have already been submitted and/or accepted for publication.

CIRCLE EWPs are available on-line at: http://www.circle.lu.se/publications

Available papers:

2013

WP 2013/01
Start-up rates, Entrepreneurship Culture and the Business Cycle
Swedish patterns from national and regional data
Martin Andersson

WP 2013/02
Market Thickness and the Early Labor Market Career of University Graduates
-An urban advantage?
Lina Ahlin, Martin Andersson and Per Thulin

WP 2013/03
Implementing an R&D Strategy without Prior R&D-Experience
Recruitment as a Source of R&D-related Routines and Capabilities?
Lina Ahlin, Martin Andersson and Thorben Schubert

WP 2013/04
The Choice of Innovation Policy Instruments
Susana Borrás, Charles Edquist

WP 2013/05

What Does Evolutionary Economic Geography Bring To The Policy Table?
Reconceptualising regional innovation systems

Bjørn Asheim, Markus M. Bugge, Lars Coenen, Sverre Herstad

WP 2013/06
Commercializing clean technology innovations – the emergence of new business in an agency-structure perspective
Sofia Avdeitchikova, Lars Coenen

WP 2013/07
Renewal of mature industry in an old industrial region: regional innovation policy and the co-evolution of institutions and technology
Lars Coenen, Jerker Moodysson and Hanna Martin

WP 2013/08
Systematic anchoring of global innovation processes and new industry formation – the emergence of on-site water recycling in China
Christian Binz, Bernhard Truffer and Lars Coenen

WP 2013/09
The internationalisation of R&D: sectoral and geographic patterns of cross-border investments
Cristina Castelli and Davide Castellani

WP 2013/10
Clean-tech innovation in Emerging Economies: Transnational dimensions in technological innovation system formation
Jorrit Gosens, Yonglong Lu and Lars Coenen

WP 2013/11
Why space matters in technological innovation systems – the global knowledge dynamics of membrane bioreactor technology
Christian Binz, Bernhard Truffer and Lars Coenen

WP 2013/12
MNC affiliation, knowledge bases and involvement in global innovation networks
Sverre J. Herstad, Bernd Ebersberger, Bjørn Asheim

2012

WP 2012/01
Is the University Model an Organizational Necessity? Scale and Agglomeration Effects in Science
Tasso Brandt and Torben Schubert

WP 2012/02
Do regions make a difference? Exploring the role of different regional innovation systems in global innovation networks in the ICT industry
Cristina Chaminade and Monica Plechero

WP 2012/03
Measuring the knowledge base of regional innovation systems in Sweden
Roman Martin

WP 2012/04

Characteristics and Performance of New Firms and Spinoffs in Sweden
Martin Andersson and Steven Klepper

WP 2012/05
Demographic patterns and trends in patenting: Gender, age, and education of inventors
Olof Ejermo and Taehyun Jung

WP 2012/06
Competences as drivers and enablers of globalization of innovation: Swedish ICT industry and emerging economies
Cristina Chaminade and Claudia de Fuentes
WP 2012/07
The Dynamics and Evolution of Local Industries – The case of Linköping
Sabrina Fredin

WP2012/08
Towards a Richer Specification of the Exploration/Exploitation Trade-off: Hidden Knowledge-based Aspects and Empirical Results for a Set of Large R&D-Performing Firms
Torben Schubert and Peter Neuhaeusler

WP 2012/09

The European Spallation Source (ESS) and the geography of innovation

Josephine V. Rekers

WP 2012/10

How Local are Spatial Density Externalities? - evidence from square grid data

Martin Andersson, Johan Klaesson, Johan P Larsson

WP 2012/11

Why Pre-Commercial Procurement is not Innovation Procurement

Charles Edquist, Jon Mikel Zabala-Iturriagagoitia

2011

WP 2011/01
SMEs' absorptive capacities and large firms' knowledge spillovers: Micro evidence from Mexico
Claudia de Fuentes and Gabriela Dutrénit

WP 2011/02
Comparing knowledge bases: on the organisation and geography of knowledge flows in the regional innovation system of Scania, southern Sweden
Roman Martin and Jerker Moodysson

WP 2011/03
Organizational paths of commercializing patented inventions: The effects of transaction costs, firm capabilities, and collaborative ties
Taehyun Jung and John P. Walsh

WP 2011/04
Global Innovation Networks: towards a taxonomy
Helena Barnard and Cristina Chaminade

WP 2011/05
Swedish Business R&D and its Export Dependence
Karin Bergman and Olof Ejermo

WP 2011/06
Innovation Policy Design: Identification of Systemic Problems
Charles Edquist

WP 2011/07
Regional Institutional Environment and Its Impact on Intra-firm and Interorganisational
Innovation Networks: A Comparative Case Study in China and Switzerland
Ju LIU

WP 2011/08
Entrepreneurship: Exploring the Knowledge Base
Hans Landström, Gouya Harirchi and Fredrik Åström

WP 2011/09
Policy coordination in systems of innovation: A structural-functional analysis of regional industry support in Sweden
Magnus Nilsson and Jerker Moodysson

WP 2011/10
Urban Design in Neighbourhood Commodification
Ana Mafalda Madureira

WP 2011/11
Technological Dynamics and Social Capability: Comparing U.S. States and European Nations
Jan Fagerberg, Maryan Feldman and Martin Srhoelec

WP 2011/12
Linking scientific and practical knowledge in innovation systems
Arne Isaksen and Magnus Nilsson

WP 2011/13
Institutional conditions and innovation systems: on the impact of regional policy on firms in different sectors
Jerker Moodysson and Elena Zukauskaite

WP 2011/14
Considering adoption: Towards a consumption-oriented approach to innovation
Josephine V. Rekers

WP2011/15

Exploring the role of regional innovation systems and institutions in global innovation networks
Cristina Chaminade

2010

WP 2010/01
Innovation policies for development: towards a systemic experimentation based approach
Cristina Chaminade, Bengt-Ake Lundvall, Jan Vang-Lauridsen and KJ Joseph

WP 2010/02
From Basic Research to Innovation: Entrepreneurial Intermediaries for Research Commercialization at Swedish 'Strong Research Environments'
Fumi Kitagawa and Caroline Wigren

WP 2010/03 Different competences, different modes in the globalization of innovation?
A comparative study of the Pune and Beijing regions
Monica Plechero and Cristina Chaminade

WP 2010/04 Technological Capability Building in Informal Firms in the Agricultural
Subsistence Sector In Tanzania: Assessing the Role of Gatsby Clubs
Astrid Szogs and Kelefa Mwantima

WP 2010/05
The Swedish Paradox – Unexploited Opportunities!
Charles Edquist

WP 2010/06
A three-stage model of the Academy-Industry linking process: the perspective of both agents
Claudia De Fuentes and Gabriela Dutrénit

WP 2010/07
Innovation in symbolic industries: the geography and organisation of knowledge sourcing
Roman Martin and Jerker Moodysson

WP 2010/08
Towards a spatial perspective on sustainability transitions
Lars Coenen, Paul Benneworth and Bernhard Truffer

WP 2010/09
The Swedish national innovation system and its relevance for the emergence of global innovation networks
Cristina Chaminade, Jon Mikel Zabala and Adele Treccani

WP 2010/10
Who leads Research Productivity Change? Guidelines for R&D policy makers
Fernando Jiménez-Sáez, Jon Mikel Zabala and José L- Zofío

WP 2010/11
Research councils facing new science and technology
Frank van der Most and Barend van der Meulen

WP 2010/12
Effect of geographical proximity and technological capabilities on the degree of novelty in emerging economies
Monica Plechero

WP 2010/13
Are knowledge-bases enough? A comparative study of the geography of knowledge sources in China (Great Beijing) and India (Pune)
Cristina Chaminade

WP 2010/14
Regional Innovation Policy beyond 'Best Practice': Lessons from Sweden
Roman Martin, Jerker Moodysson and Elena Zukauskaite

WP 2010/15
Innovation in cultural industries: The role of university links
Elena Zukauskaite

WP 2010/16
Use and non-use of research evaluation. A literature review
Frank van der Most

WP 2010/17
Upscaling emerging niche technologies in sustainable energy: an international comparison of policy approaches
Lars Coenen, Roald Suurs and Emma van Sandick

2009

WP 2009/01
Building systems of innovation in less developed countries: The role of intermediate organizations.
Szogs, Astrid; Cummings, Andrew and Chaminade, Cristina

WP 2009/02
The Widening and Deepening of Innovation Policy: What Conditions Provide for Effective Governance?
Borrás, Susana

WP 2009/03
Managerial learning and development in small firms: implications based on observations of managerial work
Gabrielsson, Jonas and Tell, Joakim

WP 2009/04

University professors and research commercialization: An empirical test of the "knowledge corridor" thesis
Gabrielsson, Jonas, Politis, Diamanto and Tell, Joakim

WP 2009/05
On the concept of global innovation networks
Chaminade, Cristina

WP 2009/06
Technological Waves and Economic Growth - Sweden in an International Perspective 1850-2005
Schön, Lennart

WP 2009/07
Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination
Rolfstam, Max; Phillips, Wendy and Bakker, Elmer

WP 2009/08
Local niche experimentation in energy transitions: a theoretical and empirical exploration of proximity advantages and disadvantages
Lars Coenen, Rob Raven, Geert Verbong

WP 2009/9
Product Development Decisions: An empirical approach to Krishnan and Ulrich
Jon Mikel Zabala, Tina Hannemann

WP 2009/10
Dynamics of a Technological Innovator Network and its impact on technological performance
Ju Liu, Cristina Chaminade

WP 2009/11
The Role of Local Universities in Improving Traditional SMEs Innovative Performances: The Veneto Region Case
Monica Plechero

WP 2009/12
Comparing systems approaches to innovation and technological change for sustainable and competitive economies: an explorative study into conceptual commonalities, differences and complementarities
Coenen, Lars and Díaz López, Fernando J.

WP 2009/13
Public Procurement for Innovation (PPI) – a Pilot Study
Charles Edquist

WP 2009/14
Outputs of innovation systems: a European perspective
Charles Edquist and Jon Mikel Zabala

2008

WP 2008/01

R&D and financial systems: the determinants of R&D expenditures in the Swedish pharmaceutical industry
Malmberg, Claes

WP 2008/02
The Development of a New Swedish Innovation Policy. A Historical Institutional Approach
Persson, Bo

WP 2008/03
The Effects of R&D on Regional Invention and Innovation
Olof Ejermo and Urban Gråsjö

WP 2008/04
Clusters in Time and Space: Understanding the Growth and Transformation of Life Science in Scania
Moodysson, Jerker; Nilsson, Magnus; Svensson Henning, Martin

WP 2008/05
Building absorptive capacity in less developed countries
The case of Tanzania
Szogs, Astrid; Chaminade, Cristina and Azatyan, Ruzana

WP 2008/06
Design of Innovation Policy through Diagnostic Analysis:
Identification of Systemic Problems (or Failures)
Edquist, Charles

WP 2008/07
The Swedish Paradox arises in Fast-Growing Sectors
Ejermo, Olof; Kander, Astrid and Svensson Henning, Martin

WP 2008/08
Policy Reforms, New University-Industry Links and Implications for Regional Development in Japan
Kitagawa, Fumi

WP 2008/09
The Challenges of Globalisation: Strategic Choices for Innovation Policy
Borrás, Susana; Chaminade, Cristina and Edquist, Charles

WP 2008/10
Comparing national systems of innovation in Asia and Europe: theory and comparative framework
Edquist, Charles and Hommen, Leif

WP 2008/11
Putting Constructed Regional Advantage into Swedish Practice? The case of the VINNVÄXT initiative 'Food Innovation at Interfaces'

Coenen, Lars; Moodysson, Jerker

WP 2008/12
Energy transitions in Europe: 1600-2000
Kander, Astrid; Malanima, Paolo and Warde, Paul

WP 2008/13
RIS and Developing Countries: Linking firm technological capabilities to regional systems of innovation
Padilla, Ramon; Vang, Jan and Chaminade, Cristina

WP 2008/14
The paradox of high R&D input and low innovation output: Sweden
Bitarre, Pierre; Edquist, Charles; Hommen, Leif and Ricke, Annika

WP 2008/15
Two Sides of the Same Coin? Local and Global Knowledge Flows in Medicon Valley
Moodysson, Jerker; Coenen, Lars and Asheim, Bjørn

WP 2008/16
Electrification and energy productivity
Enflo, Kerstin; Kander, Astrid and Schön, Lennart

WP 2008/17
Concluding Chapter: Globalisation and Innovation Policy
Hommen, Leif and Edquist, Charles

WP 2008/18
Regional innovation systems and the global location of innovation activities: Lessons from China
Yun-Chung, Chen; Vang, Jan and Chaminade, Cristina

WP 2008/19
The Role of mediator organisations in the making of innovation systems in least developed countries. Evidence from Tanzania
Szogs, Astrid

WP 2008/20
Globalisation of Knowledge Production and Regional Innovation Policy: Supporting Specialized Hubs in the Bangalore Software Industry
Chaminade, Cristina and Vang, Jan

WP 2008/21
Upgrading in Asian clusters: Rethinking the importance of interactive-learning
Chaminade, Cristina and Vang, Jan

2007

WP 2007/01

Path-following or Leapfrogging in Catching-up: the Case of Chinese Telecommunication Equipment Industry
Liu, Xielin

WP 2007/02
The effects of institutional change on innovation and productivity growth in the Swedish pharmaceutical industry
Malmberg, Claes

WP 2007/03
Global-local linkages, Spillovers and Cultural Clusters: Theoretical and Empirical insights from an exploratory study of Toronto's Film Cluster
Vang, Jan; Chaminade, Cristina

WP 2007/04
Learning from the Bangalore Experience: The Role of Universities in an Emerging Regional Innovation System
Vang, Jan; Chaminade, Cristina.; Coenen, Lars.

WP 2007/05
Industrial dynamics and innovative pressure on energy -Sweden with European and Global outlooks
Schön, Lennart; Kander, Astrid.

WP 2007/06
In defence of electricity as a general purpose technology
Kander, Astrid; Enflo, Kerstin; Schön, Lennart

WP 2007/07
Swedish business research productivity – improvements against international trends
Ejermo, Olof; Kander, Astrid

WP 2007/08
Regional innovation measured by patent data – does quality matter?
Ejermo, Olof

WP 2007/09
Innovation System Policies in Less Successful Developing countries: The case of Thailand
Intarakumnerd, Patarapong; Chaminade, Cristina

2006

WP 2006/01
The Swedish Paradox
Ejermo, Olof; Kander, Astrid

WP 2006/02
Building RIS in Developing Countries: Policy Lessons from Bangalore, India
Vang, Jan; Chaminade, Cristina

WP 2006/03
Innovation Policy for Asian SMEs: Exploring cluster differences
Chaminade, Cristina; Vang, Jan.

WP 2006/04

Rationales for public intervention from a system of innovation approach: the case of VINNOVA.
Chaminade, Cristina; Edquist, Charles

WP 2006/05
Technology and Trade: an analysis of technology specialization and export flows
Andersson, Martin; Ejermo, Olof

WP 2006/06
A Knowledge-based Categorization of Research-based Spin-off Creation
Gabrielsson, Jonas; Landström, Hans; Brunsnes, E. Thomas

WP 2006/07
Board control and corporate innovation: an empirical study of small technology-based firms
Gabrielsson, Jonas; Politis, Diamanto

WP 2006/08
On and Off the Beaten Path:
Transferring Knowledge through Formal and Informal Networks
Rick Aalbers; Otto Koppius; Wilfred Dolfsma

WP 2006/09
Trends in R&D, innovation and productivity in Sweden 1985-2002
Ejermo, Olof; Kander, Astrid

WP 2006/10
Development Blocks and the Second Industrial Revolution, Sweden 1900-1974
Enflo, Kerstin; Kander, Astrid; Schön, Lennart

WP 2006/11
The uneven and selective nature of cluster knowledge networks: evidence from the wine industry
Giuliani, Elisa

WP 2006/12
Informal investors and value added: The contribution of investors' experientially acquired resources in the entrepreneurial process
Politis, Diamanto; Gabrielsson, Jonas

WP 2006/13
Informal investors and value added: What do we know and where do we go?
Politis, Diamanto; Gabrielsson, Jonas

WP 2006/14
Inventive and innovative activity over time and geographical space: the case of Sweden
Ejermo, Olof

2005

WP 2005/1
Constructing Regional Advantage at the Northern Edge
Coenen, Lars; Asheim, Bjørn

WP 2005/02
From Theory to Practice: The Use of the Systems of Innovation Approach for Innovation Policy
Chaminade, Cristina; Edquist, Charles

WP 2005/03
The Role of Regional Innovation Systems in a Globalising Economy: Comparing Knowledge Bases and Institutional Frameworks in Nordic Clusters
Asheim, Bjørn; Coenen, Lars

WP 2005/04
How does Accessibility to Knowledge Sources Affect the Innovativeness of Corporations? Evidence from Sweden
Andersson, Martin; Ejermo, Olof

WP 2005/05
Contextualizing Regional Innovation Systems in a Globalizing Learning Economy: On Knowledge Bases and Institutional Frameworks
Asheim, Bjørn; Coenen, Lars

WP 2005/06
Innovation Policies for Asian SMEs: An Innovation Systems Perspective
Chaminade, Cristina; Vang, Jan

WP 2005/07
Re-norming the Science-Society Relation
Jacob, Merle

WP 2005/08
Corporate innovation and competitive environment
Huse, Morten; Neubaum, Donald O.; Gabrielsson, Jonas

WP 2005/09
Knowledge and accountability: Outside directors' contribution in the corporate value chain
Huse, Morten, Gabrielsson, Jonas; Minichilli, Alessandro

WP 2005/10
Rethinking the Spatial Organization of Creative Industries
Vang, Jan

WP 2005/11
Interregional Inventor Networks as Studied by Patent Co-inventorships
Ejermo, Olof; Karlsson, Charlie

WP 2005/12
Knowledge Bases and Spatial Patterns of Collaboration: Comparing the Pharma and Agro-Food Bioregions Scania and Saskatoon
Coenen, Lars; Moodysson, Jerker; Ryan, Camille; Asheim, Bjørn; Phillips, Peter

WP 2005/13
Regional Innovation System Policy: a Knowledge-based Approach
Asheim, Bjørn; Coenen, Lars; Moodysson, Jerker; Vang, Jan

WP 2005/14
Face-to-Face, Buzz and Knowledge Bases: Socio-spatial implications for learning and innovation policy
Asheim, Bjørn; Coenen, Lars, Vang, Jan

WP 2005/15
The Creative Class and Regional Growth: Towards a Knowledge Based Approach
Kalsø Hansen, Høgni; Vang, Jan; Bjørn T. Asheim

WP 2005/16
Emergence and Growth of Mjärdevi Science Park in Linköping, Sweden
Hommen, Leif; Doloreux, David; Larsson, Emma

WP 2005/17
Trademark Statistics as Innovation Indicators? – A Micro Study
Malmberg, Claes