Internationalisation of innovative activity in Finnish multinational enterprises

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Abstract: This paper examines two aspects of the internationalisation of innovation in Finnish multinational companies, the growing innovativeness of foreign subsidiaries ('creative subsidiaries') and the phenomenon of 'cross-fertilisation', between R&D labs in Finland and those in foreign subsidiaries, in the innovative process of Finnish MNEs. We review existing literature pertaining to innovation in multinational enterprises and the growing capability of foreign subsidiaries to undertake innovation. Consistent with the general thrust of the literature we develop and examine two hypotheses relating to subsidiary innovation and cross-fertilisation between subsidiaries and the parent for 30 Finnish MNEs between the years 1975–1995, employing patent data from the US patent office. Our findings provide support for the hypotheses. We conclude by pointing out the limitations of the current study and deriving implications from our findings for future research.

Keywords: multinational companies; internationalisation; cross-fertilisation; innovation; research and development.

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1 Introduction and context of the study

Knowledge and innovation have been central to the understanding of the Multinational Corporation (MNE) since the pioneering work of Hymer (1960). The initial focus was on static failures in the market for knowledge as an explanation for existence of the MNE and its superiority relative to markets in transferring knowledge. Early theories of the MNE treated knowledge creation as a centralised activity wholly located in the parent country and controlled by headquarters (Cantwell, 1995a; Caves, 1996; Patel and Pavitt, 1991). More recent research in international business has focused less on market failure and more on knowledge as a strategic resource (Bartlett and Ghoshal, 1990; Kogut and Zander, 1993; Zanfei, 2000; Almeida et al., 2002), with emphasis on the dynamics of managing knowledge creation and knowledge flows, to enhance MNE innovation and hence competitive advantage.

Partly as a consequence of this shift, the home-centred innovation perspective is seen by a number of scholars as gradually being replaced by a decentralised Research and Development (R&D) model in which knowledge is created by an increasing number of subsidiaries. Research activity has thus been directed towards a better understanding of the extent, pattern, causes/motivation and the consequences of such decentralisation (Bas and Sierra, 2002; Cantwell, 1995a; Cantwell, 1995b; Cantwell, 1989; Yamin and

Otto, 2004). However, as other authors have pointed out (Bell and Marin, 2004; Lautanen, 2000), the bulk of these studies suggest that the most significant source of knowledge for MNEs, even those with 'creative subsidiaries', remains the MNE's headquarter-established technology, rather than its subsidiaries. Therefore, the notion of creative subsidiaries is not yet conclusively established, thus meriting further research. Moreover, although studies such as those noted above highlight the growing importance of the local (host) environment as a source of knowledge for the MNE, they say little about how this contributes to innovation or how this knowledge is transferred internally within the firm (Mu et al., 2007). In this study, we attempt to highlight the evolving nature of subsidiaries as knowledge-generating and knowledge-sharing agents. In other words, using secondary chronological data, we seek to demonstrate the growing importance of creative subsidiaries in knowledge creation and transfer within MNEs.

The purpose of this paper, then, is to make a contribution to this literature by focusing on the internationalisation of innovative activities in MNEs. Finnish MNEs were chosen as the context for the study since they offer an interesting theoretical perspective due to their home country's relatively small size. Given Finland's size, a significant portion of R&D is actually performed by foreign firms (van Beers et al., 2008). Further, whereas MNEs from larger countries typically conduct R&D in their home market, those in smaller countries like Finland often need to carry out these activities abroad (Lewin et al., 2009), as evident in the intense internationalisation of Nordic firms. Specifically, we consider two aspects of the internationalisation of innovation by Finnish multinational companies. The first aspect of internationalisation we consider refers to the extent that innovation is carried out by foreign subsidiaries of Finnish MNEs. In other words, we examine the growing innovativeness of foreign subsidiaries of Finnish MNEs ('creative subsidiaries').[1] The second aspect of internationalisation of innovation considers the growing phenomenon of cross-fertilisation. In general terms this is taken to mean the extent to which innovation development takes place in a context of exchange of knowledge and discoveries between different units of the same MNE located in different countries. In our particular context, we are focusing on cross-fertilisation between different R&D labs of the same MNE located in different countries. That is, our study examines the extent to which R&D labs based in different countries exchange and develop knowledge together. We are cognizant that a definitive investigation of these two issues, particularly of the phenomenon of cross-fertilisation, requires detailed data on the intensity and frequency of inter-unit exchanges and collaboration. Patent citation data, which we employ, do not capture the organisational process underlying 'cross-fertilisation'. Nevertheless, these patent citations reflect sharing of scientific knowledge that is at least underlying the cross-fertilisation process. The issues explored in our paper raise important strategic questions in terms of the role which MNE centres are attributing to the subsidiaries, whether these are considered serious contributors to innovation, or merely seen as appendices to headquarter-induced orchestration of innovation.

The Finnish MNE context was deliberately chosen for two reasons: Firstly, the Finnish economy has performed tremendously well in recent international comparisons of technological advancement and economic competitiveness (Rutten and Boekema, 2005).[2] Finnish firms have contributed towards a rapid economic transformation from a 'forest sector society' (Lilja et al., 1992) towards a 'knowledge-based society' (Lemola, 2002). The country has moved from 'green gold to silicon' (Oinas, 2005, p.1230) and boasts world class technological capabilities (UNDP, 2001). The success has been seen as a function of wise technology policy, the purposeful creation of a Finnish innovation system (Oinas, 2005), the emergence of Finnish clusters (Brännback and Renko, 2002)

and Finnish firms' response to pressures from the global techno-economic environment by internationalising their operations and demonstrating strong commitment to innovation (Rouvinen, 2002; Palmberg, 2004).

Secondly, the investigation of innovative activities in Finnish MNEs allowed us to capture a fairly comprehensive sample of multinationals in one country in relation to their knowledge creation activities in and between foreign and home units of MNEs. Specifically, we utilised data on the thirty largest MNEs in Finland (as at the turn of the century) that accounted for over 90% outgoing FDI flows from Finland (Uranus.fi, 2008).

Empirically, we cover the manifestations of Finnish corporate innovation activity abroad utilising long time series of patent data. Other research has focused on the growing competence of subsidiaries of large multinationals in Finland, particularly in comparison with similar developments in other small countries (Benito et al., 2002; Benito et al., 2003). However the specifically innovative roles of subsidiaries are not examined in these studies and thus this offers a particular contribution of this paper. The remainder of the paper is structured as follows. Section 2 reviews the existing theoretical and empirical literature relevant to the topic and formulates hypotheses on that basis. Section 3 explains the methodology, focusing on the utilisation of patent data. Section 4 discusses the findings in relation to the test hypotheses and Section 5 concludes the paper, setting out some of the limitation of the present study and its implications for future research relating to the internationalisation of innovative activities in Finnish MNEs.

2 Literature review and hypotheses

There is now a considerable weight of evidence to support the increasingly significant innovative role of MNEs and increased decentralisation of innovative activity with subsidiaries having a prominent role in innovation activities, beyond the adoption and adaptation of new technologies (Cantwell, 1995a). This increase in decentralised innovation indicates the growing importance of MNEs in the exploitation of market and technological heterogeneity worldwide for knowledge creation, moving away from the traditional home-centred approach to innovation. Thus the emerging view is that MNEs are effective institutions not only for knowledge transfer but also for knowledge 'building' and creation (Almeida et al., 2002). This view was forcefully stated by Kogut and Zander (1993), who see the MNE as a cross-border social community, which creates knowledge in its dispersed units and transfers it to other units for diffusion and recombination with other knowledge. As a result, MNEs are increasingly motivated to invest abroad in order to increase their knowledge-creating capacities, rather than simply expanding their markets (Ambos, 2005).

The significance of MNEs in the internationalisation of innovative activity has led to a large stream of literature regarding the behaviour of subsidiaries that have acquired a competence-creating role. The literature focusing specifically on subsidiaries has considered the patterns, causes and consequences of subsidiary capability and innovativeness in detail (see e.g., Birkinshaw and Hood, 1998; Almeida and Phene, 2004; Mudambi and Navarra, 2004; Phene and Almeida, 2008). This includes considerations of factors facilitating subsidiary innovation (Ghoshal and Bartlett, 1988; Birkinshaw and Ridderstråle, 1999; Pearce, 1999; Frost, 2001; Phene and Almeida, 2003; Almeida and

Phene, 2004; Phene and Almeida, 2008), of 'creative subsidiaries' as 'centres of excellence' (Pearce, 1999; Andersson and Forsgren, 2000; Frost et al., 2002) with a proven ability to generate independent technological capabilities in accordance with the local innovative environment (Cantwell and Janne, 1999; Papanastassiou, 1999; Pearce, 1999; Zander, 1999a; Frost, 2001).

Thus the focus of this literature has decidedly shifted away from the subsidiary's traditional role of adopting technology developed in the parent company, to the subsidiary's creation of local technological competencies and to the ease or otherwise of the transfer or diffusion of such competencies elsewhere in the MNE (Forsgren, 1997; Ghoshal and Bartlett, 1988; Zander, 1999a; Zander and Sölvell, 2000). There is indeed much evidence to suggest that the MNE is likely to develop into a differentiated organisation, whereby subsidiaries possess a distinct set of capabilities that reflect the unique combination of market, technological and institutional features (Forsgren et al., 1999; Pearce and Papanastassiou, 1999).

The establishment of R&D units in foreign subsidiaries started at least several decades ago (Hewitt, 1980) and this aspect of the internationalisation of innovation activities has received considerable attention from scholars (Ghoshal and Bartlett, 1988; Patel and Pavitt, 1991; Cantwell, 1995a; Patel, 1995; Cantwell and Kotecha, 1997; Kuemmerle, 1999; Pearce, 1999; Pearce and Papanastassiou, 1999; Belderbos, 2001; Ambos, 2005; Papanastassiou and Pearce, 2005). The results of these studies suggest that innovation activity in overseas subsidiaries only began to grow rapidly in the late 1980s and early 1990s. As for qualitative change, it also appears that many R&D units now have a strategic role, which suggests that MNEs are giving more importance to internationally dispersed innovation activity, including the development of new products overseas. R&D is no longer carried out simply for local markets – MNEs increasingly recognise the importance of global markets (Ambos and Ambos, 2007), hence the desirability of subsidiaries with local knowledge engaging in the process and disseminating their knowledge with other units within the organisation. A number of other studies looking at subsidiary innovativeness more broadly (rather than specifically on R&D units) also confirm the growing innovative 'creativity' at subsidiary level (Frost, 2001; Phene and Almeida, 2003; Almeida and Phene, 2004; Mudambi and Navarra, 2004; Phene and Almeida, 2008). Finally, a number of studies have analysed the phenomenon of 'reverse transfer' from the subsidiary to the parent (Yamin, 1999; Håkanson and Nobel, 2001; Najafi et al., 2012) which again is premised on a degree of technological innovative capability at the subsidiary level.

It is evident that MNEs originating in smaller countries have the greatest tendency to source technologies globally. Much of this strain of literature is based on empirical research on Nordic MNEs (Håkanson and Zander, 1988; Håkanson and Nobel, 1993b; Zander, 1999a; Benito et al., 2002). Similar tendencies are also observable in the case of MNEs from the Netherlands (e.g., Cantwell and Janne, 1999). This is generally because, firstly, in small economies, increasing economic openness forces domestic companies to specialise and be more innovative. Firms can compete either with innovative products, or they must keep costs down by improving their process technology, or by creating process innovations (Johnson, 1988). Second, small countries usually have a smaller resource base and the number of qualified personnel available within the country is usually lower (Cantwell and Janne, 1999, p.125), creating greater incentives for MNEs to tap into the innovative resources available in other countries.

This would suggest that the internationalisation of research and development activity in small country MNEs conforms to the 'home country augmenting' pattern of investment (Kuemmerle, 1999; Bas and Sierra, 2002).

In the case of Finnish companies, the main internationalisation push of their operations started in the mid-1980s. The increasing innovativeness of Finnish firms, particularly those in the information and communications technology sector, received much attention in the popular and trade press in the late 1990s (e.g., Colvin, 1999; Klee and Bensko, 1999; Lyytinen and Goodman, 1999; Morais, 1999; Wagner, 1999). However, academic research on the subject has been less extensive. Cross-sectoral empirical studies on the innovativeness of Finnish firms, and particularly of Finnish multinational firms, are scarce. The information available has usually appeared as part of broader studies of innovation (Archibugi and Michie, 1995, p.123; Patel, 1995). Nevertheless, based on the existing theoretical and empirical literature discussed earlier, we put forward the following hypothesis:

H1: The importance of R&D units abroad ('creative subsidiaries') in the innovative activity of Finnish MNEs is expected to have increased, relative to R&D units in the same organisations in Finland, during 1976–1995.

Given the significantly differentiated capabilities amongst subsidiaries, another crucial question is how these differentiated competencies are integrated at the firm level, introducing a possible contradiction between subsidiary autonomy and MNE-wide integration. Thus the organisational design problem of the differentiated MNE has been stated by Foss and Pedersen (2002) to include both the need for subsidiaries to produce knowledge by tapping into local knowledge bases, and for such knowledge to be made available to other MNE units. Cross-unit collaboration and knowledge sharing is not an automatic or a routine process (von Hippel, 1994; Szulanski, 1996; Forsgren, 1997; Birkinshaw et al., 1998; Birkinshaw and Ridderstråle, 1999; Kostova, 1999; Zander and Sölvell, 2000; Yamin and Otto, 2004). Empirical evidence indicates that the level of tacit knowledge sharing and transfer within multinational companies is low (Gupta and Govindarajan, 2000). Recent research by Monteiro et al. (2008a) suggests possible perverse consequences of knowledge flows within MNEs, whereby knowledge exchange takes place primarily amongst a subset of subsidiaries (an 'in-crowd') with a history of mutual knowledge flows and frequent interactions, while other subsidiaries may remain 'isolated' (Monteiro et al., 2008a; Monteiro et al., 2008b) from the gravitational centre of communication. Given the existence of strong ties amongst the 'in-crowd' subsidiaries, the pattern of knowledge transfers between units may reflect more harmony or likeability amongst them rather than overall MNC strategic imperatives. However, this problem is less likely to occur if knowledge exchange is between the subsidiaries and the HQ, as in our context, because in this case, the HQ is in control of the choice of subsidiary and the type of knowledge that might be exchanged. On the other hand, of course, this raises the question of whether this qualifies as 'cross-fertilisation', given the HQ's ability to choose subsidiaries and the type of knowledge exchanged. However, it should be recalled that the definition used here does not specify any particular relationship-foundation for cross-fertilisation to occur. According to the definition, there is no requirement for the parties involved to be of equal 'significance' in the organisation's hierarchy. In other words, cross-fertilisation is seen as possible between all units, irrespective of their position in the organisation's network. Our paper just happens to focus on cross-fertilisation between the HQ and subsidiary.

Thus whilst it may be acknowledged that for a variety of reasons, such as those noted above, the level of cross-unit knowledge exchange and transfer may be low, this should not necessarily be interpreted as implying an absence of opportunity or incentive for cross-border knowledge sharing or innovation. In terms of Hansen's (1999) analysis of knowledge sharing across organisational subunits, a differentiated MNE is a 'weakly coupled' organisation with the advantage of offering greater 'search' opportunities for identifying novel ideas, concepts and practices useful in product development and innovative activities of the searching subunit (Hansen, 1999). This suggests that the admittedly low levels of knowledge transfers that do take place are likely to be potentially highly productive as there is significant scope for cross-unit learning. The research on 'reverse' transfer within MNEs (Birkinshaw et al., 1998; Pearce, 1999; Yamin, 1999; Håkanson and Nobel, 2001) illustrates that local embeddedness of subsidiaries in external networks and a degree of integration with the rest of the MNE are not incompatible phenomena (Buckley and Carter, 2002; Subramaniam and Venkatraman, 2001).

The process of intra-firm communication in innovation that crosses national borders is often referred to as 'international cross-fertilisation of innovation'. In other words, several R&D units located in different countries contribute to the creation of one innovation. Such activity was first hypothesised by Vernon (1979) and the term 'cross-fertilisation' has now been established to describe it (Sölvell and Zander, 1995; Zander, 1998). Today, there is a general agreement that 'technological knowledge is inherently embodied in human capital' (Davenport and Bibby, 1999, 442). As Sölvell and Zander (1995, p.23) point out, much of advanced and specialised knowledge tends to be tacit and is not necessarily communicable via centralised computer databases and the like. Purely relying on centralised system-based coordination mechanisms (such as enterprise resource planning systems and information and communication technologies) may even prove counterproductive to the autonomy and creativity of innovative units (Yamin and Sinkovics, 2007; Yamin and Sinkovics, 2010). Tapping such knowledge from different environments is thus very difficult without cross-border personal interaction. In line with this insight, Yamin and Otto (2004) found that while intra-MNE knowledge spillovers had at best a weak positive impact on MNE innovativeness, collaborative knowledge sharing between different units within the MNE had a much greater positive impact (see also Yamin and Andersson, 2011).

International cross-fertilisation of innovation within the same MNE could take place in three main forms. First, engineers and scientists can travel between geographically dispersed research units. The more tacit the knowledge, the greater the need for face-to-face contact and the role of such key personnel becomes even more important (Subramaniam and Venkatraman, 2001, p.363). Second, R&D personnel can exchange information and discuss problems without leaving their local units with the help of modern communication technology. This is equivalent to what Paoli and Guercini (1997, p.6) call "Internationalisation without movement". Third, MNEs could also engage in network search within the MNE network for commercialisation capabilities, e.g., 'shop around' among research units, to find a unit best fitted to help develop and commercialise the project and share technological knowledge amongst such units (Zander, 1998). Other mechanisms may include the temporary exchange of personnel and knowledge exchange that comes through shipments of physical products and components, database searches and the like.

Literature reviewed earlier suggests that in many cases, R&D units, wherever located, do not innovate in isolation. However, although there is literature on knowledge flows in multinational companies (e.g., Yamin and Otto, 2004) intra-firm cooperation in innovation has attracted less research effort. One of the first efforts to empirically establish the occurrence of international intra-firm communication as a part of innovation process is found by Ghoshal and Bartlett (1988), although in a very limited fashion only. In that study, intra-firm communication was found to be of importance only in the later stages of adoption and diffusion of innovations (Ghoshal and Bartlett, 1988, p.385).

Most of the later evidence is found in the literature concerned with the configuration of innovation activity. Themes discussed include the roles of R&D units, beneficiaries of the output of their work and their communication with the rest of the organisation. Here, the focus is on whether these units create new products and to what extent such innovation activity is enhanced by intra-firm cooperation. Many studies observe cases where local R&D units create innovations for local and global use and participate in joint projects at MNE level (Ghoshal and Bartlett, 1988; Bartlett and Ghoshal, 1990; Dunning and Narula, 1995; Medcof, 1997; Pearce and Papanastassiou, 1999; Håkanson and Nobel, 2001; Papanastassiou and Pearce, 2005).

Empirical evidence in relation to the incidence of 'cross-fertilisation' of innovation in MNEs from smaller countries is also limited. Håkanson and Nobel (1993a) investigated 'knowledge integration' within 17 Swedish MNEs, whilst survey-based evidence in Åkerblom (1994) and Koskinen (1999) shows that up to 40% of Finnish corporate R&D units cooperate with other parts of the firm (although it is not clear how much of this actually crosses international borders). It is reasonable to argue that the same factors which propel the internationalisation of R&D activities in small country MNEs also encourage greater cross-fertilisation. Thus the need for technological specialisation argues for more coordinated R&D activities across borders whilst the limited home–based innovative resources suggest that overseas R&D units may be subjected to a lower level of the 'not-invented here' syndrome (see e.g., Bartlett and Ghoshal, 1990) than may otherwise be the case. We therefore propose the following hypothesis:

H2: The relative importance of international cross-fertilisation of innovation between subsidiaries in the same Finnish MNEs is expected to have increased during 1976–1995.

3 Research methodology

This study uses US patents as a proxy for innovation activity. Patel and Pavitt (1991) specify three dimensions associated with this type of methodology. First, they point out that patents measure technology creation, or innovation in its 'purest' form. Second, there are great variations in the propensity to patent amongst countries, reflecting differing costs and benefits of such protection. Therefore, it is best to use data from one single patent authority for greater comparability. Using US patent data also creates a high degree of generalisability, as the US Patent and Trademark Office (USPTO) has tended to receive the largest number of foreign applications out of all national patent offices, at least as far as the period 1976–1995 is concerned. Third, the interpretation of time trends also creates a potential problem, since the ownership of subsidiaries can change over time. Here, this problem was eliminated by combining patent data with specific information on selected 30 Finnish companies' foreign holdings at the beginning of four five-year periods (1976–1980, 1981–1985, 1986–1990, 1991–1995), as published in

annual reports and other company literature. While this is not a large-scale population for rigorous statistical analysis, it nevertheless represents a fairly comprehensive coverage of FDI activity for the period covered in this analysis. It should also be noted that we have attempted to extend the period beyond 1995, however, this proved impossible as mergers and acquisitions would have led to the disappearance of about 70% firms from the sample, due to changing ownership. While we acknowledge the limitations of using archival patent data, there are also some important advantages in doing so. First, it offers a foundation for future studies using complementary approaches, such as surveys and case studies. Second, retrospective studies using archival records can be rewarding if the time span covers several years and if certain patterns can be identified (Welch, 2000). Welch (2000) has identified four important qualities associated with research based on archival data: theoretical generalisability, the ability to offer empirical depth, developmental explanations and the potential to challenge existing theories.

At the same time, the period of the late-1970–1995 was an important one from the perspective of Finland's international business activities, as this was a time in which the country significantly enhanced its international trade following: (a) the removal of tariff barriers between the European Union (EU) and Finland in 1978 and (b) the country's incorporation into the European Economic area in 1994 (Lautanen, 2000). Moreover, in the following year, Finland gained full membership of the EU (Lautanen, 2000). Following the OECD definition, a company located outside Finland was considered a Finnish subsidiary if a Finnish company owned at least 51% of it.

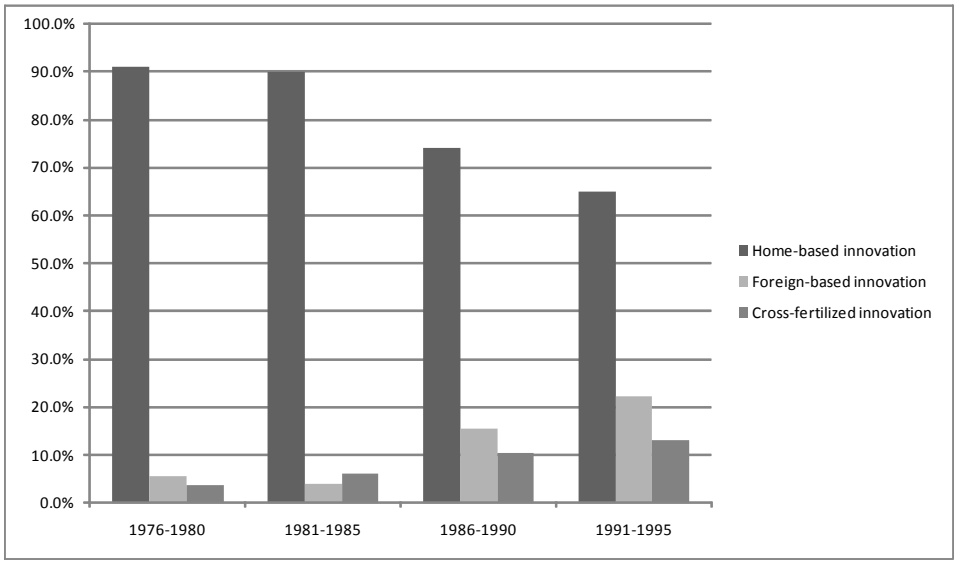
With the names of subsidiaries of Finnish MNEs known (both in Finland and abroad), their patent data were gathered from the USPTO online database (http://www.uspto.gov/patft/index.html). At this stage, only the location of the assignee (the company to whom the patent was granted) mattered. No attention was paid to the domicile of inventors. Then, the share of foreign patent in total patents during each of the five-year periods was calculated. In order to test the first hypothesis, independent sample *t*-tests were run on three pairs of data (shares of foreign patenting in the 30 MNEs 1976–1980 and 1981–1985; 1981–1985 and 1986–1990; and 1986–1990 and 1991–1995) in order to establish the significance of differences between time periods. In addition, the same test was run on the pair 1976–1980 and 1991–1995 in order to establish the statistical significance of change during the entire period under study.

In addition to the location of the innovating firm or subsidiary, the US patent database also displays the places of residence of inventors associated with a particular invention. Thus, the patents issued to parent firms or subsidiaries in Finland were scrutinised for inventors residing outside Finland. If any of the inventors resided abroad, it was taken as evidence of international cross-fertilisation of innovation as described earlier. This captures the knowledge flows or knowledge exchange occurring when inventors residing in Finland themselves engage in joint research with those in the foreign units of the Finnish MNE. It is a measure of the 'co-authorship' of patents (Cockburn and Henderson, 1998), implying socialisation and exchange of tacit knowledge. So, in the context of our paper, if a patent issued to a Finnish company has inventors that reside in two countries (Finland and a foreign country) we can infer that there has been cross-fertilisation of ideas between the investors/scientists in the same MNE.

The shares of cross-fertilised patents out of all patents issued to the 30 MNEs in Finland were calculated. In order to test the second hypothesis, independent sample *t*-tests were run on three pairs of data (shares of foreign patenting in the 30 MNEs 1976–

1980 and 1981–1985; 1981–1985 and 1986–1990; and 1986–1990 and 1991–1995) in order to establish the significance of differences between time periods. In addition, the same test was run on the pairs 1976–1980 and 1991–1995 in order to establish the statistical significance of change during the entire period under study, as was done with foreign R&D unit data. Table 1 shows a summary of the patent data for 30 Finnish MNEs for the period 1976–1995, while Figure 1 provides an illustration of the distribution of Finnish MNEs R&D activity.

Figure 1 Trends in Finnish corporate innovation activity



Notes: Vertical axis = % of all innovation activity; horizontal axis = time period.

Table 1 US Patents granted to the 30 Finnish MNEs home and abroad, 1976–1995

	1976–1980	*1981–1985*	*1986–1990*	*1991–1995*	*Total*
Number of all patents granted to the 30 MNEs in Finland	345	543	926	1467	3281
Number of all patents granted to the 30 MNEs abroad	20	23	169	417	629
Share of all patents granted to the 30 MNEs abroad	5.5%	4.1%	15.4%	22.1%	19.2%
All patents granted to the 30 MNEs	365	566	1095	1884	3910
Number of patents granted to the 30 MNEs in Finland involving cross-fertilisation of innovation	13	34	115	245	407
Share of patents granted to the 30 MNEs in Finland involving international cross-fertilisation of innovation	3.8%	6.3%	12.4%	16.7%	12.4%

Source: USPTO online database (http://www.uspto.gov/patft/index.html)

Finally, although the identities of the MNEs have been revealed here, we have refrained from going into depth on individual company characteristics as we are more concerned with broad patterns of innovative activity and knowledge dissemination, rather than specific instances which relate to particular organisations (although we do, of course, acknowledge that such an approach has its merits).

4 Findings

4.1 Innovation in foreign R&D units

Recalling the first hypothesis, it was expected that shares of patents granted to locations abroad show an increase over1976–1995 for the sample of 30 Finnish MNEs. Thus, we suggest that: H_0: $\mu \leq 0$, where μ is the difference in the shares of foreign innovations between the initial and the final sub-period (t11976–1980) and the final sub-period (t41991–1995) indicating changes in the share of foreign innovations over the whole of the period under study. The hypothesis (H_0: $\mu \leq 0$) is also tested with respect to the intervening sub-periods – that is 1976–1980 (t1) and 1981–1985 (t2); 1981–1985 (t2) and 1986–1990 (t3); 1986–1990 (t3) and 1991–1995 (t4); and 1976–1980 (t1) and 1991–1995 (t4). As the share of foreign innovations is expected to rise, one-tail tests are run (alternative hypothesis H_1: $\Delta \mathrm{FIS}_{t1-t4} \leq 0$).

The t-tests were run on the shares of foreign patents to total patents for each firm. The results of the t-tests appear in Table 2. In all cases except t1 and t2 the share of foreign patenting has increased, but that growth was statistically significant only between t2 and t3, as well as during the entire period (between t1 and t4). Between t1 and the t2 sub-periods the share of foreign innovation in fact decreased (as is evident from the negative t-value). However, as Table 1 shows the absolute number of patents granted to foreign locations increased from 20 to 23 during those years. What made their share decrease was the more rapid growth of innovation activity in Finland.

Table 2 *T*-test results for creative subsidiaries

1976–1980 and 1981–1985	*1981–1985 and 1986–1990*	*1986–1990 and 1991–1995*	*1976–1980 and 1991–1995*
–0.57	1.91**	0.76	2.38**

Notes: **Significant at 5% level.

Over the period as a whole, the shares of patents granted to foreign subsidiaries rose from 5.5% in t1 to 22.1% in t4 (Table 1). This trend corresponds fairly closely to what is known of other 'late internationalisers' such as French firms (Cantwell and Kotecha, 1997) and confirms survey-based evidence on overseas innovation activity by Finnish MNEs (Åkerblom, 1994). Compared to small-country firms such as Swedish MNEs, foreign innovation activity by Finnish MNEs appears to have grown about as fast, but owing to the former's higher initial levels of overseas R&D, they were considerably more internationalised than Finnish MNEs in this respect (Zander, 1999b).

We consider that the findings reported here constitute partial support for hypothesis H1. International innovation activity in Finnish MNEs, in terms of the number of US patents granted to the foreign subsidiaries of Finnish MNEs grew over the 1976–1996 period, although not always very fast. During the first ten years of the period of study,

innovation in foreign subsidiaries increased slower than in the Finnish headquarter (and thus the former's share fell), although not to a statistically significant degree. The most rapid growth in the share of foreign patents took place during the 1980s, slowing down in the 1990s.

4.2 International cross-fertilisation of innovation

The number of US patents granted to Finland and involving international cross-fertilisation in innovation (Table 1) was very low until the mid-1980s: 13 in *t*1 and 34 in *t*2. Thereafter, a dramatic increase is witnessed: in *t*3 there were 115 US patents granted to Finland involving international cross-fertilisation of innovation and 245 in *t*4.

Recalling the second hypothesis, it was expected that shares of patents granted to Finland and involving international cross-fertilisation of innovation within the same MNEs would show an increase as during 1976–1995 for the sample of the 30 Finnish MNEs. Thus, H_0: $\mu \leq 0$. Hereby, the parameter, FIS, constitutes the assumed difference in the shares of cross-fertilised innovations between different sub–periods in exactly the same way as described above. As the share of cross-fertilisation is expected to rise, one-tail tests are run (alternative hypothesis H_2: $\Delta FIS > 0$).

The *t*-tests were run on the shares of foreign patenting weighted according to each firm's share of the total number of patents granted. The results of the *t*-tests appear in Table 3. The increase in the shares of cross-fertilised patents observed is statistically significant for the whole period under study but not for the intervening sub-periods. As can be seen from Table 1 the share of 'cross-fertilised' innovation has increased in a more steady fashion compared to growth of foreign innovations which has been somewhat more oscillating. Thus even for the period between *t*1 and *t*2, when the share of foreign innovations fell, the share of cross-fertilised innovations increased. This is a somewhat unexpected feature of the findings as cross-fertilisation may be expected to feature more prominently when the MNEs internationalisation of R&D has reached a more 'mature' stage. This has apparently not been the case with Finnish MNEs.

Table 3 *T*-test results for international cross-fertilisation of innovation

1976–1980 and 1981–1985	*1981–1985 and 1986–1990*	*1986–1990 and 1991–1995*	*1976–1980 and 1991–1995*
0.85	1.19	0.53	1.88**

Notes: **Significant at 5% level.

5 Conclusions

5.1 Contribution and implications

A key issue arising from the decentralisation of R&D activity is to what extent such decentralisation contributes to firm level innovative performance (Sölvell and Zander, 1995; Pearce, 1999; Yamin and Otto, 2004). This is particularly important as the decentralisation of R&D activity may often come about as a consequence of cross-border merger and acquisition (de Meyer and Mizushima, 1989; Gassmann and von Zedtwitz, 1999, p.233; Räsänen, 1999). In this context, intra-firm cooperation amongst the

dispersed R&D units ('cross-fertilisation') can be regarded a key element in increasing the effectiveness of innovative activity in MNEs. This is an issue on which there has been relatively little research (Sölvell and Zander, 1995; Zander and Sölvell, 2002).

In this paper we have focused on the internationalisation of innovative activity by Finnish firms and have demonstrated that this internationalisation has been accompanied by a steady process of cross-fertilisation between the foreign-based and Finnish-based R&D units of the same MNEs. This is a significant finding; prior studies have suggested that such cross-fertilisation is likely to be a difficult process and may be hampered by intra-organisational rivalries and the prevalence of the 'not invented here' syndrome (Sölvell and Zander, 1995; Håkanson and Nobel, 2001). It is likely that the ability of Finnish MNEs to effectively conduct cross-fertilisation may have been stimulated by the 'small-country' conditions in which Finnish MNEs have emerged, reinforced by particularly Finnish characteristics, such as a highly developed networking culture. It may be a relevant consideration that Finland is a 'highly networked economy' with Finnish firm most active in taking advantage of ICT-based applications (Autio and Yli-Renko, 1998, p.974) a feature that may improve coordination of cross-border R&D activity. Cross-fertilisation of innovation requires sustained exchange and sharing of tacit knowledge between individual scientist/researchers in different subunits and across national boundaries. As such cross–fertilisation arguably represents a significant degree of intra-firm socialisation and trust. Our findings suggest that Finnish MNEs have been successful in engendering the appropriate organisation culture.

The latter observation is particularly relevant to a consideration of managerial implications. Thus, whilst cross-fertilisation is likely to be highly productive it is also an organisationally challenging phenomenon. There is evidence from the extant literatures that in the past subsidiary innovative efforts were treated with suspicion by the centre ('not invented here syndrome') or have encountered resistance from the MNE corporate 'immune system' (Birkinshaw and Ridderstråle, 1999). The general message is that if subsidiaries are to be creative, they cannot be regarded as mere 'agents of the centre' (O'Donnell, 2000). Relatedly, if subsidiaries are to be effective participants in cross-fertilisation, they must have distinctive capabilities. This notion implies an acceptance by the centre that, to a large extent, the main focus of subsidiary innovative activities will be localised and mainly directed to external rather than internal partners (Phene and Almeida, 2003). In part this necessitates that the centre does not necessarily expect subsidiaries to be 'knowledge providers' to other units as a routine function or 'role' but recognise that such flows should occur as a part of specific programs of cross-border knowledge creation.

5.2 Suggestions for future research

The findings of this paper raise a number of interesting questions which future research may address. One question is how does the pattern observed for Finnish MNEs compare to those from other small countries. Another question relates to the reasons underlying overseas R&D activity by Finnish MNEs. As we noted earlier, existing studies imply that overseas R&D activity by small country MNEs is most likely to be 'home base augmenting'. However given the highly developed technological capabilities of Finland, this generalisation may need modification particularly in sectors where Finnish firms are particularly strong. In this respect it will be useful to utilise disaggregated sectoral patent data (by patent classes) to establish any industry-specific patterns in cross-fertilisation.

Our findings further suggest that Finnish MNEs have paid attention to and encouraged cross-fertilisation at a relatively early stage and have developed relevant organisational competencies for managing the processes. However, while this is clearly an empirical question which is worthy of future research, this would require richer data than we have employed in this study, probably in the context of detailed case studies of managerial processes in Finnish MNEs.

Finally, it is notable that, starting at the late 1990s many of Finland's prominent innovators were acquired by foreign firms. As of 2001, no more than one third of the value of the Helsinki Stock Exchange was under Finnish control (Alkio and Möttölä, 2001). Nokia, for instance, is now mostly owned by international institutional investors (Steinbock, 2001, p.89). A relevant question to explore would be what kind of impact the acquisition of an R&D unit by foreigners has on its performance? Such units are usually one part of the firm, and as has happened before, that firm can have been acquired for other reasons. Thus, what exactly happens after the acquisition could be studied using US patent data as well, with due consideration of the appropriate time lags.

5.3 Limitations

The results also point to some limitations of this study which may be considered in future research. Only US patents were used in our sample. Although there are suggestions that for the high-technology sector, US patents capture the most significant stock of knowledge (Almeida and Phene, 2004), our conclusions may not generalise to patents as a whole. Related to this is the difficulty to expand the data base beyond 1995. Whether the patterns of subsidiary innovation and cross-fertilisation have been maintained more recently is a question that will have to be addressed in future research through more qualitative, case-study based approaches.

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References

Åkerblom, M. (1994) *Internationalization of Research and Development Operations of Finnish Companies: Research and Development Operations (R&D) in Finland and Abroad and Involvement in R&D Cooperation*, Statistics Finland, Helsinki, Finland.

Alkio, J. and Möttölä, M. (2001) 'Suomalaisia yrityksiä myytiin maailmalle laman jälkeen halvalla: kaksi kolmasosaa pörssin arvosta ulkomaalaisilla', *Helsingin Sanomat*, Vol. 8, No. 1.

Almeida, P. and Phene, A. (2004) 'Subsidiaries and knowledge creation: the influence of the MNC and host country on innovation', *Strategic Management Journal*, Vol. 25, Nos. 8/9, pp.847–864.

Almeida, P., Song, J. and Grant, R.M. (2002) 'Are firms superior to alliances and markets? An empirical test of cross-border knowledge building', *Organization Science*, Vol. 13, No. 2, pp.147–161.

Ambos, B. (2005) 'Foreign direct investment in industrial research and development: a study of German MNCs', *Research Policy*, Vol. 34, No. 4, pp.395–410.

Ambos, B. and Ambos, T.C. (2007) 'Outside the triad: an examination of international R&D investments within peripheral economies', in Benito, G. and Narula, R. (Eds): *Multinationals on the Periphery*, Palgrave Macmillan, Basingstoke, pp.188–205.

Andersson, U. and Forsgren, M. (2000) 'In search of centre of excellence: network embeddedness and subsidiary roles in multinational corporations', *Management International Review*, Vol. 40, No. 4, pp.329–350.

Archibugi, D. and Michie, J. (1995) 'The globalisation of technology: a new taxonomy', *Cambridge Journal of Economics*, Vol. 19, No. 1, pp.121–140.

Autio, E. and Yli-Renko, H. (1998) 'New, technology-based firms in small open economies: an analysis based on the Finnish experience', *Research Policy*, Vol. 26, No. 9, pp.973–987.

Bartlett, C.A. and Ghoshal, S. (1990) 'Managing innovation in the transnational corporation', in Bartlett, C.A., Doz, Y.L. and Hedlund, G. (Eds): *Managing the Global Firm*, Routledge, London, UK, pp.215–255.

Bas, C.L. and Sierra, C. (2002) 'Location versus home country advantages in R&D activities: some further results on multinationals' locational strategies', *Research Policy*, Vol. 31, No. 4, pp.589–609.

Belderbos, R. (2001) 'Overseas innovations by Japanese firms: an analysis of patent and subsidiary data', *Research Policy*, Vol. 30, No. 2, pp.313–332.

Bell, M. and Marin, A. (2004) 'Where do foreign direct investment-related technology spillovers come from in emerging economies? An exploration in Argentina in the 1990s', *The European Journal of Development Research*, Vol. 16, No. 3, pp.653–686.

Benito, G.R.G., Grogaard, B. and Narula, R. (2003) 'Environmental influences on MNE subsidiary roles: Economic integration and the nordic countries', *Journal of International Business Studies*, Vol. 34, No. 5, pp.443–456.

Benito, G.R.G., Larimo, J., Narula, R. and Pedersen, T. (2002) 'Multinational enterprises from small economies: internationalization patterns of large companies from Denmark, Finland, and Norway', *International Studies of Management and Organization*, Vol. 32, No. 1, pp.57–78.

Birkinshaw, J. and Hood, N. (1998) 'Multinational subsidiary evolution: capability and charter change in foreign-owned subsidiary companies', *Academy of Management Review*, Vol. 23, No. 4, pp.773–795.

Birkinshaw, J., Hood, N. and Jonsson, S. (1998) 'Building firm-specific advantages in multinational corporations: the role of subsidiary initiative', *Strategic Management Journal*, Vol. 19, No. 3, pp.221–242.

Birkinshaw, J. and Ridderstråle, J. (1999) 'Fighting the corporate immune system: a process study of subsidiary initiatives in multinational corporations', *International Business Review*, Vol. 8, No. 2, pp.149–180.

Brännback, M. and Renko, M. (2002) 'Technological and strategic change in the Finnish pharmaceutical industry: the emergence of a cluster', *Pharmaceuticals Policy & Law*, Vol. 5, No. 1, pp.27–40.

Buckley, P.J. and Carter, M.J. (2002) 'Process and structure in knowledge management practices of British and US multinational enterprises', *Journal of International Management*, Vol. 8, No. 1, pp.29–48.

Cantwell, J. (1989) *Technological Innovation and Multinational Corporations*, Basil Blackwell, Oxford, UK.

Cantwell, J. (1995a) 'The globalisation of technology: what remains of the product cycle model?', *Cambridge Journal of Economics*, Vol. 19, No. 1, pp.155–174.

Cantwell, J. (1995b) 'Multinational companies and innovatory activities: towards a new, evolutionary approach', in Molero, J. (Ed.): *Technological Innovation, Multinational Corporations and New International Competitiveness: The Case of Intermediate Countries*, Harwood Academic Publishers, Chur, CH, pp.21–57.

Cantwell, J. and Janne, O. (1999) 'Technological globalisation and innovative centres: the role of corporate technological leadership and locational hierarchy', *Research Policy*, Vol. 28, No. 2–3, pp.119–144.

Cantwell, J. and Kotecha, U. (1997) 'The internationalization of technological activity: the french evidence in a comparative setting', in Howells, J. and Michie, J. (Eds): *Technology, innovation and competitiveness*, Edward Elgar, Cheltenham, UK, pp.126–173.

Cantwell, J. and Mudambi, R. (2005) 'MNE competence-creating subsidiary mandates', *Strategic Management Journal*, Vol. 26, No. 12, pp.1109–1128.

Caves, R.E. (1996) *Multinational Enterprise and Economic Analysis*, Cambridge University Press, Cambridge, UK.

Cockburn, I.M. and Henderson, R.M. (1998) 'Absorptive capacity, co-authoring behaviour and the organisation of research in drug discovery', *Journal of Industrial Economics*, Vol. 46, No. 2, pp.157–182.

Colvin, G. (1999) 'We see the future, and it's Finland: phones, planes, and dickens on IPOs', *Forbes*, Vol. 140.4, No. 16.08.99, p.180.

Davenport, S. and Bibby, D. (1999) 'Rethinking a national innovation system: the small country as 'SME'', *Technology Analysis & Strategic Management*, Vol. 11, No. 3, pp.431–462.

de Meyer, A. and Mizushima, A. (1989) 'Global R&D management', *R & D Management*, Vol. 19, No. 2, pp.135–146.

Dunning, J.H. and Narula, R. (1995) 'The R&D activities of foreign firms in the United States', *International Studies of Management & Organization*, Vol. 25, Nos. 1/2, pp.39–73.

Forsgren, M. (1997) 'The advantage paradox of the multinational corporation', in Björkman, I. and Forsgren, M. (Eds): *The Nature of the International Firm - Nordic Contributions to International Business Research*, Copenhagen Business School Press, Copenhagen, Denmark, pp.69–85.

Forsgren, M., Pedersen, T. and Foss, N.J. (1999) 'Accounting for the strengths of MNC subsidiaries: the case of foreign-owned firms in Denmark', *International Business Review*, Vol. 8, No. 2, pp.181–196.

Foss, N.J. and Pedersen, T. (2002) 'Transferring knowledge in MNCs: the role of sources of subsidiary knowledge and organizational context', *Journal of International Management*, Vol. 8, No. 1, pp.49–67.

Frost, T.S. (2001) 'The geographic sources of foreign subsidiaries' innovations', *Strategic Management Journal*, Vol. 22, No. 2, pp.101–123.

Frost, T.S., Birkinshaw, J.M. and Ensign, P.C. (2002) 'Centers of excellence in multinational corporations', *Strategic Management Journal*, Vol. 23, No. 11, pp.997–1018.

Gassmann, O. and von Zedtwitz, M. (1999) 'New concepts and trends in international R&D organization', *Research Policy*, Vol. 28, Nos. 2/3, pp.231–250.

Ghoshal, S. and Bartlett, C.A. (1988) 'Creation, adoption, and diffusion of innovations by subsidiaries of multinational corporations', *Journal of International Business Studies*, Vol. 19, No. 3, pp.365–388.

Gupta, A.K. and Govindarajan, V. (2000) 'Knowledge flows within multinational corporations', *Strategic Management Journal*, Vol. 21, No. 4, pp.473–496.

Håkanson, L. and Nobel, R. (1993a) 'Determinants of foreign R&D in Swedish multinationals', *Research Policy*, Vol. 22, Nos. 5/6, pp.397–411.

Håkanson, L. and Nobel, R. (1993b) 'Foreign research and development in Swedish multinationals', *Research Policy*, Vol. 22, Nos. 5/6, pp.373–396.

Håkanson, L. and Nobel, R. (2001) 'Organizational characteristics and reverse technology transfer', *Management International Review*, Vol. 41, No. 4, pp.395–420.

Håkanson, L. and Zander, U. (1988) 'International management of R&D: the Swedish experience', *R & D Management*, Vol. 18, No. 3, pp.217–226.

Hansen, M.T. (1999) 'The search-transfer problem: the role of weak ties in sharing knowledge across organization subunits', *Administrative Science Quarterly*, Vol. 44, No. 1, pp.82–111.

Hewitt, G. (1980) 'Research and development performed abroad by U.S. Manufacturing multinationals', *Kyklos*, Vol. 33, No. 2, pp.308–327.

Hymer, S. (1960) *The International Operations of National Firms: A Study of Direct Investment*, MIT Press, Boston, MA, USA.

Johnson, B. (1988) 'An institutional approach tot he small-country problem', in Freeman, C. and Lundvall, B-Å. (Eds): *Small Countries Facing the Technological Revolution*, Pinter, London, UK, pp.279–297.

Klee, K. and Bensko, J. (1999) 'The future is Finnish: Finland bets on high-technology', *Newsweek International*, Vol. 1999.05.24, p.58.

Kogut, B. and Zander, U. (1993) 'Knowledge of the firm and the evolutionary theory of the multinational corporation', *Journal of International Business Studies*, Vol. 24, No. 4, pp.625–645.

Koskinen, J. (1999) 'Internationalization of R&D in Finnish firms', in Pajarinen, M. and Ylä-Anttila, P. (Eds): *Cross border R&D in a Small Country: The Case of Finland*, Taloustieto, Helsinki, Finland, pp.11–39.

Kostova, T. (1999) 'Transnational transfer of strategic organizational practices: a contextual perspective', *Academy of Management Review*, Vol. 24, No. 2, pp.308–324.

Kuemmerle, W. (1999) 'The drivers of foreign direct investment into research and development: an empirical investigation', *Journal of International Business Studies*, Vol. 30, No. 1, pp.1–24.

Lautanen, T. (2000) 'Modelling small firms' decisions to export – evidence from manufacturing firms in Finland, 1995', *Small Business Economics*, Vol. 14, No. 2, pp.107–124.

Lemola, T. (2002) 'Convergence of national science and technology policies: the case of Finland', *Research Policy*, Vol. 31, Nos. 8/9, pp.1481–1490.

Lewin, A.Y., Massini, S. and Peeters, C. (2009) 'Why are companies offshoring innovation? The emerging global race for talent', *Journal of International Business Studies*, Vol. 40, No. 6, pp.901–925.

Lilja, K., Räsänen, K. and Tainio, R. (1992) 'A dominant business recipe: the forest sector in Finland', in Whitley, R. (Ed.): *European Business Systems: Firms and Markets in their National Contexts*, Sage, London, UK, pp.137–154.

Lyytinen, K. and Goodman, S. (1999) 'Finland: the unknown soldier on the it front', *Communications of the Association for Computing Machinery (ACM)*, Vol. 42, No. 3, pp.13–18.

Medcof, J.W. (1997) 'A taxonomy of internationally dispersed technology units and its application to management issues', *R & D Management*, Vol. 27, No. 4, pp.301–318.

Monteiro, L.F., Arvidsson, N. and Birkinshaw, J. (2008a) 'Knowledge flows within multinational corporations: explaining subsidiary isolation and its performance implications', *Organization Science*, Vol. 19, No. 1, pp.90–107.

Monteiro, L.F., Birkinshaw, J. and Arvidsson, N. (2008b) 'Being in the "out" crowd', *MIT Sloan Management Review*, Vol. 49, No. 2, pp.13–14.

Morais, R.C. (1999) 'Smoked reindeer and wap phones: Finland has emerged from recession brought on by the collapse of the U.S.S.R. To become the eu's capitalist showcase. How did it do that?', *Forbes*, Vol. 1999.12.27, p.100.

Mu, S., Gnyawali, D. and Hatfield, D. (2007) 'Foreign subsidiaries' learning from local environments: an empirical test', *Management International Review*, Vol. 47, No. 1, pp.79–102.

Mudambi, R. and Navarra, P. (2004) 'Is knowledge power? Knowledge flows, subsidiary power and rent-seeking within MNCs', *Journal of International Business Studies*, Vol. 35, No. 5, pp.385–406.

Najafi-Tavani, Z., Giroud, A. and Sinkovics, R.R. (2012) 'Mediating effects in reverse knowledge transfer processes', *Management International Review*, Vol. 52, No. 3, pp.461–488.

O'Donnell, S.W. (2000) 'Managing foreign subsidiaries: agents of headquarters, or an interdependent network?', *Strategic Management Journal*, Vol. 21, No. 5, pp.525–548.

Oinas, P. (2005) 'Finland: a success story?', *European Planning Studies*, Vol. 13, No. 8, pp.1227–1244.

Palmberg, C. (2004) 'The sources of innovations - looking beyond technological opportunities', *Economics of Innovation & New Technology*, Vol. 13, No. 2, pp.183–197.

Paoli, M. and Guercini, S. (1997) *R&D Internationalisation in the Strategic Behaviour of the Firm*, SPRU, STEEP, Discussion Paper no. 39, University of Sussex, Brighton, England, UK.

Papanastassiou, M. (1999) 'Technology and production strategies of multinational enterprise (MNE) subsidiaries in Europe', *International Business Review*, Vol. 8, No. 2, pp.213–232.

Papanastassiou, M. and Pearce, R. (2005) 'Funding sources and the strategic roles of decentralised R&D in multinationals', *R&D Management*, Vol. 35, No. 1, pp.89–99.

Patel, P. (1995) 'Localised production of technology for global markets', *Cambridge Journal of Economics*, Vol. 19, No. 1, pp.141–153.

Patel, P. and Pavitt, K. (1991) 'Large firms in the production of the world's technology: an important case of 'non-globalisation'', *Journal of International Business Studies*, Vol. 22, No. 1, pp.1–21.

Pearce, R. (1999) 'The evolution of technology in multinational enterprises: the role of creative subsidiaries', *International Business Review*, Vol. 8, No. 2, pp.125–148.

Pearce, R. and Papanastassiou, M. (1999) 'Overseas R&D and the strategic evolution of MNEs: evidence from laboratories in the UK', *Research Policy*, Vol. 28, No. 1, pp.23–41.

Phene, A. and Almeida, P. (2003) 'How do firms evolve? The patterns of technological evolution of semiconductor subsidiaries', *International Business Review*, Vol. 12, No. 3, pp.349–367.

Phene, A. and Almeida, P. (2008) 'Innovation in multinational subsidiaries: the role of knowledge assimilation and subsidiary capabilities', *Journal of International Business Studies*, Vol. 39, No. 5, pp.901–919.

Räsänen, V. (1999) 'Effects of internationalization on R&D processes', in Pajarinen, M. and Ylä-Anttila, P. (Eds): *Cross Border R&D in a Small Country: The Case of Finland*, Taloustieto, Helsinki, Finland, pp.41–90.

Rouvinen, P. (2002) 'Characteristics of product and process innovators: some evidence from the Finnish innovation survey', *Applied Economics Letters*, Vol. 9, No. 9, pp.575–580.

Rutten, R. and Boekema, F. (2005) 'Innovation, policy and economic growth: theory and cases', *European Planning Studies*, Vol. 13, No. 8, pp.1131–1136.

Sölvell, Ö. and Zander, I. (1995) 'Organization of the dynamic multinational enterprise: the home-based and the heterarchical MNE', *International Studies of Management & Organization*, Vol. 25, No. 1,2, pp.17–38.

Steinbock, D. (2001) 'Assessing Finland's wireless valley: can the pioneering continue?', *Telecommunications Policy*, Vol. 25, Nos. 1/2, pp.71–100.

Subramaniam, M. and Venkatraman, N. (2001) 'Determinants of transnational new product development capability: testing the influence of transferring and deploying tacit overseas knowledge', *Strategic Management Journal*, Vol. 22, No. 4, pp.359–378.

Szulanski, G. (1996) 'Exploring internal stickiness: impediments to the transfer of best practice within the firm', *Strategic Management Journal*, Vol. 17, pp.27–43.

UNDP (2001) *Human Development Report*, United Nations, Geneva, Switzerland.

Uranus.fi (2008) *100 Largest Companies in Finland*, Uranus Consulting Available online at: http://www.uranus.fi/en/opportunities/working_in_finland/open.php?id=19982 (accessed on 20 September 2010).

van Beers, C., Berghäll, E. and Poot, T. (2008) 'R&D internationalization, R&D collaboration and public knowledge institutions in small economies: evidence from Finland and the Netherlands', *Research Policy*, Vol. 37, No. 2, pp.294–308.

Vernon, R. (1979) 'The product cycle hypotheses in a new international environment', *Oxford Bulletin of Economics & Statistics*, Vol. 41, No. 4, pp.255–267.

von Hippel, E. (1994) ''Sticky information' and the locus of problem solving: implications for innovation', *Management Science*, Vol. 40, No. 4, pp.429–440.

Wagner, C.G. (1999) 'Small country strategies', *The Futurist*, Vol. 33, No. 10, p.6.

Welch, C. (2000) 'The archaeology of business networks: the use of archival records in case study research', *Journal of Strategic Marketing*, Vol. 8, No. 2, pp.197–208.

Yamin, M. (1999) 'An evolutionary analysis of subsidiary innovation and 'reverse' transfer in multinational companies', in Burton, F.N., Chapman, M. and Cross, A. (Eds): *International Business Organization: Subsidiary Management, Entry Strategies and Emerging Markets*, MacMillan Press, Basingstoke, England,UK, pp.67–82.

Yamin, M. and Andersson, U. (2011) 'Subsidiary importance in the MNC: what role does internal embeddedness play?', *International Business Review*, Vol. 20, No. 2, pp.151–162.

Yamin, M. and Otto, J. (2004) 'Patterns of knowledge flows and MNE innovative performance', *Journal of International Management*, Vol. 10, No. 2, pp.239–258.

Yamin, M. and Sinkovics, R.R. (2007) 'ICT and MNE reorganisation: the paradox of control', *Critical Perspectives on International Business*, Vol. 3, No. 4, pp.322–336.

Yamin, M. and Sinkovics, R.R. (2010) 'ICT deployment and resource-based power in multinational enterprises', *Futures*, Vol. 42, No. 9, pp.952–959.

Zander, I. (1998) 'The evolution of technological capabilities in the multinational corporation--dispersion, duplication and potential advantages from multinationality', *Research Policy*, Vol. 27, No. 1, pp.17–35.

Zander, I. (1999a) 'How do you mean `global'? An empirical investigation of innovation networks in the multinational corporation', *Research Policy*, Vol. 28, Nos. 2/3, pp.195–213.

Zander, I. (1999b) 'Whereto the multinational? The evolution of technological capabilities in the multinational network', *International Business Review*, Vol. 8, No. 3, pp.261–291.

Zander, I. and Sölvell, Ö. (2000) 'Cross-border innovation in the multinational corporation: a research agenda', *International Studies of Management & Organization*, Vol. 30, No. 2, pp.44–67.

Zander, I. and Sölvell, Ö. (2002) 'The phantom multinational', in Havila, V., Forsgren, M. and Håkansson, H. (Eds): *Critical Perspectives on Internationalisation*, Pergamon, Amsterdam, The Netherlands, pp.81–106.

Zanfei, A. (2000) 'Transnational firms and the changing organisation of innovative activities', *Cambridge Journal of Economics*, Vol. 24, No. 5, pp.515–542.

Notes

1 This aspect of internationalization of innovation connects with the literature on subsidiary capability development and locational qualities (Cantwell and Mudambi, 2005).

2 For examples of rankings see, the Global Competitiveness Report (http://www.competitiveness.lk/gcr.htm) and the European Innovation Scoreboard (see http://ec.europa.eu/enterprise/innovation/index_en.htm).

Raw data

allpat 95	*allpat 90*	*allpat 85*	*allpat 80*	*totpat*	*firm*	*forpat 95*	*forpat 90*	*forpat 85*	*forpat 80*	*totforpa*	*finpat 95*	*finpat 90*	*finpat 85*	*finpat 80*	*totfinpa*	*Crosfe 95*	*crosfe 90*	*crosfe 85*	*Crosfe 80*	*totcrosf*
562	114	13	14	703	nokia	93	43	1	0	137	469	71	12	14	566	89	3	1	0	93
243	180	97	68	588	valmet	17	20	7	2	46	226	160	90	66	542	12	11	1	0	24
202	132	42	33	409	ashstrom	76	3	0	0	79	126	129	42	33	330	32	39	5	2	78
70	64	67	51	252	outokump	5	2	0	0	7	65	62	67	51	245	5	4	3	2	14
63	88	43	22	216	tampella	20	5	0	0	25	43	83	43	22	191	1	0	0	0	1
45	51	65	39	200	metra	15	2	3	5	25	30	49	62	34	175	3	11	6	3	23
90	73	21	8	192	kone	26	46	3	2	77	64	27	18	6	115	11	1	1	0	13
106	28	25	19	178	fiskars	45	5	4	4	58	61	23	21	15	120	41	11	12	0	64
74	71	22	8	175	neste	6	0	0	0	6	68	71	22	8	169	17	11	0	3	31
74	36	26	22	158	repola	40	12	1	0	53	34	24	25	22	105	4	0	2	2	8
60	33	25	4	122	instumei	3	0	3	1	7	57	33	22	3	115	5	1	0	0	6
65	28	12	5	110	orion	7	0	0	0	7	58	28	12	5	103	4	1	0	0	5
52	30	9	9	100	kemira	31	8	0	3	42	21	22	9	6	58	4	1	0	0	5
16	27	19	12	74	partek	2	6	1	0	9	14	21	18	12	65	1	1	1	1	4
30	18	10	6	64	vaisala	0	0	0	0	0	30	18	10	6	64	2	1	0	0	3
2	7	26	21	56	enso	0	0	0	0	0	2	7	26	21	56	1	1	0	0	2
12	15	8	3	38	cultor	2	2	0	1	5	10	13	8	2	33	3	5	1	0	13

allpat 95	*allpat 90*	*allpat 85*	*allpat 80*	*totpat*	*firm*	*forpat 95*	*forpat 90*	*forpat 85*	*forpat 80*	*totforpa*	*finpat 95*	*finpat 90*	*finpat 85*	*finpat 80*	*totfinpa*	*Crosfe 95*	*crosfe 90*	*crosfe 85*	*Crosfe 80*	*totcrosf*
23	15	0	0	38	uponor	23	9	0	0	32	0	6	0	0	6	0	5	0	0	5
27	3	3	4	37	huhtamak	1	1	0	1	3	26	2	3	3	34	0	0	0	0	0
18	15	1	1	35	alko	0	0	0	0	0	18	15	1	1	35	10	5	0	0	15
9	15	7	1	32	tamfelt	1	2	0	0	3	8	13	8	2	31	1	0	0	0	1
4	7	5	6	22	metsa-se	0	0	0	0	0	4	7	5	6	22	0	3	0	0	3
10	10	1	0	21	imatran	0	0	0	0	0	10	10	1	0	21	0	0	0	0	0
10	8	1	0	19	rautaruu	0	0	0	0	0	10	8	1	0	19	0	0	0	0	0
3	2	6	4	15	kymmene	0	0	0	1	1	3	2	6	3	14	0	0	0	0	0
0	7	6	2	15	lanen te	0	0	0	0	0	0	7	6	2	15	0	0	0	0	0
5	9	1	0	15	valio	0	0	0	0	0	5	9	1	0	15	1	0	0	0	1
3	7	2	2	14	hackman	1	1	0	0	2	2	6	2	2	12	0	0	0	0	0
4	2	3	0	9	raute	3	2	0	0	5	1	0	3	6	10	0	0	0	0	0
2	0	0	1	3	raisio	0	0	0	0	0	2	0	0	1	3	0	0	0	0	0

Notes: allpat = all patents, forpat = foreign patents, finpat = finnish patents, crossfe = cross fertilisation