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How does Knowledge Transfer from Foreign Subsidiaries affect
Parent Companies' Innovative Capacity?

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Abstract:

The paper addresses reverse knowledge transfer (RKT) from foreign subsidiary to parent company. Specifically, it aims at investigating to what extent the effectiveness of such a transfer is influenced by: (i) the organizational mechanisms employed for transferring knowledge; (ii) the subsidiary's role, its autonomy, and its relationships with the local context. The empirical analysis considers 162 transfers of best practices possessed by foreign subsidiaries and transferred back to their Italian parent companies.

Results confirm that the impact of RKT on the parent company's innovativeness is greater when: (i) person-based mechanisms are employed for transferring knowledge; (ii) subsidiaries are competence-creating; and (iii) knowledge developed by subsidiaries benefits from local external linkages.

Key words: External linkages, organizational mechanisms, parent company's innovativeness, reverse knowledge transfer, subsidiary's characteristics.

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INTRODUCTION

Over the last decades there has been an upsurge of interest in the importance of knowledge management in multinational corporations (MNCs) as a crucial source of strategic competitive advantage. The very reason why MNCs exist and succeed is that they are efficient vehicles for creating and transferring knowledge across borders (Gupta and Govindarajan, 1991; Kogut and Zander, 1993). This idea has stimulated research on the process through which knowledge is managed by and within the MNC, and how this affects its innovativeness, productivity, and competitive advantage (Grant, 1996). Accordingly, although the parent company continues to serve as the most active creator and diffuser of knowledge within the corporation, foreign subsidiaries may also engage in knowledge transfer (KT) with their parent companies and sister units (e.g. Gupta and Govindarajan, 2000). In other words, as clearly explained by the seminal work of Bartlett and Ghoshal (1989), innovations can be developed on a joint basis, at both headquarters and subsidiary level, thanks to the integration of resources and capabilities of diverse worldwide units within the MNC.

From a theoretical point of view, the literature on KT in MNCs has implicitly (and positively) related it to the ability to integrate new geographic dispersed skills, know-how, and capabilities in the existing knowledge base, that consequently fosters technological and managerial innovation and creates synergies that can significantly leverage the MNC's competitive advantage (Bartlett and Ghoshal, 1989; Cantwell, 1995; Gupta and Govindarajan, 2000; Hedlund, 1986). In this context, MNCs appear to be more innovative thanks to the subsidiaries' access to a larger stock of ideas, and to the extent that they are able to draw upon the existing knowledge pool in the local environment (Almeida, 1996; Frost, 1998; Iwasa and Odagiri, 2004; Yamin and Otto, 2004). However, while the empirical evidence generally relies on the patent citations analysis, this approach has been recently criticized in accordance with the well known shortcomings of patents (Patel and Pavitt, 1997). Therefore, KT has also been related to objective measures of performance – such as the Return on Investment – at the business unit level (Tsai, 2001), although in this case, given the very aggregated nature of the performance measure, it is rather difficult to identify the direct effects induced by the use of transferred knowledge. A smaller number of studies has instead addressed the effect induced by KT on changes in the parent company's productivity (Darr et al., 1995; Mansfield, 1984) and innovativeness (Subramaniam and Venkatraman, 2001; Tsai, 2001; Tsai and Ghoshal, 1998).

The present paper focuses on knowledge that flows from foreign subsidiaries to the parent company (Håkanson and Nobel, 2000), otherwise called ‘reverse knowledge transfer’ (RKT). Specifically, we are interested in studying which conditions enable parent companies to benefit from RKT. We argue that the probability that parent companies improve their innovative capacity, by leveraging existing knowledge possessed by foreign subsidiaries, is likely to be higher when: 1) parent firms have developed a suitable organizational structure allowing them to transfer and utilize the subsidiary’s distinctive knowledge effectively; and, 2) the subsidiary is able to generate valuable knowledge for the parent company. As far as (1) is concerned, we consider both person-based mechanisms and those based on ICT and/or written media; as far as (2), we focus on the subsidiary’s role, its degree of autonomy, and its interactions with the local context.

In order to investigate these relationships in detail, we developed an empirical analysis run at the level of each transfer occurred from the subsidiary to the parent company. Data collection was based on face-to-face structured interviews with 84 Italian MNCs (concerning the relationships with their relevant 350 foreign subsidiaries); the key respondents to the questionnaire were the parent company’s top managers. It might not be out of place here to specify that, following previous approaches (Björkman et al., 2004; Foss and Pedersen, 2002; Gupta and Govindarajan, 2000; Szulanski, 1996), we meant RKT as the effective use by the parent company of the transferred foreign subsidiary’s best practices. Specifically, we asked first to identify distinctive knowledge and best practices existing in the subsidiary; secondly, whether they have been transferred and used by the parent company; and finally, how parent company evaluates the innovative impact of using the transferred knowledge.

The rest of the paper is organized as follows. In the next Section, we review prior literature on factors influencing KT effectiveness, and we put forward our research hypotheses on the impact of RKT on parent companies’ innovative capacity. Then, we illustrate the research design, the data used in the empirical analysis, and some qualitative results. Next, we report the numerical investigation explaining the econometric model and the results. Finally, we conclude the paper with the implication of the key findings for the international business theory and practice.

THEORY AND HYPOTHESES

Mechanisms for transferring knowledge

The literature often makes the distinction between tacit and explicit knowledge (Polanyi,

1967). Explicit knowledge is what can be formally expressed clearly, fully, and leaves nothing implied. Tacit knowledge, on the other hand, cannot be expressed outside the action of the person who has it; it is unvoiced and unspoken. Although different areas of knowledge have been categorized as relatively tacit or explicit – quantifiable technologies and process are more explicit (Von Glinow and Teagarden, 1988), managerial and marketing expertises are more tacit (Dhanaraj et al., 2004) than product development, production, and technology (Lane et al., 2001; Shenkar and Li, 1999) – it is always difficult to decide which knowledge can be considered as tacit rather than explicit. However, the two types are not completely distinct: knowledge codifiability and tacitness should be considered as a continuum and when knowledge is transferred, that process will generally involve both tacit and explicit knowledge (Nonaka and Takeuchi, 1995). On the other hand, what is crucial to be taken into account is that the transfer of different types of knowledge requires different types of channels (Szulanski, 1996). In fact, the larger is the use of unsuitable transfer channels, the greater is the knowledge's transmission losses and the lower is the effectiveness and the efficiency of KT (Daft and Lengel, 1986; Feinberg and Gupta, 2004).

As tacit knowledge is a good that is difficult to make explicit, it is more 'sticky' than codified knowledge, it generally resides in individuals, and it is harder to transfer and reproduce (for an exhaustive survey, see Ambrosini and Bowman, 2001). Thus, the efficient sharing of tacit knowledge is typically characterized by tight coupling between people from different MNC units, and to enhance this transfer it is important that each people involved know each other beforehand (Bresman et al., 1999). Accordingly, both direct face-to-face interaction and mobility of knowledge carrying individuals across organizations are the most appropriate mechanisms for transferring tacit knowledge in an effective and efficient manner (Dhanaraj et al., 2004; Feinberg and Gupta, 2004; Gupta and Govindarajan, 2000; Hansen, 2002). Person-based mechanisms, such as inter-unit trips and visits, international committees, teams, task forces, and training – involving participants from multiple units – facilitate the development of interpersonal ties in the MNC, thus favoring KT (Björkman et al., 2004; Bresman et al., 1999; Ghoshal et al., 1994; Gupta and Govindarajan, 2000; Pedersen et al., 2003).

However, knowledge – in particular explicit knowledge – can also be transferred through written media as reports, publications, manuals, templates, and blueprints (Dhanaraj et al., 2004; Pedersen et al., 2003), as well as by ICT-based mechanisms (Howells, 1995; Sambharya et al., 2005). The role of ICT and their effects in KT have also been celebrated as fundamental in the international transfer of knowledge (Almeida et al., 2002; Andersen and Foss, 2005). Nevertheless, recent empirical evidence indicates that 'codified communication'

based on impersonal source such as publications and reports, database or firm's extensive intranet, is a much less effective way of transferring knowledge than the 'personal communication' (Buckley and Carter, 2004; Cross and Sproull, 2004). The transfer of knowledge through ICT and documents works only when supplemented by more complex mechanisms, such as frequent direct contacts between people belonging to the different MNC's units, that allow for the exchange of qualitative, indefinite, and uncertain knowledge, i.e. tacit knowledge (Almeida et al., 2003).

Electronic and written mechanisms can efficiently transfer codified knowledge about products, operations, tangible assets, and so on (Daum, 2003), and the transfer of such a knowledge mainly stimulates exploitation processes, increasing the overall efficiency in the receiving unit (Nonaka et al., 2001). However, ICT and written mechanisms do not allow for the additional transfer of tacit and experience-based knowledge critical to enhance new knowledge combinations. The 'rich' communication media may overcome the limits of electronic media (Daft and Lengel, 1986), and the more tacit knowledge transferred through them is expected to have a greater effect on the receiving unit's innovativeness. Thus, the following hypothesis can be formulated:

HP1: The effect of RKT on the parent company's innovative capacity is greater when the transfer occurs through person-based mechanisms (than through ICT and written media).

Foreign subsidiary's characteristics

Traditionally, firms' internationalization had been considered as mainly driven by the need of exploiting ownership advantages (Dunning and Narula, 1995) and/or accessing low cost resources and/or adapting existing products and processes to different demand and market conditions across locations. Over the last two decades, an active debate has focused on the idea that MNCs can undertake 'home base augmenting' (Kuemmerle, 1997) or 'competence creating' (Cantwell and Mudambi, 2005) investments, with the aim of accessing to new skills and competences. Accordingly, the subsidiary's role shifts from the simple adoption of technology transferred by the parent company to the creation and development of local competences complementary to the rest of the MNC (Bartlett and Ghoshal, 1989; Birkinshaw, 1996; Gupta and Govindarajan, 1991; Kuemmerle, 1997). While competence exploiting subsidiaries mainly refer to the adaptation of products and processes developed in the home countries to the local needs and production conditions, competence-creating subsidiaries possess richer knowledge, as they are instead more likely to generate and develop new

products and technologies that might become a valuable source of new knowledge for the parent company and the MNC as a whole (Cantwell, 1995; Pearce, 1999; Zander, 1999).

Therefore, we expect that the transfer of capabilities and skills affects the parent company's innovative capacity but its impact depends on the subsidiary's role. Specifically, the hypothesis sounds as follows:

HP2: The effect of RKT on the parent company's innovative capacity is greater when the relevant subsidiary has a competence-creating role.

The empirical literature and the international management research also suggest the subsidiary's autonomy degree as an influencing factor on KT within the MNC. On the one hand, relying on the 'information processing theory' (Egelhoff, 1988), it has been assumed that most of the MNC's organizational processes occur because they are mediated by the parent company. Accordingly, the central role of the parent company provides coordination and integration across foreign units, and KT occurs through the enforcement of hierarchical control over geographic dispersed subsidiaries (Ghoshal et al., 1994). When an excessive level of autonomy is granted to the subsidiary, the distance between the parent company and the subsidiary can increase, and reciprocal trust can be reduced, thus diminishing KT (Forsgren et al., 2000). Nevertheless, empirical research has failed to find support for the hypothesis suggested by this perspective (Ghoshal et al., 1994).

On the other hand, the 'differentiated network' concept (Bartlett and Ghoshal, 1989) suggests that centralization limits the subsidiary's initiative. In fact, a lower level of autonomy might reduce the subsidiary's initiatives in intra-group knowledge exchange (Cantwell and Mudambi, 2004; Tsai, 2002). Only when beliefs and values are shared between parent companies and subsidiaries, the propensity of the subsidiary's managers to transfer knowledge to the parent company can be high (Ghoshal et al., 1994). Consistently with the previous literature (Bartlett and Ghoshal, 1989; Birkinshaw, 1997; Castellani and Zanfei, 2006; Foss and Pedersen, 2002; Zanfei, 2000), we argue that the subsidiary's autonomy is a reliable indicator of the extent to which the subsidiary is organized to better tap into networks and local clusters, and to create an internal structure of incentives that is more conducive to creativity and innovation among local workers and managers. Limiting the extent of subsidiary autonomy reduces its ability to learn from the local system of innovation (Nobel and Birkinshaw, 1998), and to be attractive for qualified researchers (Criscuolo, 2004) thus preventing the generation of new knowledge. It can also be expected that subsidiaries with a higher degree of autonomy are more likely to gain a 'contributory role' (Birkinshaw et al.,

1998), i.e. they develop specialized resources that are potentially less duplicative vis-à-vis the knowledge stock of the rest of the corporation. Thus, when RKT occurs, the utilization of that knowledge is expected to create more valuable opportunities of knowledge re-combination. As RKT is concerned, the above considerations suggest the following hypothesis:

HP3: The effect of RKT on the parent company's innovative capacity is greater when the subsidiary has a higher degree of autonomy.

The literature has shown that the ability of MNC subsidiaries of generating own knowledge depends also on the localized knowledge sources (Cantwell et al., 2000). Therefore, their relationships with the local research centers become crucial for the knowledge creating processes, as well as their linkages with customers, competitors and local research institutions become central for upgrading existing products and for the introduction of new technologies (Pearce and Papanastassiou, 1999; Zander, 1999). Research has also highlighted that knowledge from customers, supply chain partners, lead users (Kyriakopoulos and de Ruyter, 2004; von Hippel, 1988), outside expert or consultants (Huber, 1991), and universities (Cohen et al., 2002), enhances novelty. Therefore, innovation is more likely to be stimulated in a context characterized by a wide range of specialized skills, capabilities, and knowledge (Cohen and Levinthal, 1990).

However, it has also been observed that close relationships with the local environment can also enhance capabilities that are too context-specific, and therefore are hardly applicable elsewhere in the MNC (Forsgren et al., 2000). Likewise, other empirical studies have shown that the more engaged a subsidiary is in absorbing external knowledge, the less resources it is likely to allocate to the interaction with the other MNC's units (Andersson, 2003; Forsgren, 1997).

Building on these arguments, we predict a connection between the extent of the subsidiary's embeddedness into the local context, and the probability of observing a positive impact of RKT on the parent company's innovative capacity. In other words, when interactions between the foreign subsidiary and local actors affect the generation of subsidiary's knowledge, we predict a positive impact on the parent company's innovativeness. Accordingly, the following hypothesis can be formulated:

HP4: The effect of RKT on the parent company's innovative capacity is greater when the subsidiary benefits from external relationships with local actors (suppliers, customers, universities, etc.)

RESEARCH DESIGN

Context of the Study

A review of the literature on KT within MNCs reveals that empirical studies are largely based on case studies (Bresman et al., 1999; Chakravarthy et al., 2003; Kuemmerle, 1997; Lyles and Dhanaraj, 2004; Schulz and Lloyd, 2001) or patent citation data (Almeida, 1996; Edwards et al., 2005; Frost, 2001; Frost and Zhou, 2000; Iwasa and Odagiri, 2004; Yamin and Otto, 2004). However, the latter has been recently criticized in accordance with the well known shortcomings of patents. Namely, most patents are not commercialized and they are widely acknowledged to be a partial indicator of the innovation process only, since many innovations are only partly covered by patent protection - or not patented at all (Klevorick et al., 1995; Levin et al., 1987). Therefore, knowledge flows identified by patent citations are only partially captured. Patents citations may also reflect technological similarities in technological profiles of different firms (Patel and Pavitt, 1997), rather than transfer of knowledge. Moreover, many of the citations in patents are added by the Patent Office, rather than by the patentee (Alcacer and Gittelman, 2006) and in those cases the citations in patents itself may say little about the importance of different knowledge flows. Finally, it can also be observed that patent analyses can only be applied in specific high technology intensive industries, where patents are used intensively.

Additionally, the international empirical literature has investigated only the largest MNCs, while small and medium-sized enterprises (SMEs) have increasingly become important actors within the “club” of the multinational investors (Acs and Yeung, 1999).

Based on the above considerations, we attempted to define the most appropriate research method to study a larger sample of Italian MNCs and address our research questions. As a first step, we relied on case studies in order to understand how parent firms develop and choose suitable organization structures for facilitating RKT, and how they value the use of the transferred knowledge. Specifically, we selected four Italian MNCs in medium and high technology intensive sectors (chemicals, biomedical, synthetic fibers, and automotive components) with both production and R&D facilities abroad.

According with our expectations, these firms were involved in RKT and they might represent a good benchmark in the subsequent analysis of the wider sample. We interviewed, through a structured questionnaire, the parent companies’ top managers, which are generally the founders of the company. Some peculiarities do emerge. First, with the exception of firms in the biomedical sector, secrecy is usually preferred to patents as a method of appropriability.

Secondly, knowledge has been transferred mainly through person-based mechanisms, database exchange, and ICT systems. Third, in several cases the RKT did not induce any substantial effect on the parent company's activities. Instead, the respondents emphasized the crucial role played by the subsidiaries in developing knowledge afterwards combined with the parent company's knowledge.

The descriptions of KT by the respondents helped us to become familiar with their terminology (how managers understand the concept of KT, what is knowledge for them, how knowledge is reused, and their interpretation of different mechanisms utilized for transferring knowledge), and to refine the questionnaire accordingly. At the end of this process we realized that a face to face structured interview should provide a deeper understanding of the phenomena under investigation, instead of a postal or an on-line survey. Taking into account these considerations and the information collected during the case studies, we proceeded in reviewing previous research to sharp our questionnaire and to choose, wherever possible, measures that would appropriately capture the constructs under study. Finally, we pre-tested the questionnaire for clarity and relevance with academics and some other parent companies' top managers.

Sample and Data Collection

Data has been collected through personal structured interviews at the parent company level, which allow us to evaluate the effects induced by RKT directly. The sample of parent companies to address was drawn from the database Reprint¹, which provides a census of foreign activities by the Italian firms, as at the beginning of 2004. Then, out of the population of 2,343 Italian MNCs operating into manufacturing industry, we contacted only those with at least one majority-owned subsidiary located in advanced countries and involved in "primary upstream activities" such as R&D and/or manufacturing. Additionally, we excluded the smallest Italian MNCs (less than 50 employees). Therefore, our population consisted of 358 Italian MNCs. A preliminary study of these firms through secondary data confirmed the predominance of family owned firms, and – as expected – that they are relatively small,

¹ The dataset Reprint is developed and yearly updated at Politecnico di Milano (see, Mariotti and Mutinelli, 2005). It provides a census of the Italian firms with foreign activities from the beginning of 1986 to the beginning of 2005, and the information available are the followings: (i) corporate name and address of the head office, for both the Italian parent companies and their foreign affiliates; (ii) the code of the industrial activity, and other relevant economic variables (the dimensional class in terms of employees and turnover) for the Italian parent companies; (iii) the year and the type of participation in each foreign affiliate participated by Italian firms (e.g. *greenfield* vs. acquisition, wholly/control/minority ownership).

although they are among the largest MNCs in Italy (324 MNCs out of 358 have less than 5,000 employees²).

We began the data collection process by contacting parent companies' top managers – variously titled as president, managing director, or general manager – by telephone and sending them a personalized letter with the description of the project, the assurances regarding the confidentiality of collected data, and a formal request for a personal interview. The interviews, which lasted 120-180 min each, were conducted in February-June 2005. Such a process allowed the construction of the RITMO (Research on Innovation and Technology in Multinational Organizations) database, that provides primary information on 84 Italian MNCs (corresponding to a response rate of about 24%), and their relevant 350 foreign subsidiaries³. More than half of the surveyed subsidiaries is located in Western Europe (55%), followed by North America (15%) and Eastern Europe (12%). These results are in line with the distribution of the aggregate amount of the Italian FDI as in 2004 (see, Mariotti and Mutinelli, 2005). The great majority (84%) of the subsidiaries have been created in the Nineties, mainly through acquisitions (58%). As far as the sectoral distribution of the sample, subsidiaries in 'scale intensive' sectors are predominant (55%); followed by subsidiaries in 'specialized suppliers' (22%), 'science based' (18%), and 'supplier dominated' sectors (5%), according with the characteristics of the Italian outward FDI.

Concerning non-response bias, we compared the two subsets of respondents and non-respondents in terms of size (class of number of employees), sectors, and area of location in Italy (see Table AI in the Appendix). Regarding size and parent company's location area, no statistically significant differences between respondents and non-respondents were found, the only exception being firms with 500-5,000 employees (that are overrepresented in our sample), and parent companies located in central regions (that are underrepresented). The two groups differ in terms of sector: our sample is overrepresented in science based and specialized supplier sectors, while it is underrepresented in traditional ones⁴.

For the scope of the present study, we focus on parent company-foreign subsidiary pairs in which RKT occurred. Specifically, we found that 162 single distinctive best practices were

² In detail, 27.4% of the sample consists of MNCs with 50-249 employees, 22.6% belongs to the 250-499 class, about 40.5% of the MNCs has between 500-5,000 employees, and only 9.5% has more than 5,000 employees.

³ We excluded subsidiaries that have only commercial scopes and financial holdings in order to reduce complexity to a manageable level. However, it should be observed that the sampled manufacturing subsidiaries often operate also in other functional area, such as marketing, logistic and distribution, and so on.

⁴ One reason for the small number of firms in the traditional sector could be that most of the contacted MNCs in that sector declared they do not consider RKT an important issue. That has prevented their interest in participating in the project.

transferred from 94 subsidiaries (corresponding to about the 26% of the total number of foreign subsidiaries) to their relevant 45 Italian MNEs.

During the interview, the respondents to the questionnaire were directed to search for transfer of distinctive best practices from each single foreign subsidiary to the parent company. Following previous approaches (e.g. Gupta and Govindarajan, 2000), we consider the use of a foreign subsidiary's set of know-how and capabilities by the parent company. These capabilities might relate to eight different business activities: R&D, manufacturing, marketing/sales, logistic/distribution, purchasing, human resource management, general management, and quality management. First, the respondents were asked to rate the extent to which the subsidiary knowledge has been of use to the parent company within the eight business activities (on a 7-point Likert scale, where 1 = 'not useful at all for the parent company' and 7 = 'very useful for the parent company'). Second, for each business activities with values greater than 1, we asked to list and describe the distinctive transferred practices. The sample contained both technological (for instance, product/process know-how, know-how about materials, design, etc.) and managerial best practices (for instance, quality management know-how, marketing strategies, managerial technique in production, etc.).

We performed the Harman's single-factor test (Harman, 1967; Jansen et al., 2005; Podsakoff and Organ, 1986) on items included in our econometric model to examine whether common method bias augmented relationships. If common-method bias exists in the data, a single factor will emerge from a factor analysis of all measurement items included in the study, or one general factor that accounts for most of the variance will result. The factor analyses reported good properties, thus supporting the validity of the data.

Qualitative Results

While the structured questionnaire was important for the availability of data for making empirical analyses based on statistical and econometric techniques, a crucial strength of the 'face-to-face survey' was the possibility to better understand the questionnaire's answers through clarifications, detailed information and examples provided by the respondents. Therefore, before presenting our econometric model and numerical results, it might be useful reviewing the most important findings from the 84 interviews.

The parent companies' top managers revealed that the majority of their foreign subsidiaries were established to gain a direct access to a strategic market. Accordingly, both their products and technological competences are often similar to the parent company's ones. In some cases foreign initiatives were important to gain an internal critical mass to specialize the R&D,

manufacturing and commercial facilities controlled over the world by the MNC, with the aim of rationalizing and specializing the group activities. Accordingly, foreign subsidiaries were crucial to activate substantial economies of scale, eliminate parallel or redundant indivisible activities, thus reducing the incidence of the overhead cost. An Italian-centric view seems to be quite diffused: foreign subsidiaries are not expected to generate knowledge superior to that already available at the parent company. There were also cases in which the foreign initiative has allowed to access to new products and/or technologies, but the extreme specialization did not favor the occurrence of KT processes.

However, we also observed cases in which the foreign subsidiaries play a crucial role within the MNCs. For example, a group of parent companies recognized that their new product design and manufacturing processes involve foreign subsidiaries in order to capitalize on differences in capabilities across units in different countries. The subsidiary's customers provide unique and specialized knowledge,⁵ their demands and needs are shared with the subsidiary's engineers and technicians through activities of co-design and co-project, their suggestions stimulate marketing and product development departments, resulting in incremental product innovation and continuous customization efforts. Especially in high technology intensive and specialized sectors, the respondents highlighted the crucial role of the foreign subsidiaries' researchers and engineers involved in basic research and cooperation with universities⁶.

If this is the case, the transfer of knowledge embedded in the subsidiary's activities benefits from connecting the central R&D laboratory to managerial and technical staff in the foreign company, through flexible control and communication mechanisms. In some cases, parent companies have also developed and implemented a business process database to be used in

⁵ Quoting the President of an MNC producing automotive components: "this greenfield initiative has been motivated essentially by the need to follow an important customer, recognising local customers as an important source of knowledge for innovation. On the one hand, the subsidiary's relationships with the local actors are crucial for monitoring and assimilating localised technology, as well as to better integrate subtler stimuli coming from co-operation with different customers and suppliers, external of us [the parent company]. On the other hand, subsidiary's knowledge used in managing and operating a business, such as new managerial skills, human resource management practices, and so on, is crucial for the adoption of new management techniques. We transfer best practices from the foreign subsidiaries (first of all from the U.S. and France units) through job rotation programs at the management level. This process allows the company to extract synergies from different management teams and to diffuse innovative organisational and management techniques within the MNC itself."

⁶ Some examples: in the biomedical instruments, one of the parent company interviewed, in 2003 counts more than 60 projects with universities, hospitals and research centres in Italy, France, Germany, Switzerland, Belgium, the UK and the U.S., in which were involved at least one foreign subsidiary; a parent company managers of a different MNC operating in the same sectors quotes that "that foreign subsidiary is at the centre of a large and well-established network of customers (hospital and clinics) and market leaders (cardiologists and surgeons), it has crucial projects with the local research centres and universities"; another parent company specialized in gear manufacturing equipment has established a crucial and stable relationships with an important German Technical University through its local subsidiary.

the parent-subsidiary relationship in order to facilitate global co-ordination and knowledge exchange. In other cases, informal mechanisms between high qualified personnel of both subsidiary and parent company are preferred. Integration teams, meeting within and between the functions of the two firms, and extensive face-to-face communication, are integral parts of the process by which the parent companies try to integrate the subsidiaries' knowledge and both the firms learn about each other's technology and processes. In order to augment knowledge flows, some parent companies hosted engineers and managers from the foreign subsidiaries for quite a long period . At the same time the parent companies also sent their managers and technical staff to help the subsidiary's employees with problems in marketing, engineering and manufacturing systems.

However, only a small number of MNCs has adopted a *formalized knowledge transfer process* based on specific managerial tools. In that case, the most common mechanisms consists of formal and periodical meetings of key persons (managers, researchers, technical staff) and/or the movement of a group of experts within the MNC to the different and dispersed foreign subsidiaries, in order to evaluate possible best practices that can be utilized elsewhere in the MNC. A substantial number of MNCs are only recently promoting knowledge flows through the support of systematic informal mechanisms, such as personal contacts among managers from different R&D and marketing functions of the MNC, temporary or permanent task force, job rotation programs, as well as corporate meetings and conferences.

ECONOMETRIC ANALYSIS

Measures

Dependent variable. As the phenomenon we want to study is the effectiveness of RKT – specifically its impact on the parent company's innovative performance (see also, Ambos et al., 2006), we asked the respondents to rate – on a 7-point Likert scale where 1 = 'no impact at all'; 7 = 'a very high positive impact' – the extent to which each best practice transferred from the subsidiary affected the parent company's ability of "developing new product" and of "developing new technology". The variable *innovativeness* takes the maximum value of the two items mentioned above (Cronbach's alpha = 0.924). It emerges that a substantial amount of foreign subsidiaries' best practices did not impact at all the innovative capacity of their parent companies (81 out of 162, corresponding to 50%). In about the 20% of cases (33 cases) the respondents indicated both a low impact (scores 2 and 3) and a medium (scores 4 and 5)

impact on the parent companies' innovativeness, while only 10.5% of the subsidiaries' knowledge strongly (scores 6 and 7) affected the parent companies' innovativeness.

Independent variables. As far as our explanatory variables are concerned, we rely on proxies for different mechanisms used for transferring knowledge and the subsidiary's capacity to generate valuable knowledge.

- Mechanisms for transferring knowledge. The questionnaire's respondents were asked to assign a relative percentage of use (summing up to 100%) to the following KT mechanisms: teamwork, managers' transfer, manual/database exchange and corporate intranet, reporting system. As far as the variables employed, the generic *KT-mechanism(j)* is defined as $\ln(p_{jk}/100 + 1)$, where p_{jk} is the percentage assigned to the mechanism j for transferring the best practice k . The variable *KT-mechanism(j)* equals zero if the mechanism j has not been used in the RKT process.

- Subsidiary's role. Respondents were asked to indicate whether 'the foreign subsidiary j has provided the MNC with: (i) new technology, and/or (ii) new product. Based on this information, we built two dummy variables: *strong competence creating* equals 1 when both the 2 items have been ticked; *weak competence creating* equals 1 when respondents ticked only one of the 2s. The baseline is the case when none of the 2 items has been ticked, that is the subsidiary has a competence-exploiting role.

- Subsidiary's autonomy. Respondents were asked to indicate the allocation of strategic decision-making. Specifically, we have detailed information on the following three firm's strategic decisions: (i) definition of R&D projects, planning, resources, etc.; (ii) introduction of new technologies; (iii) changes in products/services. Following the operationalization by Ghoshal et al. (1994), we used a five levels scale, where: (1) 'the parent company decides alone'; (2) 'the parent company decides but considers subsidiary inputs'; (3) 'both parent company and subsidiary have roughly equal influence on decision'; (4) 'the subsidiary decides, but considers parent company suggestions'; (5) 'the subsidiary decides alone'. The variable *autonomy* is the average of responses to the three items (Cronbach alpha = 0.793).

- Subsidiary's embeddedness in the local context. Respondents were asked to indicate whether local actors were important in the developing of the distinctive best practices possessed by the subsidiary, the local actors being: customers, universities or research centers, specific competitors, experts or consultants. Then, to reduce collinearity, we run a principal

component analysis for the four categories of local actors, thus obtaining two factors that we called *industrial context* and *research context* (see Table I).

Table I. Local context and subsidiary's knowledge development (Principal Component Analysis)

	<i>Industrial context</i>	<i>Research context</i>
Customers	0.679	0.170
University or research centers	0.269	0.900
Specific competitors	0.856	-0.042
Experts or consultants	0.727	-0.442
Eigenvalue	1.795	1.036
Cronbach's alpha	0.64	
Cumulative % of variance	70.76%	

Specifically, *industrial context* expresses the importance of the subsidiary's external relationships with local customers, competitors, and experts and consultants for developing its distinctive best practices; *research context* captures instead the role of local universities and research centers.

Control variables. Finally, to avoid picking up spurious effects, it is important to control for other likely predictors of the parent company's innovativeness. Namely, we considered the following factors.

- The type of the best practices involved in the transfer process. Specifically, based on the precise description of each competence given to us by the respondents, we defined the dummy variable *technological competence* that equals one if the transferred best practice is of technological nature instead of being of managerial nature. In our sample, of 162 best practices transferred from the foreign subsidiaries to the relevant parent companies, 94 are technical best practices and the 68 leftovers refer to managerial best practices. Intuitively, one can expect technological knowledge to show a higher impact on the parent's capacity to create distinctive products and services, through product and/or process innovation (Chakravarthy et al., 2003).
- The entry mode. Acquisitions and joint ventures have been recognized as a common way the MNC may adopt to access local resources, competences, skills, and precious links to the local environment (Bresman et al., 1999; Gupta and Govindarajan, 2000; Lyles and Dhanaraj, 2004). Even if the entry into a foreign market through a greenfield investment in a privileged centre of excellence may cause the subsidiary to enjoy positive externalities stemming from the interaction with other local actors, thus stimulating KT

over time (Holm and Pedersen, 2000), subsidiaries established through acquisitions or joint ventures are more likely to have a knowledge stock that is less duplicative vis-à-vis the knowledge stock of the rest of the corporation (Hennart and Park, 1993). In order to test the effect of the entry mode, we built two dummy variables: *acquisition* and *joint venture*.

- The age of the investment. The variable *FDI age* is the difference between 2005 (when the interviews were conducted) and the year when the subsidiary became a part of the Italian MNC.
- The industry-specific effects. As foreign subsidiaries operating in different industries face different technological opportunities to enhance knowledge creation and development, we control for the industry. Therefore, using the taxonomy developed by Pavitt (1984), we define the dummy *high-tech* that equals one if the subsidiary operates either in science-based or specialized suppliers sectors.
- The region-specific effects. We inserted the dummy variable *advarea* that equals one if the foreign subsidiary is located in an OECD⁷ country, and zero otherwise.

Table II shows descriptive statistics and the correlation matrix for all the explanatory variables.

⁷ Unfortunately our sample census only one FDI located in Japan.

Table II. Variables characteristics and correlation matrix

	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1 Team work	1.942	1.481														
2 Managers' transfer	1.399	1.507	-0.093													
3 Manual/Database- Corporate intranet	1.577	1.710	-0.017	0.262												
4 Reporting system	0.597	1.134	-0.386	-0.064	-0.101											
5 Strong competence creating	0.204	0.404	0.116	-0.290	-0.388	-0.087										
6 Weak competence creating	0.185	0.390	-0.172	-0.115	-0.164	0.159	-0.238									
7 Autonomy	2.298	0.731	0.146	0.062	-0.076	-0.175	0.234	0.014								
8 Industrial context	0.000	1.000	0.085	0.185	0.503	-0.270	-0.223	-0.169	0.028							
9 Research context	0.000	1.000	0.289	-0.098	0.104	-0.172	-0.035	0.026	0.108	-0.005						
10 High tech	0.315	0.466	0.039	-0.309	-0.273	0.344	0.415	0.237	0.031	-0.246	0.017					
11 FDI age	10.037	5.918	-0.192	-0.113	-0.119	-0.035	0.031	-0.041	-0.042	-0.077	-0.048	0.014				
12 Acquisition	0.481	0.501	0.249	-0.313	-0.556	0.132	0.376	0.101	0.140	-0.431	0.137	0.417	-0.101			
13 Joint venture	0.086	0.282	-0.058	-0.144	0.075	-0.097	-0.048	-0.087	-0.167	0.107	-0.102	-0.210	-0.080	-0.296		
14 Advarea	0.765	0.425	0.061	-0.415	-0.313	-0.021	0.277	0.218	0.016	-0.410	-0.007	0.277	0.266	0.405	-0.041	
15 Technological competence	0.580	0.495	0.117	0.337	0.124	0.001	0.123	-0.221	-0.022	0.267	0.155	0.042	-0.180	-0.088	-0.093	-0.437

Analysis

Given the nature of our dependent variable, i.e. the effect of RKT at the level of the single best practice on the parent company's innovative capacity, we use the Heckman selection model, a two stage procedure that corrects for problems of sample selection (Heckman, 1979). In fact, we want to estimate the intensity of the RKT impact on parent companies' *innovativeness*, but this is limited only to best practices that have influenced the parent company's ability of developing new products and processes (81 out of 162).

Heckman's (1979) two-step approach includes two equations. The first one (probit selection equation) predicts the likelihood of each best practice to affect or not the parent company's innovativeness:

$$k_i^* = \alpha'z_i + v_i \quad (1a)$$

The second equation is the central relationship we want to estimate, i.e. the extent of such an effect. Accordingly, for the selected sub-sample of best practices that influenced the parent company's innovative capacity (if $k_i^* = 1$), we tested the following Ordered Probit Model:

$$y_i^* = \beta'x_i + u_i \quad \text{where } y_i^*, \text{ as usual, is unobserved.} \quad (1b)$$

The dependent variable, y_i^* , is the level of the parent company's innovativeness induced by the use of each transferred subsidiaries' best practice, ranging from 2 (very low impact) to 7 (very high impact).

When the error terms v_i and u_i are significantly correlated (with $corr(v_i, u_i) = \rho$), standard regressions techniques applied to the equation (1b) alone can yield biased results, and it is therefore necessary to correct it (see, Greene, 2000). Heckman's (1979) two-step proposal is to estimate the so-called inverse Mills ratio:

$$\lambda(z_i'\alpha / \sigma_v) = \frac{\phi(-z_i'\alpha / \sigma_v)}{1 - \Phi(-z_i'\alpha / \sigma_v)}$$

using equation (1a), and then reformulate and estimate equation (1b) as follow:

$$y_i^* = \beta'x_i + \rho\sigma_u\lambda_i + \varepsilon_i$$

where the inverse Mills ratio terms are regressors along with \mathbf{X}_i , in order to observe unbiased estimates of the parameters.

Results

Results from the econometric estimations and the relevant marginal effects are reported in Table III and IV, respectively. In order to control for the heteroskedasticity, we use the Huber/White/sandwich estimator of variance. Likewise, we correct the estimated standard

errors and the variance-covariance matrix of the estimators by clustering on MNCs, i.e. the fact that the observations are independent across MNCs, but not necessarily within the MNC.

Table III. RKT effect on parent company innovative capacity (Two step Heckman model)

Variables	Probit selection equation		Ordered probit equation	
	<i>Dummy-Innovativeness</i>		<i>Innovativeness</i>	
Team work	-0.004	(0.144)	0.313**	(0.149)
Managers' transfer	-0.229	(0.144)	0.320**	(0.143)
Manual/Database- Corporate intranet	-0.173	(0.191)	0.277*	(0.165)
Reporting system	0.138	(0.207)	-0.156	(0.212)
Strong competence creating	-0.561	(0.655)	2.309***	(0.601)
Weak competence creating	-0.171	(0.552)	2.639***	(0.594)
Autonomy	-0.333	(0.259)	-0.176	(0.251)
Industrial context	0.197	(0.184)	0.365*	(0.188)
Research context	0.962***	(0.339)	-0.372	(0.302)
FDI age	0.081***	(0.026)	0.016	(0.029)
Acquisition	0.772*	(0.437)		
Joint venture	0.043	(0.376)		
High tech	0.290	(0.581)		
Advarea	-0.054	(0.263)		
Technological competence	1.719***	(0.381)		
Constant	-0.847	(1.002)		
Inverse Mills ratio			-0.935**	(0.453)
Observations	162		81	
Log pseudolikelihood	-58.542		-98.574	
Wald chi2	112.04***		63.18***	
Pseudo R2	0.479		0.264	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; two-tailed t-tests. Standard errors in parentheses.

Looking at the results of the Ordered Probit Model, the estimates obtained generally seem to confirm our hypotheses. In particular, as far as Hypothesis 1 is concerned: (a) variables related to the use of person-based mechanisms, *teamwork* and *managers' transfer*, are positive and statistically significant at $p < 0.05$; (b) the variable *reporting system* comes out to be not statistically significant at any conventional level; (c) the variable *manual/database exchange and corporate intranet* is positive and significant at $p < 0.1$, but its marginal effects on the dependent variable (see Table IV) are always about 10-15% lower than those induced by knowledge transferred through the person-based mechanisms.

Table IV. Marginal effects of independent variables on parent company's *Innovativeness*

	I=2	I=3	I=4	I=5	I=6	I=7
Team work	-0.058	-0.030	-0.036	0.060	0.054	0.010
Managers' transfer	-0.060	-0.031	-0.037	0.061	0.056	0.010
Manual/Database-Corporate intranet	-0.052	-0.027	-0.032	0.053	0.048	0.009
Reporting system	0.029	0.015	0.018	-0.030	-0.027	-0.005
Strong competence creating	-0.243	-0.138	-0.263	-0.043	0.370	0.317
Weak competence creating	-0.218	-0.134	-0.280	-0.163	0.321	0.475
Autonomy	0.033	0.017	0.020	-0.034	-0.031	-0.006
Industrial context	-0.068	-0.035	-0.042	0.070	0.064	0.012
Research context	0.069	0.036	0.043	-0.071	-0.065	-0.012

Considering the role of the foreign subsidiary, the coefficients of both the variables *strong competence creating* and *weak competence creating* come out positive and statistically significant ($p < 0.01$), thus supporting our second hypothesis, that is competence-creating subsidiaries are likely to possess high quality knowledge-based resources that contribute to increase the parent company's probability to develop new product and process.

As far as Hypothesis 3 is concerned, we do not find any support to the expected role of the subsidiary's autonomy. In fact, the coefficient of *autonomy* is negative and not significant at any conventional level. Such a result may be due – at least partially – to the fact that a high level of autonomy might increase the distance between the parent company and the subsidiary, thus constraining the circulation of knowledge within the MNC.

Considering the role of the subsidiary's embeddedness in the local context, the variable *industrial context* shows a positive and significant impact on the parent company's innovativeness ($p < 0.1$). The coefficient of the variable *research context* is positive and statistically significant ($p < 0.01$) in the selection equation, suggesting that the subsidiary's relationships with local university and research centers positively impact on the parent company's probability of innovating, although they do not affect the intensity of the parent company's innovativeness.

As far as the control variables are concerned, the transfer of technological knowledge and the use of best practices transferred from acquired subsidiaries increase the parent company's probability to develop new product and technology (the variables *technological knowledge* and *acquisition* come out positive and significant at $p < 0.01$ and $p < 0.1$, respectively in the selection equation). Likewise, the older FDI initiatives are more likely to increase the parent company's probability of innovating, as shown by the positive sign of the coefficient of the variable *FDI age* ($p < 0.01$) in the selection equation.

DISCUSSION

This study contributes to the research on the relationship between knowledge transfer and the MNC's ability to innovate. As far as we know, it is among the first attempts to: (i) explore empirically whether the occurrence of 'reverse knowledge transfer' (RKT), that is knowledge flows from the foreign subsidiary to the parent company, positively affects the latter's innovativeness, and (ii) evaluate if and how different organizational mechanisms, as well as the characteristics of the subsidiary, influence RKT and its impact on the parent company's innovativeness.

The empirical investigation has produced three key findings that we discuss in the next sections with regard to the implication for the theory and the management practice.

Implication for Theory

A first key finding is that the way of transferring knowledge affects the parent company's innovativeness, the latter being measured as the ability of developing new products and technologies. We found that when RKT occurs through person-based mechanisms, in particular through teamwork and transfer of managers, rather than through ICT and written media, it induces a greater impact on the parent company's innovativeness. By including the use of electronic and written media as possible transmission channels, we extend the previous literature on KT within MNCs (see, for instance Björkman et al., 2004; Gupta and Govindarajan, 2000). Our results also corroborate previous studies that have focused either on the role of tacit knowledge in innovation (notably, contributions within the resource based view of the firm), or on the relevance of the personnel contacts as transmission channels for tacit knowledge (notably, within the organizational behavior literature). In fact, previous work has suggested tacit knowledge as a crucial source of competitive advantage due to its characteristics in term of uniqueness, imperfect mobility, imperfect imitability, and non-substitutability (e.g. Wernerfelt, 1984). Other work has highlighted that for tacit knowledge to be exchanged, a close relationship between "the teacher" and "the student" is required (Daft and Lengel, 1986; Dhanaraj et al., 2004), because it is difficult to write down; it is personal knowledge; and attached to the knower.

A second key finding is that the ability of foreign subsidiaries to tap into the local context and to develop own competences through close relationships with the local actors impacts on the parent company's innovative capacity. While previous literature has investigated the conditions favoring or preventing the subsidiary embeddedness in the host country

(Andersson and Forsgren, 2000; Cohen and Levinthal, 1990), this is, to the best of our knowledge, one of the first studies providing empirical evidence on the benefits that the subsidiary's external relationships may add to the innovative outcomes of the parent company. Because there is reason to believe that a subsidiary's capability for developing such valuable external relationships will attract the recognition at the corporate management level, it could be expected that the parent company will assign a specific role and more responsibility to the subsidiary (Birkinshaw and Hood, 1998). This perception is also supported by our third key finding, showing that knowledge transferred from competence-creating subsidiaries is more likely to positively affect the parent company's likelihood of developing new products and processes.

Finally, this study also contributes to the empirical literature, as the hypotheses developed have been tested using a novel database – RITMO – created through personal interviews and gathering data on 84 Italian MNCs, and 350 relevant subsidiaries located in about 50 countries. The empirical analysis developed in the present paper relied on a sample of 162 distinctive best practices, developed in different business areas by foreign subsidiaries and transferred back to their parent companies. Given that the MNCs surveyed in RITMO vary in size, the data may offer a different perspective to the literature that too often addresses larger MNCs only. Such a perspective is becoming increasingly crucial, since in the most recent period, small and medium-sized companies have started to invest substantial resources abroad. It is also worth noting that while the majority of empirical works adopt a 'nodal' level of analysis, and that data are typically collected at the foreign subsidiary level, we conduct our examination with a 'dyadic' perspective, i.e. we examine KT within each pair of units (parent company and foreign subsidiary).

Implication for Practice

This study also offers potentially important messages to parent companies' managers. The results reveal which factors influence the effectiveness of RKT, thus offering some suggestions in designing and implementing specific organizational structures to govern the parent company-foreign subsidiary relationship. By identifying mechanisms for transferring knowledge and subsidiaries' characteristics favoring effectiveness of RKT, the primary practical implication of the present study is that parent companies can employ organizational mechanisms as a strategic choice for enhancing effective RKT. The empirical analyses presented in this paper showed that RKT that occurs through person-based mechanisms – in particular, teamwork and short-term two-ways transfer of managers – assures a positive effect

on the parent companies' innovativeness. However, although mechanisms mainly based on personal cross border interactions provide an immediate access to knowledge available somewhere within the MNC, they are also costly to maintain due to travel costs, availability of time, and differences in cultures and language. Therefore, managers should target those subsidiaries that are more likely to own valuable knowledge for the parent companies, that is competence creating subsidiaries.

Study Limitations

As usual, the study remains subject to certain limitations that need to be considered. First, the fact that the same person provided all the questionnaire's answers may entail potential general common method bias. We checked this issue running the Harman's single-factor test and we also tried to reduce this risk by submitting the questionnaire directly. However, given the limitation of self-reported data, the complexity, and multi-dimensional nature of the phenomenon under consideration, future research should observe not only the parent companies' perception of the effects induced by RKT, but also secondary measures and multiple respondents should be incorporated, if possible. We also acknowledge the shortcomings of using perceptual instruments to measure the occurrence of RKT and its effects on parent companies' innovative capacity, rather than more objective indicators such as innovation counts, R&D expenditure, and value of the knowledge accessed, which are unavailable in most cases.

Although this study analyzed RKT at the dyadic level, a superior approach would be an analysis at the 'systemic' level. The latter would allow us to study the occurrence of RKT and its effect on the receiving unit taking into account all of the multinational network relationships. It can also be noted that, like most social science models, some potentially important factors may have been omitted (for instance, corporate control mechanisms may have an effect on RKT and its effectiveness).

CONCLUSIONS

Do parent companies perceive the use of knowledge created and developed by their foreign subsidiaries as beneficial? We argue, overall, that depending on the characteristics of the knowledge transfer process, the development of new products and technologies of the parent company can benefit from the reuse and recombination of subsidiary's knowledge with the parent company's knowledge. Specifically, the effectiveness of the RKT process it is likely to be influenced by the type of the mechanisms utilized for transferring knowledge and by the

characteristics of the subsidiary and its relationship with the local context. Our findings suggest that parent companies' managers should increase the use of joint teamwork with their competence creating foreign subsidiaries and stimulate these firms to strongly interact with their local context. These results support recent developments in the International Business field, where the creative role of foreign subsidiaries is increasingly taken into account when assessing the competitive advantage of the MNC as a whole.

It may also be important to notice that the research questions addressed here shed some light on the importance of outward FDI as a means of technological catching up even for a developed country such as Italy. Indeed, multinational growth might be considered as a means to tap into the capabilities available in foreign countries that, at least partially, may help to overcome poor domestic innovative performance and lack of competitiveness.

REFERENCES

- Acs, Z. J., and Yeung, B. (1999). *Small and Medium-Size Enterprises in the Global Economy*. Michigan: The University of Michigan Press.
- Alcacer, J., and Gittelman, M. (2006). 'How do I know what you know? Patent examiners and the generation of patent citations'. Forthcoming in *Review of Economics and Statistics*.
- Almeida, P. (1996). 'Knowledge sourcing by foreign multinationals: patent citation analysis in the US semiconductor industry'. *Strategic Management Journal*, **17**, 155-65.
- Almeida, P., Anupama, P., and Grant, R. M. (2003). 'Innovation and knowledge management: scanning, sourcing, and integration'. In Easterby-Smith, M. and Lyles, M. A. (Eds.), *Handbook of Organizational Learning and Knowledge Management*. Padstow, Cornwall, UK: Blackwell Publishing Ltd, 356-71.
- 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*, **13**, 147-61.
- Ambos, T. C., Ambos, B., and Schlegelmilch, B. B. (2006). 'Learning from foreign subsidiaries: an empirical investigation of headquarters' benefit from reverse knowledge transfers'. *International Business Review*, **15**, 294-312.
- Ambrosini, V., and Bowman, C. (2001). 'Tacit knowledge: some suggestions for operationalization'. *Journal of Management Studies*, **38**, 811-29.
- Andersen, T. J., and Foss, N. J. (2005). 'Strategic opportunity and economic performance in multinational enterprises: The role and effects of information and communication technology'. *Journal of International Management*, **11**, 293-310.
- Andersson, U. (2003). 'Managing the transfer of capabilities within multinational corporations: the dual role of the subsidiary'. *Scandinavian Journal of Management*, **19**, 425-42.
- Andersson, U., and Forsgren, M. (2000). 'In search of centre of excellence: Network embeddedness and subsidiary roles in multinational corporations'. *Management International Review*, **40**, 329-50.
- Bartlett, C. A., and Ghoshal, S. (1989). *Managing Across Borders: the Transnational Solution*. Boston: Harvard Business School Press.
- Birkinshaw, J. (1996). 'How multinational subsidiary mandates are gained and lost'. *Journal of International Business Studies*, **27**, 467-96.
- Birkinshaw, J. (1997). 'Entrepreneurship in multinational corporations: The characteristics of subsidiary initiatives'. *Strategic Management Journal*, **18**, 207-29.
- Birkinshaw, J., and Hood, N. (1998). 'Multinational subsidiary evolution: Capability and charter change in foreign-owned subsidiary companies'. *Academy of Management Review*, **23**, 773-95.
- Birkinshaw, J., Hood, N., and Jonsson, S. (1998). 'Building firm-specific advantages in multinational corporations: the role of subsidiary initiative'. *Strategic Management Journal*, **9**, 221-41.
- Björkman, I., Barner-Rasmussen, W., and Li, L. (2004). 'Managing knowledge transfer in MNCs: the impact of headquarters control mechanisms'. *Journal of International Business Studies*, **35**, 443-55.

- Bresman, H., Birkinshaw, J., and Nobel, R. (1999). 'Knowledge transfer in international acquisitions'. *Journal of International Business Studies*, **30**, 439-62.
- Buckley, P. J., and Carter, M. J. (2004). 'A formal analysis of knowledge combination in multinational enterprises'. *Journal of International Business Studies*, **35**, 371-84.
- Cantwell, J. A. (1995). 'The globalisation of technology: what remains of the product cycle model?' *Cambridge Journal of Economics*, **19**, 155-74.
- Cantwell, J. A., Iammarino, S., and Noonan, C. (2000). 'Sticky places in slippery space: the location of innovation by MNCs in the European regions'. In Pain, N. (Ed.), *Inward Investment, Technological Change and Growth*. London: Macmillan.
- Cantwell, J. A., and Mudambi, R. (2004). 'Multinational enterprises and competence-creating knowledge flows: A theoretical analysis'. In Mahnke, V. and Pedersen, T. (Eds.), *Knowledge Flows, Governance and the Multinational Enterprise* New York: Palgrave Macmillan, 38-57.
- Cantwell, J. A., and Mudambi, R. (2005). 'MNE competence-creating subsidiary mandates'. *Strategic Management Journal*, **26**, 1109-28.
- Castellani, D., and Zanfei, A. (2006). *Multinational Firms, Innovation and Productivity*. Cheltenham: Edward Elgar.
- Chakravarthy, B., McEvily, S., Doz, Y., and Rau, D. (2003). 'Knowledge management and competitive advantage'. In Easterby-Smith, M. and Lyles, M. A. (Eds.), *Handbook of Organizational Learning and Knowledge Management*. Padstow, Cornwall, UK: Blackwell Publishing Ltd, 305-23.
- Cohen, W. M., and Levinthal, D. A. (1990). 'Absorptive capacity: A new perspective of learning and innovation'. *Administrative Science Quarterly*, **35**, 128-52.
- Cohen, W. M., Nelson, R. R., and Walsh, J. P. (2002). 'Links and impacts: The influence of public research on industrial R&D'. *Management Science*, **48**, 1-23.
- Criscuolo, P. (2004). 'R&D Internationalisation and knowledge transfer. Impact on MNEs and their home countries'. Doctoral dissertation, Merit.
- Cross, R., and Sproull, L. (2004). 'More than an answer: information relationships for actionable knowledge'. *Organization Science*, **15**, 446-62.
- Daft, R. L., and Lengel, R. H. (1986). 'Organizational information requirements, media richness and structural design'. *Management Science*, **32**, 554-71.
- Darr, E. D., Argote, L., and Epple, D. (1995). 'The acquisition, transfer and depreciation of knowledge in service organizations: productivity in franchises'. *Management Science*, **41**, 1750-62.
- Daum, J. H. (2003). *Intangible Assets and Value Creation*. Chichester: J. Wiley.
- Dhanaraj, C., Lyles, M. A., Steensma, K. H., and Tihanyi, L. (2004). 'Managing tacit and explicit knowledge transfer in IJVs: the role of relational embeddedness and the impact on performance'. *Journal of International Business Studies*, **35**, 428-42.
- Dunning, J. H., and Narula, R. (1995). 'The R&D activities of foreign firms in the United States'. *International Studies of Management and Organisation*, **25**, 39-73.
- Edwards, T., Almond, P., Clark, I., Colling, T., and Ferner, A. (2005). 'Reverse Diffusion in US Multinationals: Barriers from the American Business System'. *Journal of Management Studies*, **42**, 1263-86.

- Egelhoff, W. G. (1988). *Organizing the Multinational Enterprise: An Information-Processing Perspective*. Cambridge, MA: Ballinger.
- Feinberg, S. E., and Gupta, A. K. (2004). 'Knowledge spillovers and the assignment of R&D responsibilities to foreign subsidiaries'. *Strategic Management Journal*, **25**, 823-45.
- 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: Copenhagen Business School Press.
- Forsgren, M., Johanson, J., and Sharma, D. (2000). 'Development of MNC centres of excellence'. In Holm, U. and Pedersen, T. (Eds.), *The Emergence and Impact of MNC Centres of Excellence*. Basingstoke: MacMillan, 45-67.
- Foss, N. J., and Pedersen, T. (2002). 'Transferring knowledge in MNCs: the role of sources of subsidiary knowledge and organization context'. *Journal of International Management*, **8**, 49-67.
- Frost, T. (1998). 'The geographic sources of innovation in the multinational enterprise: U.S. subsidiaries and host country spillovers 1980-1990'. Doctoral dissertation, Massachusetts Institute of Technology, Boston.
- Frost, T. (2001). 'The geographic sources of foreign subsidiaries' innovations'. *Strategic Management Journal*, **22**, 101-23.
- Frost, T., and Zhou, C. (2000). 'The geography of foreign R&D within a host country'. *International Studies of Management and Organization*, **30**, 10-43.
- Ghoshal, S., Korine, H., and Szulanski, G. (1994). 'Interunit communication in multinational corporations'. *Management Science*, **40**, 96-110.
- Grant, R. M. (1996). 'Toward a knowledge-based theory of the firm'. *Strategic Management Journal*, **17**, 109-22.
- Greene, W. H. (2000). *Econometric Analysis*. Upper Saddle River, New Jersey: Prentice-Hall, Inc.
- Gupta, A. K., and Govindarajan, V. (1991). 'Knowledge flows and the structure of control within multinational corporations'. *Academy of Management Review*, **16**, 768-92.
- Gupta, A. K., and Govindarajan, V. (2000). 'Knowledge flows within multinational corporations'. *Strategic Management Journal*, **21** 473-96.
- Håkanson, L., and Nobel, R. (2000). 'Technology characteristics and reverse technology transfer'. *Management International Review*, **40**, 29-48.
- Hansen, M. T. (2002). 'Knowledge networks: explaining effective knowledge sharing in multiunit companies'. *Organization Science*, **13**, 232-48.
- Harman, H. H. (1967). *Modern Factor Analysis*. Chicago, IL: University of Chicago Press.
- Heckman, J. (1979). 'Sample selection bias as a specification error'. *Econometrica*, **47**, 153-61.
- Hedlund, G. (1986). 'The hypermodern MNC - A heterarchy?' *Human Resource Management*, **25**, 9-25.
- Hennart, J.-F., and Park, Y.-R. (1993). 'Greenfield vs. acquisitions: The strategy of Japanese investors in the United States'. *Management Science*, **39**, 1054-70.
- Holm, U., and Pedersen, T. (2000). *The Emergence and Impact of MNC Centres of Excellence*. Basingstoke: MacMillan.

- Howells, J. R. (1995). 'Going global: the use of ICT networks in research and development'. *Research Policy*, **24**, 169-84.
- Huber, G. P. (1991). 'Organizational learning: the contributing processes and a review of the literature'. *Organization Science*, **2**, 88-117.
- Iwasa, T., and Odagiri, H. (2004). 'Overseas R&D, knowledge sourcing, and patenting: an empirical studies of Japanese R&D investment in the US'. *Research Policy*, **33**, 807-28.
- Jansen, J. J. P., van de Bosch, F. A. J., and Volberda, H. W. (2005). 'Managing potential and realized absorptive capacity: how do organizational antecedents matter?' *Academy of Management Journal*, **48**, 999-1015.
- Klevorick, A. K., Levin, R. C., Nelson, R., and Winter, S. (1995). 'On the sources and significance of interindustry differences in technological opportunities'. *Research Policy*, **24**, 185-205.
- Kogut, B., and Zander, U. (1993). 'Knowledge of the Firm and the Evolutionary-Theory of the Multinational-Corporation'. *Journal of International Business Studies*, **24**, 625-45.
- Kuemmerle, W. T. J. (1997). 'Building effective R&D capabilities abroad'. *Harvard Business Review*, **75**, 61-70.
- Kyriakopoulos, K., and de Ruyter, K. (2004). 'Knowledge stocks and information flows in new product development'. *Journal of Management Studies*, **41**, 1469-98.
- Lane, P. J., Salk, J. E., and Lyles, M. A. (2001). 'Absorptive capacity, learning, and performance in international joint ventures'. *Strategic Management Journal*, **22**, 1139-61.
- Levin, R., Klevorick, A., Nelson, R., and Winter, S. (1987). 'Appropriating the returns from industrial research and development'. *Brookings Papers on Economic Activity*, **3**, 783-820.
- Lyles, M. A., and Dhanaraj, C. (2004). 'Organizational learning and international alliances'. In Mahnke, V. and Pedersen, T. (Eds.), *Knowledge Flows, Governance and the Multinational Enterprise*. New York: Palgrave Mcmillan.
- Mansfield, E. (1984). 'R&D and innovation: some empirical findings'. In Griliches, Z. (Ed.), *R&D, Patents and Productivity*. Chicago and London: The University of Chicago Press and NBER.
- Mariotti, S., and Mutinelli, M. (2005). *Italia Multinazionale 2004. La Partecipazioni Italiane all'Estero e Estere in Italia*. Soveria Mannelli: Rubbettino Editore.
- Nobel, R., and Birkinshaw, J. (1998). 'Innovation in multinational corporations: control and communication patterns in international R&D operations'. *Strategic Management Journal* **19**, 479-96.
- Nonaka, I., Reinmöller, P., and Toyama, R. (2001). 'Integrated information technology systems for knowledge creation'. In Dierkes, M., Berthoin-Antal, A., Child, J. and Nonaka, I. (Eds.), *Handbook of Organizational Learning and Knowledge*. Oxford University Press.
- Nonaka, I., and Takeuchi, H. (1995). *The Knowledge-Creating Company*. Oxford: Oxford University Press.
- Patel, P., and Pavitt, K. L. R. (1997). 'The technological competencies of the world's largest firms: complex and path dependent, but not much variety'. *Research Policy*, **26**, 141-56
- Pavitt, K. L. R. (1984). 'Sectoral patterns of technical change: towards a taxonomy and a theory'. *Research Policy*, **13**, 343-73.

- Pearce, R., and Papanastassiou, M. (1999). 'Overseas R&D and the strategic evolution of MNEs: evidence from laboratories in the UK'. *Research Policy*, **28**, 23-41.
- Pearce, R. D. (1999). 'The evolution of technology in multinational enterprises: the role of creative subsidiaries'. *International Business Review*, **8**, 125-48.
- Pedersen, T., Petersen, B., and Sharma, D. D. (2003). 'Knowledge transfer performance of multinational companies'. *Management International Review*, **43**, 69-90.
- Podsakoff, P. M., and Organ, D. W. (1986). 'Self-reports in organizational research: problems and prospects'. *Journal of Management*, **12**, 531-44.
- Polanyi, M. (1967). *The Tacit Dimension*. London: Routledge and Kegan Paul.
- Sambharya, R. B., Kumaraswamy, A., and Banerjee, S. (2005). 'Information technologies and the future of the multinational enterprise'. *Journal of International Management*, **11**, 143-61.
- Schulz, M., and Lloyd, J. A. (2001). 'Codification and tacitness as knowledge management strategies. An empirical exploration'. *The Journal of High Technology Management Research*, **12**, 139-65.
- Shenkar, O., and Li, J. (1999). 'Knowledge search in international cooperative ventures'. *Organization Science*, **10**, 134-43.
- Subramaniam, M., and Venkatraman, V. N. (2001). 'Determinants of transnational new product development capability: testing the influence of transferring and deploying tacit knowledge'. *Strategic Management Journal*, **22**, 359-78.
- Szulanski, G. (1996). 'Exploring internal stickiness: impediments to the transfer of best practice within the firm'. *Strategic Management Journal*, **17**, 27-43.
- Tsai, W. (2001). 'Knowledge transfer in interorganizational networks: effects of network position and absorptive capacity on business unit innovation and performance'. *Academy of Management Journal*, **44**, 996-1004.
- Tsai, W. (2002). 'Social structure of "coopetition" within a multiunit organization: coordination, competition, and intraorganizational knowledge sharing'. *Organization Science*, **13**, 179-90.
- Tsai, W., and Ghoshal, S. (1998). 'Social capital and value creation: the role of intrafirm networks'. *Academy of Management Journal*, **41**, 462-76.
- Von Glinow, M. A., and Teagarden, M. (1988). 'The transfer of human resource management technology in Sino-US cooperative ventures: problems and solutions'. *Human Resource Management*, **27**, 201-29.
- von Hippel, E. (1988). *The Sources of Innovation*. New York and Oxford: Oxford University Press.
- Wernerfelt, B. (1984). 'A resource-based view of the firm'. *Strategic Management Journal*, **5**, 171-80.
- Yamin, M., and Otto, J. (2004). 'Patterns of knowledge flows and MNE innovative performance'. *Journal of International Management*, **10**, 239-58.
- Zander, I. (1999). 'How do you mean global? An empirical investigation of innovation networks in the multinational corporations'. *Research Policy*, **28**, 195-213.
- Zanfei, A. (2000). 'Transnational firms and changing organisation of innovative activities'. *Cambridge Journal of Economics*, **24**, 515-54.

APPENDIX

Table AI. Sample's representativeness

	MNEs	Non Respondent	Respondent	χ^2 test
<i>Sectors</i>				
Science based	44	29	15	0.0757*
Specialized suppliers	65	42	23	0.0122**
Scale intensive	163	125	38	0.9765
Supplier dominated	86	78	8	0.0003***
<i>Size</i>				
50 – 249	98	80	18	0.1624
250 – 499	81	66	15	0.2325
500 – 5000	145	102	43	0.0225**
> 5000	34	26	8	0.9924
<i>Parent company's location area</i>				
North West	202	149	53	0.1587
North East	109	82	27	0.6994
Centre	40	36	4	0.0330**
South – Island	7	7	0	0.1390