KNOWLEDGE SHARING AND SOCIAL INTERACTION WITHIN MNCS

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ABSTRACT

Social interaction between managers from different units of a multinational corporation (MNC) has been shown to be an important factor stimulating intra-MNC knowledge sharing. Face-to-face social interactions form a communication channel particularly conducive to the transfer of tacit, non-codified knowledge. But intensive social interaction also provides opportunities for social construction of knowledge in a learning dialogue. The first (sender-receiver) explanation makes us expect social interaction to positively moderate the effects of the factors giving rise to knowledge flows in the first place, such as differences in capabilities between MNC subsidiaries. The second (social learning) perspective also grants an independent effect to social interaction as a main factor stimulating intra-MNC knowledge flows. We formulate hypotheses based on both perspectives, and test these on data from 169 MNC subsidiaries. Our findings show a considerable main effect of social interaction on all intra-MNC knowledge flows, confirming the expectations based on the social learning model. Interaction effects, based on the predictions of the sender-receiver model, are only partly confirmed. These findings suggest that future research should devote more attention to the social constitution of MNC knowledge.

INTRODUCTION

Recent studies of multinational corporations (MNCs) commonly conceptualize this type of firm as a network (Ghoshal & Bartlett 1990; Nohria & Ghoshal 1997; Rugman & Verbeke 2001). An important implication of the network view is that the hierarchical relationship between the center (headquarters or parent firm) and the periphery (subsidiaries or business units at various locations) is de-emphasized. Instead, the network MNC is seen as a "social community" (Kogut & Zander 1993) or a "heterarchy" (Hedlund 1986). Ghoshal & Bartlett (1990: 603) describe the MNC as "a group of geographically dispersed and goal disparate organizations that include its headquarters and the different national subsidiaries".

As the emphasis on authority relations within the MNC declines, attention to knowledge flows increases. Knowledge is an important, if not the most important strategic resource of firms (Grant 1996; McEvily & Chakravarthy 2002; Szulanski 1996), and the ability to share knowledge between units of the organization is an important basis of competitive advantage of firms (Argote & Ingram 2000; Nonaka & Takeuchi 1995). The ability to share knowledge across national borders is the prime reason behind the formation of MNCs (Gupta & Govindarajan 1994). Within the MNC network, knowledge may be created in one location, and put to productive use in many other locations (McCann & Mudambi 2005; Mudambi & Navarra 2004). The MNC as an organizational form arises, according to this view, because of its "superior efficiency as an organizational vehicle by which to transfer … knowledge across borders" (Kogut & Zander 1993: 625; see also Almeida *et al*. 2002; Reagans & McEvily 2003). It is the "synthesis" of knowledge originating in diverse locations that is seen to be the prime source of MNC innovation (Buckley & Carter 1996; see also Håkanson & Nobel 2001).

Detailed practical examples of knowledge transfer within an MNC can be found in Bélanger *et al*.'s (1999) book on ABB's power transformer business. This study illustrates how in some cases peripheral units try to catch up by learning from the MNC center, while in other cases lateral learning relationships form, "not imposed and not even organized by corporate headquarters" (p. 253). These authors also note that in several cases the initial roles are reversed, as "former teachers have to become pupils" (p. 11).

Acknowledgement of the importance of knowledge sharing within the MNC has led to a number of studies of the factors promoting or impeding intra-MNC knowledge flows. One factor that has

repeatedly come out as conducive to intra-MNC knowledge sharing is what we in this paper call "social interaction". Björkman *et al*. (2004), for instance, found that interunit trips and visits, international committees, teams and task forces, and training involving teams from multiple units, positively influence knowledge outflows from a focal subsidiary. Persson (2006) found positive influences of liaison mechanisms and temporary teams with members from different subsidiaries on knowledge flows between subsidiaries. Schultz (2003) looked at knowledge inflows (both vertical and lateral) at a focal subsidiary, and found that informal relations between the units have a positive effect. Subramaniam & Venkatraman (2001) discovered that cross-national teams positively influence cross-border knowledge flows. In all cases the informal, face-to-face nature of the social interactions promoted by the focal mechanisms stands out.

Although the conclusion that social interaction endorses intra-MNC knowledge flows appears to be inescapable, from a theoretical perspective an independent positive effect of social interaction on intra-MNC knowledge flows is far from self-evident. Many studies in this field employ a "sender-receiver" model rooted in general information and communication theories (Carlile 2004). In this view social interaction serves as an efficient conduit for knowledge transfer, a "channel" with the requisite "bandwidth" to transmit complex, context-dependent knowledge. However, the existence of a channel or pipeline can in itself never explain the flows it accommodates. In the logic of the model other factors need to exist that lead to knowledge flows, and a communication channel can only positively moderate the effects of these underlying factors.

In this paper we look at the influence of social interaction on knowledge sharing within the MNC from both the perspective of the sender-receiver model and the perspective of social learning. We argue that in the logic of the sender-receiver approach there is only limited ground for assuming that social interaction has an independent effect on intra-MNC knowledge flows. We would rather expect social interaction to strengthen the effects of other variables that may be assumed to motivate knowledge flows in the first place, such as the relative superiority of the capabilities of the sending subsidiary, or the relative needs of the receiving subsidiary. Assuming the perspective of social learning theory, in contrast, gives more scope for discussing an independent role of social interaction. Social learning theory does not deny the role of senders, receivers and channels in knowledge flows, but emphasizes that the knowledge shared between partners is likely to have a tacit dimension to it (Brown & Duguid 2001). Tacit knowledge "cannot be 'captured', 'converted' or 'transferred', but only displayed and manifested, in what we do" (Tsoukas 2003: 410). The metaphor of knowledge "flows" should consequently not be taken too literally: knowledge, at least the tacit dimension of it, does not so much flow from one individual or unit to another, as it is shared in a social process of mutual engagement (Elkjaer 2003). Tacit knowledge needs to be disembedded, translated, interpreted and integrated in order for learning to occur (Becker-Ritterspach 2006). This is possible only in a dialogue in which both parties assume the roles of sender as well as receiver. Hence social interaction assumes a much more important role: instead of being a "pipeline" for the transfer of knowledge produced at one location and consumed at another, it forms an important condition for the possibility of knowledge sharing and integration.

In developing our ideas about social interaction and intra-MNC knowledge streams, we assume a subsidiary perspective— looking at knowledge flows into and out of a focal subsidiary (for this perspective see, e.g., the various contributions in Birkinshaw & Hood 1998). The subsidiary perspective is important, as subsidiaries in network-type MNCs may play very different roles (Birkinshaw & Hood 1998; Ghoshal & Nohria 1989; 1993; Nohria & Ghoshal 1994; Harzing & Noorderhaven 2006), and may consequently also have very different kinds of knowledge inflows and outflows. We decompose knowledge flows into four categories, depending on the direction (*to* versus *from* the focal subsidiary) and on the sender/recipient (the MNC parent firm or another MNC subsidiary). It is important not to treat knowledge streams as a single composite variable, but to acknowledge role differentiation between subsidiaries (Gupta & Govindarajan 1991) that may be associated with differences in inflows, outflows, or both.

We develop hypotheses regarding the influence of social interaction on knowledge flows within MNCs from the perspectives of both the sender-receiver model and social learning theory. We focus on the role of factors such as social interaction, workflow integration, subsidiary capabilities and subsidiary autonomy in knowledge sharing within MNCs. We test our hypotheses on survey data from 169 MNC subsidiaries. Instead of looking only at one particular component of intra-MNC knowledge

flows, such as knowledge flows from subsidiaries to the parent firm (e.g., Ambos *et al*. 2006) or knowledge outflows from one subsidiary to another (e.g., Persson 2006), we investigate knowledge inflows and outflows to/from the parent firm and to/from other subsidiaries simultaneously.

The next section of the paper discusses the sender-receiver model and social learning theory, and develops hypotheses regarding knowledge inflows and outflows to/from a focal MNC subsidiary, both in relations with the MNC parent firm and in the relations with other subsidiaries. The third section describes our dataset and methods of analysis. Subsequently we present our findings in the fourth section, and close with a discussion and conclusions in the fifth section.

THEORY AND HYPOTHESES

As indicated above, we distinguish two perspectives on intra-MNC knowledge flows. The first perspective, the sender-receiver model, was introduced to the study of intra-MNC knowledge flows by Gupta & Govindarajan (1991; 2000). The social learning perspective in the study of intra-MNC knowledge flows is exemplified by Kogut & Zander (1996). Below we first define the way in which we use the concept of "knowledge" in this paper. After that we briefly discuss the two perspectives, and subsequently develop hypotheses regarding intra-MNC knowledge flows on the basis of a combination and confrontation of the two views.

The Concept of Knowledge

Regarding the concept of "knowledge", we adopt the definition of Davenport & Prusak (1998: 5):

> *Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms.*

This definition draws our attention to the co-existence of more explicit and codified, and more tacit and uncodified forms of knowledge. Any study of intrafirm knowledge flows must take the distinction between these different types of knowledge into account. Non-codifiable and tacit knowledge is not easy to transmit within a firm, let alone across national boundaries within an MNC. Codified and explicit knowledge can be transferred more easily, within as well as across organizational and national boundaries (Kogut & Zander 1993). The distinction between the different types of knowledge is important not only because the internal transmission of know-how is one of the *raisons d'être* of MNCs (Kogut & Zander 1993). It also should be taken into account because information flows within the MNC also comprise routine orders (e.g., from headquarters to subsidiaries) and reports (e.g., from subsidiaries to headquarters). These flows of "declarative knowledge" (Harvey & Anderson 1996) are closely tied to the formal organization. Know-how, in contrast, is a form of "procedural knowledge" (Anderson 1983): the knowledge about how to do something, which may plausibly be assumed to be associated to other internal mechanisms than declarative knowledge. Our discussion of intra-MNC knowledge streams focuses on procedural knowledge, which always has a tacit dimension to it (Brown & Duguid 2001), while the explicit elements represent no more than the "tip of the iceberg" (Nonaka & Takeuchi 1995).

The Sender-Receiver Model

The sender-receiver model is adopted by many studies of intra-MNC knowledge flows, albeit often implicitly (see, e.g., Adler & Hashai, 2007). Szulanski (2000: 11) observes that "the signaling metaphor …. informs most of the actual research in knowledge transfer. This metaphor specifies the basic elements of a transfer: source, channel, message, recipient, and context". The roots of this perspective lie in the information-processing approach in organization theory (Egelhoff 1993; Galbraith 1973; Lawrence & Lorsch 1967), which in turn has its basis in more general communication and information theories (Carlile 2004). Publications in this stream of research typically focus on one or more of the following factors: characteristics of the sender unit, characteristics of the receiving unit,

characteristics of the relationship between sender and receiver, and characteristics of the knowledge transferred.

Regarding characteristics of the sender unit, the most important assumption is that the sender needs to be relatively well endowed with knowledge. Foss & Pedersen (2002), for instance, consider three sources of transferable knowledge at the subsidiary level: investments in internal knowledge production, knowledge based in direct linkages to local players, and knowledge based in more diffuse linkages to sources of knowledge in their environment. The authors find that the presence of each of the three types of knowledge does indeed positively influence knowledge transfer from the focal subsidiary to other MNC units. With regard to characteristics of the receiving unit, the receiver must be able to absorb the knowledge transmitted by the sender. Tsai (2001) uses R&D intensity of business units as a proxy for absorptive capacity, and finds that absorptive capacity has positive independent as well as moderating effects on the units' rate of innovation and profitability. Minbaeva *et al*. (2003) distinguish between an ability-based and a motivation-based dimension of subsidiary absorptive capacity, and find positive effects of both factors. Gupta & Govindarajan (2000) focus, among other things, on the richness of transmission channels between sender and receiver. They find significant positive effects of both formal and informal integrative mechanisms. Regarding the characteristics of the knowledge transferred, Dhanaraj *et al*. (2004) compare the flow of tacit and explicit knowledge between a parent firm and an international joint venture. These authors find that trust between parent firms and international joint ventures is significantly more important for the transfer of tacit knowledge than for that of explicit knowledge. This finding, pertaining to both characteristics of the knowledge transferred and characteristics of the relationship between the focal units, echoes the findings of an earlier study by Hansen (2002), who found that direct relationships (distinguished from indirect relationships) between units were conducive for the transfer of non-codified knowledge, but not for the transfer of codified knowledge.

The examples given above indicate that the sender-receiver model, taken broadly, has generated a stream of research leading to interesting findings. Nevertheless, Becker-Ritterspach (2006: 360) criticizes this approach, precisely because of the focus on flows of knowledge, "where knowledge assumes almost liquid-like properties, and different viscosities or different characteristics of pipelines and storage facilities determine flows". This author stresses that more attention needs to be paid to "what happens to the knowledge as well as receiving contexts when knowledge is transferred and integrated into a new social (societal–organizational) environment" (Becker-Ritterspach 2006: 360).

In the context of this paper the role of social interaction, as emphasized by, e.g., Gupta & Govindarajan (2000), is important. As indicated in the Introduction, we believe that the logic of the sender-receiver model points in the direction of a moderating, but not a main effect of communication channels such as social interaction. Although the importance of social interaction for knowledge sharing appears to be generally accepted, we think it is important to analytically separate main effects from moderating effects.

The Social Learning Approach

In the "hydraulic" perspective of the sender-receiver approach, knowledge will flow (under certain conditions) from units that are relatively knowledge-rich to units that are relatively knowledge-poor. Although intuitively appealing, this idea may also be misleading. We can speak of knowledge "flows" only metaphorically. The image of knowledge flowing from one individual or unit to another does insufficient justice to the inherently social nature of the process. For a better understanding of this, we must turn to social learning theory.

The aim of this section is not to provide an overview of the vast and rapidly expanding literature on social learning, but rather to discuss briefly some aspects of social learning theory that may be assumed to have implications for our view on intra-MNC knowledge flows. A first and obvious observation is that, in social learning theory, learning occurs and knowledge is created through conversations and interactions between people (Easterby-Smith *et al*. 2000). Unlike the sender-receiver approach, social learning theory explicitly emphasizes that knowledge is not an object that is "passed physically from one to another" (Dewey, quoted in Plaskoff 2003: 163). Rather, knowledge "is socially constructed through collaborative efforts with common objectives or by dialectically opposing different perspectives in dialogic interaction" (Plaskoff 2003: 163). With regard to intra-

MNC knowledge flows, this means that in the view of social learning theory such "flows" will be possible only where individuals working in different units of the MNC engage in social interaction.

This implication for intra-MNC knowledge flows is strengthened by the focus in social learning theory on the tacit component of knowledge. Van Baalen *et al*. (2005: 301) identify two different views on the relationship between explicit and tacit knowledge. On the one hand, authors such as Nonaka & Takeuchi (1995) endorse a "near tangible view", according to which explicit and tacit knowledge can — under certain conditions — be converted to each other. In contrast, the more radical "distributed view", as formulated for instance by Tsoukas (2003), states that tacitness is an aspect of all knowledge, and that this can never be made completely explicit. Adoption of this view implies that the "procedural knowledge" (Anderson 1983) on which we focus in this paper will be assumed to be largely tacit, and transfer (learning) takes place through "observation and emulation of skilled practitioners and socialization" (Easterby-Smith & Araujo 1999: 5). Hence, knowledge transfer necessitates quite intensive (face-to-face) interaction and cooperation.

Third, social learning theory accentuates the situated and contextual nature of knowledge and learning (Fox 2000; Plaskoff 2003). Knowledge is strongly tied to activities or practices, outside of which it has little relevance. Learning occurs where individuals are engaged jointly in a shared activity. This is the essence of a "community of practice" (Fox 2000). Communities of practice encompass individuals working closely together to accomplish certain tasks (Wenger 1998). The shared practice in which the members of such a community engage may be seen as a sort of rail along which tacit knowledge travels (Fox 2000; Fineman 2003). With regard to intra-MNC knowledge flows, these flows are thus to be expected predominantly where individuals from different MNC units are engaged in shared practices (i.e., where there is strong operational integration between units).

While the social learning perspective is not diametrically opposed to the sender-receiver approach, there are important differences. We see these two approaches as partly complementary, partly competitive. The social learning approach enriches the sender-receiver model, which has been used in many of the previous studies of intra-MNC knowledge flows. But social learning theory also leads to expectations that are at odds with what we might expect from a sender-receiver perspective. In developing hypotheses with regard to intra-MNC knowledge flows, we specifically focus on social interaction between a focal subsidiary and other parts of the MNC, the integration within the MNC of the focal subsidiary in terms of workflows, and the level of capabilities and the extent of autonomy of the focal subsidiary. The sender-receiver model leads us to expect that factors such as the relative capabilities of a subsidiary, its level of autonomy and its integration in intra-MNC workflows are the main factors promoting or impeding knowledge flows, moderated by the existence of the requisite communication channels (social interactions). Social learning theory, on the other hand, provides us with arguments to expect social interaction to be knowledge-generating factor, and hence an independent factor causing knowledge flows.

Development of Hypotheses

In this section we will discuss the influence of a number of factors on intra-MNC knowledge flows, focusing in particular on social interaction. We have mentioned earlier, and substantiate below, that findings from previous studies posit social interaction between parts of MNCs as an important variable explaining intra-MNC knowledge flows. In addition to social interaction we focus on three other factors that we hypothesize to influence intra-MNC knowledge flows, directly as well as in conjunction with social interaction: workflow integration, subsidiary capabilities, and subsidiary autonomy. Although we do not pretend that our explanation on the basis of these factors is complete, we do believe that these variables play a crucial role. Workflow integration we see as an important factor because it makes it more likely that knowledge shared between two units is relevant to the operational processes of these units (Schultz, 2003). Subsidiary capabilities are important because they relate to the stratification of knowledge stocks that needs to be taken into account in explaining knowledge flows (Foss & Pedersen, 2004). Subsidiary autonomy, finally, we consider to be important because if subsidiaries are managed less hierarchically (as in the networked MNC) this may positively influence a subsidiary's competitiveness and local knowledge base (Birkinshaw *et al*., 1998; Foss & Pedersen, 2002), but at the same time make effective knowledge sharing with other parts of the MNC less likely.

Social interaction intensity. It has often been argued that social interaction and communication facilitate knowledge flows within MNCs. Ghoshal & Bartlett (1988) stated that inter-unit communication density facilitates the movement of knowledge. Gupta & Govindarajan (1994) also found that the use of lateral integration mechanisms (liaison personnel, temporary taskforces, and permanent teams that coordinate with sister subsidiaries) and the intensity of both corporate-subsidiary and inter-subsidiary communication are important predictors of knowledge outflows and inflows at the subsidiary level. In their study published in 2000, the same authors find that corporate socialization mechanisms influence the knowledge inflows and outflows, both to/from headquarters and with other subsidiaries (Gupta & Govindarajan 2000). Hansen *et al*. (2005) argue that frequent and intense interactions increase the exposure to the views and skills of other subsidiaries, thereby reducing negative perceptions. Apparently, rich communication media allowing for face-to-face communication, informal interaction, and teamwork help to overcome the "transmission losses" that occur during the transfer of complex procedural knowledge (Mudambi 2002, see also Björkman *et al*., 2004, Tsai, 2001, and Tsai & Ghoshal, 1998). Direct, face-to-face interaction has two desirable characteristics: "bandwidth" and "synchrony". *Bandwidth* refers to the ability to convey non-verbal and visual cues (Short *et al*. 1976; Daft & Lengel 1986); *synchrony* refers to the ability to provide and receive immediate feedback (Kraut *et al*. 2002). For reasons of bandwidth and synchrony, face-to-face communication remains the "gold standard" (Rice 1993) when tacit, non-codified knowledge needs to be transferred, in spite of the development of new communication technologies (Barner-Rasmussen & Björkman 2005; Nadler *et al*. 2003; Urry 2003).

Direct face-to-face contacts between members of different MNC units can be stimulated in various ways. Barner-Rasmussen & Björkman (2005) found the intensity of inter-unit communication within MNCs to be related to participation in corporate training programs. Ghoshal *et al*. (1994) found subsidiary employees to engage in inter-unit communication more frequently the more time they spent in inter-unit committees, teams, taskforces, meetings, conferences, and at world headquarters. Ghoshal *et al*. (1994) also found that interpersonal relationships that are developed through lateral networking mechanisms such as joint work in teams, taskforces, and meetings have positive effects on the frequency of both subsidiary-headquarter- and inter-subsidiary communications. Bresman *et al*. (1999) point to the importance of "protracted modes of interaction" (technical meetings, extended visits and joint training programs) for the transfer of knowledge between units. Ghoshal & Bartlett's (1988) concept of "normative integration" is associated with practices such as "extensive travel and transfer of managers between the headquarters and the subsidiary" and "joint-work in teams, taskforces, and committees" (Ghoshal & Bartlett 1988: 371).

We refer to the various forms of communication within the MNC described above as "social interaction". Importantly, however, the argument that this factor has an independent (main) effect on intra-MNC knowledge flows cannot credibly be based on the logic of the sender-receiver model. In the sender-receiver approach social interaction is a factor influencing the "bandwidth" of the channel for knowledge flows between units, but nothing will flow through the channel unless for instance one of the units has superior capabilities or unless the units need to share knowledge because of for instance operational interdependency.

In contrast to the sender-receiver approach, the perspective of social learning theory does allow us to argue that social interaction should indeed be seen as more than a moderating factor for intra-MNC knowledge flows. In the Introduction we quoted Plaskoff's (2003: 163) assertion that knowledge "is socially constructed through collaborative efforts with common objectives or by dialectically opposing different perspectives in dialogic interaction". To the extent that knowledge is indeed socially constructed, social interaction should be seen not primarily as a means for transferring existing knowledge, but rather as a necessary condition for the social production of knowledge. This is the essence of the communities-of-practice view (Lave & Wenger 1993). The knowledge developed in social communities is "collective knowledge, shared sense making and distributed understanding that doesn't reduce to the content of individual heads" (Brown & Duguid 1998: 96). Social learning theory posits that social cohesion around a relationship affects the willingness and motivation of individuals to invest time, energy and effort in sharing knowledge with others (Reagans & McEvilly 2003). Brown & Duguid (2000) refer to the role of "face-to-face communities" in learning processes. The existence of such communities is predicated on direct contact between members. In order to be useful to others, knowledge has to be disembedded from the local situation, translated so that it is

understandable to the receiver, interpreted by the receiver, and adapted to local practices (Becker-Ritterspach 2006; Zander 1991). The result is the occurrence of a learning dialogue and reciprocal knowledge transfer (Adenfelt & Lagerström 2006; Bresman *et al*. 1999). Taken to the extreme, this view implies that there will be no knowledge to transfer if there is no social interaction.

This discussion illuminates a fault line between the sender-receiver approach and social learning theory. The sender-receiver model cannot predict the central role given to social interaction in social learning theory. Hence our first hypothesis is based in social learning theory, but not in the sender-receiver approach:

Hypothesis 1: Social interaction between a subsidiary and other parts of the MNC will be positively related to knowledge exchange (inflows as well as outflows).

Hypothesis 1 is our baseline hypothesis, i.e., we strongly expect this hypothesis to be confirmed, and such a confirmation will not in itself form a contribution to the knowledge of the factors influencing intra-MNC knowledge flows. But we need to posit and test this hypothesis for two reasons: to explicitly distinguish between the expectations based in sender-receiver logic and those based in social learning theory, and to provide us with a backdrop against which we can formulate and test predictions with regard to the contingent effects of social interaction.

Workflow integration. Our next hypothesis pertains to the relation between knowledge exchange between MNC units and their operational integration. Foss & Pedersen (2002) argued that inter-subsidiary trade stimulates attempts to interactively solve problems and hence transfer knowledge, and they do indeed find a positive effect of interdependence between the focal subsidiary and the MNC and intra-MNC trade on knowledge flows. Likewise, in a study of subsidiaries of Swedish MNCs, Persson (2006) finds that product flows are positively related to knowledge flows. From the point of view of the sender-receiver perspective, the effect of workflow integration would be mainly a motivational effect: both sender and receiver are likely to be more motivated to share knowledge to the extent that this knowledge is more strongly tied to their operational processes, and thus more relevant (see Schultz, 2003).

As mentioned earlier, the social learning literature states that learning is not an isolated process, but is tied to ongoing activities and practices (Fox 2000). Learning and working go hand-in-hand (Brown & Duguid 1991). This suggests that knowledge sharing is most likely between MNC units that are connected through operational practices: "knowledge leaks in the direction of shared practice, it sticks where practice is not shared" (Brown & Duguid 2001: 207). Previous studies of MNCs and other multi-unit firms have argued that similarity in knowledge content among business units is a prerequisite for effective knowledge sharing (see, e.g., Farjoun 1998). While interdependency between units can take various forms, the intensity of physical flows between parts of the MNC has been argued to be the most important indicator of multinational integration (Bartlett & Ghoshal 1987). This would presumably be linked to inter-unit relationships in other dimensions, including knowledge flows (Egelhoff *et al*. 2003). We define workflow integration as the extent to which material inflows and outflows from a focal subsidiary originate from or are destined for other parts of the MNC. These material flows consist of parts, semi-manifactured articles, and/or finished products.

To be sure, it is entirely possible that two MNC subsidiaries are linked by high material flow dependencies while not exchanging knowledge (other than declarative knowledge).[i] One subsidiary could for instance be a sales subsidiary that receives 100 percent of its material inputs from a production subsidiary. In this case low (or absent) flows of procedural knowledge could co-exist with very high levels of operational workflow dependency. In our empirical analysis we will control for this possibility to some extent by including an indicator of the breadth of activities (sales, marketing, assembly, production, etc.) the focal subsidiary engages in.

Hypothesis 2a: MNC subsidiaries will engage in more knowledge exchange (inflows as well as outflows) with those parts of the MNC with which they have more strongly integrated work processes.

Regarding the combined influence of social interaction and workflow integration, both the sender-receiver perspective and social learning theory make us expect a positive interaction effect. If stronger workflow integration motivates MNC units to share knowledge, social interaction will enable them to do so more effectively. In the logic of the social learning approach operational interdependence and social interaction are strongly linked. To the extent that two units are engaged in shared or interrelated practices, social interaction between them can be expected to have a more positive effect on knowledge sharing. Hence:

Hypothesis 2b: The positive effect of social interaction on intra-MNC knowledge flows will be stronger for subsidiaries connected by strong workflow integration.

Subsidiary capabilities. Social learning theory frequently refers to the master-apprentice relationship (Fox 2000). Apprentices participate in the practice under the guidance of the more experienced masters. In the constantly emerging structure of the community of practice formed by masters and apprentices, both types of participants learn from each other in a process of negotiation of meaning and identity formation (Wenger 1998). But the position of masters in such communities of practice is quite different than that of apprentices. Although a master may be influenced by an apprentice (e.g., challenged to think through more carefully the truth of received wisdom), the influence in the opposite direction will logically be stronger.

Hence, knowledge outflows from a given subsidiary are to be expected specifically if the subsidiary has a stock of knowledge that is valuable for other parts of the MNC (i.e., has superior capabilities). Bartlett & Ghoshal (1990) identify tangible assets such as plants and equipment, but also intangible assets such as expertise, skills, capabilities or creativity as the basis of knowledge flows. These are most likely to lead to knowledge outflows if the subsidiary has certain capabilities that are stronger than what is present at other parts of the MNC. We therefore assert that the apposite measure of subsidiary capabilities pertains to the capabilities at the level of the focal subsidiary, *relative to the rest of the MNC*. Accordingly, we define subsidiary capabilities as the strength of a focal subsidiary in technological, operational, organizational and marketing activities, relative to the rest of the MNC (Holm & Pedersen 2000). In accordance with the sender-receiver model, we expect units that have stronger capabilities to be more likely to act as senders of knowledge than units that are relatively deprived of capabilities, and vice-versa (see, e.g., Foss & Pedersen 2002).

Hypothesis 3a: Strong capabilities (relative to other subsidiaries of the same MNC) make a subsidiary more likely to act as a knowledge sender, relatively weak capabilities make a subsidiary more likely to act as a knowledge receiver.

As with hypothesis 1, this hypothesis is not surprising and its confirmation will not increase our knowledge substantially. However, we need to establish the importance of subsidiary capabilities to make the step to the contingent effect of social interaction. Based on the sender-receiver model, we hypothesize that having communication channels with the requisite bandwidth is particularly important when a difference in relative subsidiary capabilities motivates knowledge flows. Outflows of knowledge from relatively strong subsidiaries (and inflows to relatively weak subsidiaries) will be greater to the extent that intensive social interaction with receiver units (sender units) occurs. Hence our next hypothesis:

Hypothesis 3b: The positive effect of social interaction on knowledge outflows will be stronger for subsidiaries with relatively strong capabilities, the positive effect on knowledge inflows will be stronger for subsidiaries with relatively weak capabilities.

Subsidiary autonomy. Above we have discussed several factors promoting intra-MNC knowledge flows. In contrast, we expect the level of autonomy of a focal subsidiary to have a negative impact on intra-MNC knowledge sharing. Hierarchical coordination has been found to positively correlate with the information flow within the MNC (Gates & Egelhoff 1986), and more autonomy means less hierarchical coordination. We define subsidiary autonomy as the influence a focal subsidiary has on decisions regarding the development or customization of products, selection of and price negotiations

with suppliers, and advertising and pricing policy in the local market. The effect of subsidiary autonomy on knowledge transfer is uncertain, however. Ghoshal & Bartlett (1988) found no effect, while Gupta & Govindarajan (2000) found a positive relation between centralization (the opposite of subsidiary autonomy) and the knowledge flow from headquarters to subsidiary. The study of Foss & Pedersen (2002), however, found that autonomy positively influences knowledge flows to other subsidiaries, and this was particularly true of knowledge originating from local clusters.

However, the logic of both the sender-receiver perspective and the social learning leads us to expect a negative main effect of subsidiary autonomy. A very autonomous subsidiary will likely be less motivated to either send or receive knowledge. Autonomy, to the extent that it indicates stand-alone activities, also makes social learning in the context of shared practices less likely.

Hypothesis 4a: Subsidiary autonomy will be negatively related to intra-MNC knowledge flows to and from that subsidiary.

Like with workflow integration and subsidiary capabilities, we hypothesize for subsidiary autonomy not only a main effect, but also an interaction effect with social interaction. In contrast to the negative main effect, we expect a positive interaction effect of subsidiary autonomy and social interaction on intra-MNC knowledge flows. A subsidiary functioning at arm's length of the MNC can nevertheless have knowledge of considerable value to other units, for instance because it is embedded in a local knowledge infrastructure as demonstrated by Foss & Pedersen (2002). In this situation the existence of social interactions will be particularly important to realize knowledge flows that are not dictated by the needs of day-to-day business.

Hypothesis 4b: The positive effect of social interaction on intra-MNC knowledge flows will be stronger for subsidiaries characterized by a high level of autonomy.

Other Factors

It is important to distinguish the variables that we hypothesize to influence knowledge flows within MNCs, independently and in interaction with social interaction, from other factors that may influence these flows. Social interaction should be distinguished from more formal coordination procedures, which according to the argumentation developed above are more appropriate for the transfer of declarative knowledge than for the transfer of procedural knowledge. While we reason that formal coordination mechanisms are important for the transfer of declarative rather than procedural knowledge (and we therefore refrain from formulating a hypothesis regarding its effect), we must nevertheless control for this factor.

Other factors that have been associated with intra-MNC knowledge flows in previous studies are the type of the focal subsidiary and the functions it performs. With type of subsidiary we refer to the distinction between acquired and newly established subsidiaries. Gupta & Govindarajan (2000) reason that acquired subsidiaries have a stock of knowledge that is less duplicative vis-à-vis the knowledge stock of the rest of the MNC. Hence, greater knowledge outflows are to be expected. Conversely, because of a lower relative absorptive capacity, these authors expect acquired subsidiaries to have a lower inflow of knowledge than the rest of the subsidiaries. Furthermore, the business functions performed by a given subsidiary may vary. Traditionally, many MNC subsidiaries performed mainly downstream activities (such as marketing, sales and distribution), but now, more and more subsidiaries also perform upstream activities (including production, design and R&D) (Mudambi & Navarra 2004). We also control for this factor, as differences in the kinds of activities performed are likely to be related to differences in knowledge flows.

Other factors that may be expected to influence intra-MNC knowledge flows are the age of the subsidiary (older subsidiaries have had more time to develop a knowledge stock), the size of the subsidiary (larger subsidiaries being more likely to have strong capabilities), and the size of the MNC. We therefore also control for these effects, as well as for industry (because industries differ in knowledge intensity; see Gupta & Govindarajan 2000) and home country of the MNC (because country of origin is a factor influencing the global strategy of the MNC; see Harzing & Sorge, 2003; Noorderhaven & Harzing 2003).

DATA AND METHODS

Data Collection

Data for this study were collected through a questionnaire survey that was developed after an extensive review of the relevant literature on headquarters-subsidiary relationships. It was subsequently pilot-tested in a focus group consisting of five postgraduate students from five different countries. These students had between four and ten years of work experience in multinational corporations. Pilot testing focused on both content and questionnaire design. After modification, the questionnaire was pilot-tested again with a different (but equally diverse) student group. Further modifications were made, and the questionnaire then was pilot-tested by four subsidiary managing directors, which resulted in some minor changes to enhance comprehensibility. The final questionnaire had a total of 149 questions measuring a range of aspects of the headquarters-subsidiary relationship.

Final questionnaires were mailed to the subsidiary managing directors of 2754 subsidiaries of MNCs headquartered in the USA, Japan, Germany, the UK, France and the Netherlands. Subsidiaries were located in more than 50 different countries. Data were collected in 2002. The sample was drawn from the Dun & Bradstreet *Who Owns Whom* database. Four very different manufacturing industries (motor vehicles and parts, chemicals, food & beverages, and electronics) were selected, including MNCs from most of the six home countries. Three to five MNCs were selected for each home country[ii], resulting in a total of 82 MNCs. For each MNC, 30-50 subsidiaries were selected, taking care to not select more than five subsidiaries in each subsidiary country. Subsidiaries with less than 25 employees were excluded, as were pure service subsidiaries.

Of the 2754 questionnaires, 553 were returned as undeliverable. After an initial mailing and one follow-up mailing, a total of 174 questionnaires were returned. Five of these contained more than 15% missing values and were thus discarded, leading to a usable response of 169, or 8%. Although very low, this response is not unusual for multi-country studies. Harzing (1997) reported that response rates for international mail surveys typically varied between 6% and 16%, and key studies in the field (Ghoshal & Nohria, 1989) have been based on response rates of 15%. Ghoshal & Nohria's data were collected nearly twenty years ago. Intensification of the pace of business as well as the increasing use of mail surveys are likely to have led to a substantial decline in willingness to respond to mail surveys.

The resulting sample of 169 subsidiaries represented nearly 50 different MNCs, with the number of responses per MNC varying from one to five. Since only six MNCs were represented by five subsidiaries, our findings are unlikely to be influenced by factors specific to any of the MNCs in our sample. Non-response bias was evaluated in a number of ways. First, we tested whether responses on the key variables in this study differed systematically between respondents in the original mailing and respondents in the reminder. In this procedure, late respondents were treated as a proxy for non-respondents. No significant differences were found for any of the key variables in our study. We then compared responding and non-responding firms with regard to size (number of employees), age, industry and country of headquarters. No significant differences were found on any of the variables. We can therefore be reasonably confident that non-response bias is not a problem in our study.

Given our relatively small sample size and the fact that many questionnaires had incidental missing values, we decided to use the EM (expectation-maximization) method to estimate missing values. The advantage of the EM method is that, unlike mean substitution, it does not reduce variability in the sample and preserves the underlying relationships in the data (Hair *et al*., 1998). The EM method is generally considered superior to list- or pair-wise deletion, mean substitution or imputation by multiple regression (Fichman & Cummings 2003; Roth, 1994), especially with more than 10% missing values. Although we used 15% missing values as the cut-off point, 85% of our sample had less than 5% missing values (for a questionnaire with around 150 questions). This would seem to indicate that our questionnaire was generally well understood and felt to be applicable to the subsidiary's circumstances.

Measures

Subjective constructs in our study were all measured with multi-item scales. Our measures of *knowledge flows* were taken from Gupta & Govindarajan (2000). However, given the large number of constructs in our questionnaire, we decided to reduce their seven items to four: (1) marketing know-how, (2) distribution know-how, (3) product design, (4) management systems and practices. Following

Gupta & Govindarajan (2000), the respondent was asked to indicate on a scale from 1 to 7 the extent to which the subsidiary engaged in the transfer of knowledge and skills in the areas above, in each of the following four directions: (1) provides knowledge and skills to HQ ($\alpha = 0.90$), (2) provides knowledge and skills to other subsidiaries ($\alpha = 0.85$), (3) receives knowledge and skills from HQ ($\alpha = 0.75$), (4) receives knowledge and skills from other subsidiaries ($\alpha = 0.84$).

Turning to our independent variables, we developed four measures of workflow integration. Inward workflow integration was measured as the proportion of all of the material inputs of the subsidiary originating from the parent company or from other subsidiaries, and outward workflow integration as the proportion of all of the subsidiary's outputs that flow to the parent company, or to sister subsidiaries. All four measures vary between zero and 100 percent. These workflow integration measures are formative scales, hence Cronbach's alpha is not a relevant measure (Cortina, 1993; Diamantopoulos & Siguaw, 2006).

The measure for *subsidiary capabilities* was adapted from Holm & Pedersen (2000). Respondents were asked to evaluate their subsidiary's capabilities relative to other subsidiaries on functions ranging from R&D to logistics and human resource management to the management of international activities. Alpha reliability of this nine-item scale was 0.80.

Subsidiary autonomy, adapted from Otterbeck (1981), asked the respondent to assess (on a five-point scale) the influence that headquarters would normally have on a range of issues— from selection of suppliers to design of advertising for the local market. Alpha reliability of this six-item scale was 0.82.

Social interaction intensity was measured by three items based on Harzing (1999), referring to the use (in the contacts between the focal subsidiary and the MNC) of international taskforces, international training programs, and informal communication (all measured on seven-point scales). These coordination mechanisms create face-to-face communication between employees/managers of different MNC units. Cronbach's alpha for this composite scale was 0.65.[iii]

In order to test hypotheses 2b, 3b and 4b, we calculated interaction terms of social interaction intensity with the four types of workflow integration, with subsidiary capabilities, and with subsidiary autonomy. Because in testing our hypotheses we are interested in comparing the main effects of these variables with the interaction effects, we followed the procedure recommended by Aiken & West (1991: 37-39) and use mean-centered variables and their interaction terms in all regressions.

We used confirmatory factor analysis to evaluate convergent and discriminant validity of our four dependent variables and of three of the independent variables (excluding the formatively scaled workflow integration indicators). The confirmatory factor analysis was carried out with the maximum likelihood estimation in LISREL 8.20. Each item was restricted to load on its specified construct, with the seven constructs being allowed to correlate freely. All of the items loaded significantly on their latent variable (t-statistics ranging from 2.67 to 7.25), demonstrating convergent validity. We assessed discriminant validity by comparing the model in which the latent variables were allowed to correlate freely with a model in which all latent variables were restricted to correlate perfectly. The difference in chi-square between the two models (489.16, df=21) was highly significant ($p < .0000$), demonstrating discriminant validity (Byrne, 1998). As both dependent and independent variables were perception-based and measured with the same instrument a pairwise test of the main perceptual reflective scales (subsidiary capabilities, subsidiary autonomy, social interaction and the four types of knowledge flows) was performed. For each of the 21 pairs of constructs a model in which the two latent variables were allowed to correlate freely was compared with a model in which the latent variables were restricted to correlate perfectly. In all cases the chi-square statistic of the second model was significantly higher than that of the first model, demonstrating discriminant validity.

Turning to our control variables, *type of subsidiary* was operationalized in our study in the form of a dummy variable with the value of 1 for an acquisition, and zero for a greenfield subsidiary. The *upstream function* of the subsidiary was coded as a dummy variable — subsidiaries with an upstream function (R&D, assembly, production) were coded as 1, and those without this function were coded as zero. *Formal coordination* was based on three items (Cronbach's alpha 0.70), referring to the use of planning systems, formal procedures, and reporting and Enterprise Resource Planning systems.

Finally, we used controls for subsidiary age and size, MNC size, industry, and the home country of the MNC. Subsidiary age was measured by subtracting the year of establishment from the year of data collection. The number of employees served as a measure of subsidiary size. As this variable was

badly skewed, we used the natural logarithm of the number of employees as the final measure of size. The same procedure was followed for MNC size. In the questionnaire, HQ country and industry were verified with tick boxes, and an additional variable "other" was created. We created dummy variables for the following industries: motor, food and beverages, chemicals and electronics (the reference group being "other industries"); dummy variables were also created for the MNC home countries most frequently observed in our dataset: the UK, Germany, Japan and the USA (the reference group being "other home countries").

Methods

We used OLS regression analyses to test our hypotheses. We first regressed each of our dependent variables (knowledge outflows to the parent company, knowledge outflows to other subsidiaries, knowledge inflows from the parent company, and knowledge inflows from other subsidiaries) on fourteen control variables: subsidiary age and size, MNC size, type of subsidiary, upstream functions, and formal coordination, plus controls for industry and MNC home country. After that, we entered the independent variables: social interaction intensity, the relevant types of workflow integration (depending on whether we look at subsidiary-headquarters relations or at subsidiary-subsidiary relations), subsidiary capabilities and, subsidiary autonomy, and in the next steps the interaction terms of social interaction intensity with workflow integration, subsidiary capabilities and subsidiary autonomy.

Multicollinearity. As a number of our independent variables are correlated (see Table 1), we also checked for possible collinearity problems by inspecting Variance Inflation Factors. The highest of these in any equation was 2.521 (control variable for MNC home country USA), suggesting that multicollinearity is not an issue.

Common-method bias. As all of our variables were measured using the same instrument, we checked for common-method bias by performing a factor analysis on all of the variables used in the regressions (Podsakoff & Organ, 1986). This factor analysis did not indicate that there is a single background factor that could be seen as an indication of a common method influencing our results. It resulted in eleven factors with Eigenvalues above 1, with the first factor explaining only 10 percent of the variance. Furthermore, following Lindell & Whitney (2001), we checked for common-method variance by introducing a marker variable. A marker variable should be measured by the same instrument as the scales used in the analysis, but should be theoretically unrelated to the variables of interest. We selected "performance-based coordination" as our marker variable, as we did not use this variable in our analyses, there seemed to be no theoretical reason to assume a relationship with any of our variables of interest, and the marker variable was measured in the same way as most of our other variables. We checked the partial correlations between all of our perceptual variables, controlling for performance-based coordination, and found that all of the significant correlations in Table 1 remained significant. Based on these checks, we conclude that common-method variance does not play an important role in our findings.

Missing data. As described above, we estimated missing data using the EM method. To check for the robustness of our findings, we repeated all of our regression analyses using only cases that missed, at most, values of two single items, and listwise deleted all other cases. This left us with 116 cases. Virtually all of our substantive findings were replicated with this reduced dataset— with a few exceptions in which the smaller sample size rendered some of the weaker effects insignificant, while the direction of the effects remained the same. These findings bolster our confidence that missing data substitution has not produced any artificial effects.

RESULTS

Table 1 reports the main descriptives and correlations of the dependent and independent variables used in this study.

*** INSERT TABLE 1 ABOUT HERE ***

As can be seen in Table 1, *knowledge inflows from the parent company* forms the strongest knowledge stream in our sample, and *knowledge inflows from other subsidiaries* the weakest. This finding echoes

that of Gupta & Govindarajan (2000), whose data were collected in 1991 (i.e., more than ten years earlier than our data). The mean inflow from the parent firm is virtually identical in both studies (3.81 vs. 3.75). The other flows, however, are all substantially higher in our study (knowledge outflows to the parent firm: 3.05 *vs*. 2.39; knowledge inflows from other subsidiaries: 2.84 *vs*. 2.21; knowledge outflows to other subsidiaries: 3.26 *vs*. 2.36). Thus, even though inflows from HQ are still significantly greater (at $p < 0.001$) than the other three types of knowledge flows, it appears that, in the decade between the two studies, MNCs have become more interdependent and less hierarchical. Furthermore, we see that the four knowledge flows are positively correlated — particularly the two types of outflows. Apparently, if a subsidiary has valuable knowledge, this is transmitted to various parts of the MNC. The subsidiaries in our sample receive, on average, more than 50% of their material inputs from other parts of the MNC. In contrast, less than 20% of outputs are transferred to other MNC units, indicating that the subsidiaries deliver mainly to external customers.

Tables 2 show the results of our regression analyses with knowledge flows to/from the parent firm as dependent variables.

*** INSERT TABLES 2 AND 3 ABOUT HERE ***

The first model in each series (Models 1 and 4 in Tables 2 and 3) shows the effects of our control variables on the different types of knowledge flows (controls for industry and MNC home country were also included, but since none of these reached the level of significance we do not report these). In the second model in each series (Models 2 and 5 in Tables 2 and 3) the main terms of the independent variables are entered into the regression. Finally, the third model in each series (Models 3 and 6 in Tables 2 and 3) shows the interaction effects of social interaction intensity with workflow integration, subsidiary capabilities and subsidiary autonomy.

Overall the control variables explain very little of the variance. Formal coordination is negatively related to knowledge flows to headquarters, but (marginally) positively related to knowledge flows from headquarters. The latter effect disappears when the explanatory variables are entered into the regression. Model 4 in Table 3 shows that acquired subsidiaries are somewhat less likely to receive knowledge from other subsidiaries, but this marginal effect also disappears in the more complete models. Those subsidiaries with upstream functions are marginally more likely to receive knowledge both the parent firm and from other subsidiaries than those without these activities. This is somewhat surprising, as an effect on knowledge outflows seems more intuitive.

Turning to the main effects of the explanatory variables, intensity of interaction has a consistent positive effect on all four types of knowledge flows. This confirms hypothesis 1, our baseline hypothesis. Since the scale reliability of our social interaction scale was not very strong, we repeated our analyses using the separate items instead of the composite scale (only for the main effects). The coefficient for *international training* came out significantly in all regressions, and the coefficient for *international taskforces* in three of the four regressions. The coefficient for *informal communication*, in contrast, did not reach the level of significance in any of the regression analyses. While this does not materially alter our conclusions regarding the importance of social interaction for knowledge exchange within the MNC, it does suggest that informal communication is too vague a concept to be of much use. The two other items, however, did tap into aspects of MNC management that are related to knowledge exchange.

We also checked for a possible alternative explanation of the unexpected negative sign of the interaction between social interaction and subsidiary capabilities. If two independent variables are positively correlated, their interaction might act like a quadratic term, indicating a non-linear (inverted U-shaped) relationship between (one of) these variables and the dependent (Blanton & Jaccard 2006). This alternative explanation can be ruled out in our case, however, since we constructed our interaction term from centered variables, and as a result it is significantly correlated to neither of the main terms (correlation coefficients with social interaction intensity and subsidiary capabilities are .043 and .090, respectively). As the main terms of social interaction intensity and subsidiary autonomy are unrelated (correlation is -.070) we do not need to check for this alternative explanation in this case.

The findings with regard to the main effects of workflow integration are less consistent. In the relationship with headquarters, workflow integration is only related to knowledge inflows, but not to knowledge outflows. In the relationships with other subsidiaries the pattern suggests that knowledge

streams follow workflow streams: knowledge flows to other subsidiaries are positively associated with workflows to these subsidiaries; knowledge inflows from other subsidiaries with workflows from these subsidiaries. Thus hypothesis 2a is partly confirmed. The finding that between subsidiaries knowledge flows do indeed seem to follow workflows gives credence to the social learning perspective. However, in the relationship between a focal subsidiary and the parent firm a different mechanism seems to be at work. Subsidiaries that are strongly integrated into workflows to/from the parent firm also receive more knowledge from headquarters (regardless of the direction of the workflow integration). These subsidiaries are also more likely to have upstream functions such as R&D and production. Perhaps knowledge flows to MNC headquarters depend more strongly on the formal status of the subsidiary (e.g., explicit recognition as a "center of excellence", Frost *et al*. 2002).

The effect of subsidiary capabilities on knowledge outflows is consistently positive. The expected negative effect on knowledge inflows is found only in the relationship with other subsidiaries. Hence hypothesis 3a is confirmed as far as knowledge outflows are concerned, but only partly confirmed for knowledge inflows.

Subsidiary autonomy is negatively related to knowledge flows to and from headquarters, but unrelated to knowledge flows to/from other subsidiaries. Hence hypothesis 4a is confirmed for the relationship with headquarters, but rejected for the relationship with other subsidiaries. In each case adding the main effects to the control variables leads to a significant increase in explanatory power of the models (hierarchical-F values are reported in the tables).

In the final model of each series the interaction terms of social interaction intensity with workflow integration, subsidiary capabilities and subsidiary autonomy are entered into the equation. Only in the two models with knowledge outflows as the dependent variable this leads to a significant increase in explanatory power. The interactions with workflow integration only reach a marginal level of significance for outflows to headquarters. Hence we reject hypothesis 2b: the effect of social interaction on knowledge sharing is *not* stronger under conditions of workflow integration. The interaction terms between social interaction and subsidiary capabilities are consistently negative, although only significantly so in the equations with knowledge outflows as the dependent variable. We hypothesized a positive effect. Hence we reject hypothesis 3b: not only is the effect of social interaction on knowledge sharing not stronger when subsidiaries have strong capabilities, but the opposite effect seems to be at work. We will return to an interpretation of this finding below. Finally, the interaction of social interaction and subsidiary autonomy has a positive effect on knowledge outflows, both to headquarters (marginally) and to other subsidiaries. We also see a (marginally) positive effect on knowledge inflows from headquarters, but not from other subsidiaries. Hence hypothesis 4b is partly confirmed.

In Figure 1 we illustrate the effects of the interactions of social interaction intensity with subsidiary capabilities and subsidiary autonomy on knowledge outflows to HQ and to other subsidiaries.

* * * INSERT FIGURE 1 ABOUT HERE * * *

Although intensive social interaction in all cases has a positive effect on knowledge outflows to other subsidiaries, this effect is particularly strong for subsidiaries with relatively weak capabilities. We suggest that the intensive interaction may bring to the light what can be learned even from a subsidiary with relatively weak capabilities. Furthermore, the social interaction process could itself lead to the creation of new knowledge, as observed by Adenfelt & Lagerström (2006: 392) in a transnational team: "the close collaboration […] among the members of the team also brings about new knowledge, as it creates a means of combining their existing knowledge in diverse areas in new ways".

Turning to the interaction effect of social interaction and subsidiary autonomy, our reason to expect a positive effect was that we thought that informal interaction would be particularly important if a subsidiary functions relatively independently from headquarters. Figure 2 illustrates the effect we found for knowledge flows to other subsidiaries. Although subsidiary autonomy has no main effect on these knowledge flows, moderated by social interaction the effect is clear: for highly autonomous

subsidiaries social interaction leads to considerably more knowledge outflows, for less autonomous subsidiaries the effect is much weaker. The same pattern (but weaker) is found in the regression with knowledge outflows to headquarters as the dependent variable.

DISCUSSION AND CONCLUSION

Findings Pertaining to Main Effects

Our analyses were guided by the ideas developed in two different perspectives on intra-MNC knowledge flows: the sender-receiver model and social learning theory. Based on both perspectives we expected (as our baseline hypothesis) a positive effect of social interaction intensity on all intra-MNC knowledge flows, and this effect was indeed very clear and consistent. We also hypothesized that knowledge flows would be associated with relevant workflows, both because this would increase the motivation of the subsidiary to send/receive knowledge (sender-receiver model) and because it opens the possibility of linking knowledge sharing to shared practices (social learning approach). Here we found mixed results: knowledge flows seem to follow workflows in lateral relations within the MNC, but not in vertical relations.

As predicted, subsidiaries with relatively strong capabilities are more likely to act as knowledge senders, both to the parent firm and to other subsidiaries. Relatively weak capabilities are associated only with knowledge inflows in the relationship with other subsidiaries. In the relationship with the parent firm knowledge flows do not seem to be motivated by a relative lack of skills of the focal subsidiary, but rather to the importance of its position in workflows, as suggested above.

Finally, more autonomous subsidiaries do indeed send as well as receive less knowledge from their headquarters, as predicted. However, contrary to our predictions, subsidiary autonomy seems to be unrelated to knowledge sharing between subsidiaries. This suggests that hierarchical relations still play an important role in vertical knowledge sharing, but not in horizontal relations. This confirms the network view of the modern MNC.

Findings with Regard to Interaction Effects

Our findings pertaining to the main effects of social interaction, workflow integration, capabilities and autonomy are not very surprising. By and large, these findings confirm those of earlier studies, although these typically tended to look only at one or two of the four types of knowledge flows we analyzed simultaneously. We believe however that our study is particularly interesting in as far as the interaction effects are concerned.

In the logic of the sender-receiver model social interaction is a “pipeline” accommodating knowledge sharing, but not a factor that would in and by itself lead to knowledge flows. Hence its main effect would be expected to be overshadowed by its interaction effects with independent motivators of knowledge sharing, such as workflow integration and relative subsidiary capabilities in our study. However, our findings are very different. The main effect of social interaction intensity is strong and consistent; the interaction effects with the other predictor variables are much weaker and in many cases insignificant. The interaction effect with workflow integration is mostly positive, but (marginally) significant only for knowledge flows from headquarters. The interaction effect with subsidiary capabilities is consistently negative, and significantly so for knowledge outflows (both to headquarters and to other subsidiaries). The interaction effects with subsidiary autonomy are mostly positive, as predicted.

Contributions to Theory

Overall, our findings strongly emphasize the importance of social interaction for intra-MNC knowledge streams. This confirms ideas developed originally by Sumantra Ghoshal and Christopher Bartlett twenty years ago (Ghoshal & Bartlett 1988). Although it is debatable whether the transnational corporation as an organizational form is on the rise to the extent expected by Ghoshal & Bartlett and almost a generation of scholars following in their footsteps (Gooderham & Ulset 2002), many of the seminal ideas of Ghoshal & Bartlett regarding the internal management of the MNC appear to remain very relevant. In particular, it seems that there are important limitations to what MNCs can achieve with hierarchical coordination, particularly when it comes to knowledge sharing

between subsidiaries. Social interaction seems to be more than just a communication channel with considerable "bandwidth". Bringing employees from different subsidiaries together in informal settings may have serendipitous effects, and lead to ideas and solutions not previously considered (Galunic & Rodan 1998). Furthermore, with regard to the dissemination of existing knowledge intensive social interaction may have a strong main effect, just because "utilization of knowledge residing elsewhere in the organization has to be preceded by the notion of its existence and whereabouts" (Persson 2006: 552).

From a theoretical point of view, our findings suggest that social learning theory has much to offer to the study of intra-MNC knowledge flows. The sender-receiver model has its limitations, in particular because it gives insufficient attention to the importance of social interaction for the (co-)production and integration of knowledge between MNC units. Social learning theory emphasizes that learning, in practice, takes place in communities (Wenger 1998). Conventional theory based on the sender-receiver model may miss the most crucial point: that knowledge worth transferring and integrating originates in the coming together of disparate MNC units. Less attention should thus be paid to the isolated characteristics of senders, receivers and communication channels, and more attention should be devoted to the social constitution of MNC knowledge (Becker-Ritterspach 2006).

Rather than treating social interaction as a factor that positively moderates the effects of a number of independent factors causing intra-MNC knowledge flows (like knowledge characteristics, motivation and capabilities) we need to consider how communication influences or even creates these factors. For instance, Monteiro et al. (2008) argue that frequent communication between MNC units makes managers more aware of opportunities for leveraging competencies, i.e., more communication increases both the perceived capabilities of the other unit and the motivation to learn. In the view of these authors, the subjective self-assessment of a subsidiaries capabilities therefore is not a second-best indicator, but rather a theoretically privileged measure of a factor influencing motivation to share knowledge. Another example of the interweaving of the various factors of the sender-receiver model can be taken from a case study of knowledge sharing within SCA Packaging, a leading European producer of corrugated paper packaging. Jonsson & Kalling (2007: 167) note that certain pieces of production knowledge used within SCA Packaging are considered to be tacit: "We have a complex process that we can't write down. There are too many parameters to think of". However, at some plants, where management was more strongly motivated to share knowledge such obstacles were overcome, and much of the production knowledge was made explicit. As one production manager remarks: "Only the lazy claim it is tacit" (Jonsson & Kalling 2007: 167). Motivation influences (perceived) capabilities as well as knowledge characteristics, and social interaction influences all these factors.

We see these examples from recent work on intra-MNC knowledge flows as supportive for our conclusion that the sender-receiver metaphor that has dominated much of the work on intra-MNC knowledge flows has reached its limits. To make further progress, we need to focus more squarely on social interaction processes within MNCs, and study how these processes affect the perceived knowledge base, the motivation to share knowledge, and even the very nature of that knowledge (i.e., more or less tacit or explicit). Forsgren (1997) talks about the paradox that MNCs face. On the one hand the ability to integrate knowledge between disparate units is their most important potential advantage; on the other hand the very fact that these units are spread out over the globe make such knowledge sharing more difficult. This study suggests that successful MNCs may very well be the ones that support the social interaction processes that both motivate and enable knowledge sharing.

Managerial Implications

The overriding recommendation that can be based on our findings is the advice to MNC managers to consider the network characteristics of the internal MNC environment when making decisions concerning knowledge development and sharing. In their direct relationships with subsidiaries, MNC headquarters can influence knowledge streams by means of formal coordination mechanisms. For many contemporary MNCs, however, this is only part of the story, and lateral knowledge flows between subsidiaries are increasingly seen as equally important. Our analysis suggests that whereas vertical knowledge flows may be increased by giving a subsidiary less autonomy, this parameter does not influence knowledge sharing between subsidiaries. Lateral knowledge flows seem to be more strongly linked to the relative strength of subsidiary capabilities, and to follow workflows. This

implies that knowledge is shared between subsidiaries when something valuable is offered that is connected to the main tasks of the focal subsidiaries. Having a requisite level of informal social interaction between managers from these units is an important condition for this knowledge sharing. Hence, vertical knowledge sharing within the MNC can be organized in a top-down fashion, but lateral knowledge sharing can better be stimulated by headquarters by enabling social interaction between subsidiaries.

We operationalized social interaction intensity in our study as the use of international taskforces, international training programs, and informal communication. MNCs that want to stimulate the sharing of knowledge need to invest in these coordination mechanisms. However, this is costly, in terms of both management time and travel expense. Nowadays, information technology enables MNCs to achieve a certain level of informal integration by working with "virtual teams", avoiding the high costs of face-to-face contacts. However, virtual teams pose their own particular management challenges (see, e.g., Kirkman *et al*. 2004), and it remains an open question to what extent virtual teams can substitute for face-to-face interaction (Kiesler & Cummings 2002). Managers should thus be aware that to the extent that face-to-face interaction is important, intra-MNC knowledge transfer is far from costless. Hence, MNC managers need to carefully select the nodes in the MNC network that they want to engage in intensive lateral knowledge sharing, and concentrate the use of intensive interaction mechanisms on these nodes.

Limitations and Suggestions for Further Research

Our study is characterized by several limitations. First of all, and as noted in the methods section, all of our measures were perception-based. Although we requested factual information as much as possible (e.g., with regard to the use of inputs from other parts of the MNC, measured in percentages), some degree of bias can be present. While our robustness analyses (reported in the findings section) and our substantive outcomes do not point in the direction of biases, future studies could improve on our work by collecting data from several sources (e.g., from headquarters as well as from subsidiaries). Needless to say, such an approach will pose its own research challenges.

Second, we provide a cross-sectional analysis of a fundamentally dynamic process. Knowledge exchange within MNCs is often bound to projects and goes through different phases (Hansen *et al*. 2005). The cross-sectional nature of our study gives us a snapshot of knowledge flows from the perspectives of subsidiaries that may be in very different phases of knowledge production and integration processes. More fine-grained and longitudinal research could reveal whether the factors we studied are equally important in different phases.

Third, our model might not be complete. We did not for instance include motivational disposition of the sender and receiver, a factor that was mentioned in previous studies. However, previous studies did not find strong support for this factor and it is less important for the social learning perspective than for the sender receiver model.

Fourth, the variable *social interaction intensity*, which proved to be of considerable interest in our study, needs to be better operationalized and measured in future studies. Future researchers may first want to study more closely what MNCs do in order to promote exchange of information between units, and then base an improved measure of social interaction on these observations.

Fifth, although we based our measure of knowledge flows on previous studies, we might not have captured all aspects of inter-unit learning in the MNCs studied. For instance, it might be desirable to include manufacturing know-how as a knowledge domain in future studies.

Sixth, in our study we looked at knowledge sharing, but this is only part of the job: the knowledge acquired must also be put to productive use to be of value to the MNC (Subramaniam 2006). Future studies may include a measure of the extent to which the knowledge acquired is also used, and has a positive effect.

Finally, the strong and consistent findings concerning the positive association between social integration and intra-MNC knowledge flows clearly suggest the importance of the use of international taskforces and international training programs. However, we cannot on the basis of our study tell how the mechanisms work. Does social interaction give managers access to fine-grained information that helps to bring about knowledge integration? Or does social interaction mainly help to remove obstacles to knowledge transfer? In-depth, qualitative and longitudinal studies of MNC teams as exemplified by Maznevski & Chudoba (2000), for example, may help to answer these questions.

The study of the management of MNCs has made substantial progress since the seminal work of Ghoshal & Bartlett (1988). The general picture sketched by these authors has inspired a number of follow-up studies, many of which have focused on the role of subsidiaries, and to knowledge flows within the MNC network. Our study has contributed to this stream of research by systematically analyzing four types of knowledge flows (knowledge outflows and inflows to/from MNC headquarters and other subsidiaries). We focused on the role of social interaction and theoretically explored and empirically tested the functions that can plausibly be assigned to this factor (in conjunction with other factors) from the perspectives of the sender-receiver model and the social learning approach. Our findings suggest that future work needs to go beyond the study of characteristics of senders, receivers and communication channels, and look more closely at social processes of knowledge production, integration and sharing within the MNC network.

REFERENCES

Adenfelt, M., & Lagerström, K. 2006. Knowledge development and sharing in multinational corporations: The case of a centre of excellence and a transnational team. *International Business Review*, 15(4): 381-400.

Adler, N., & Hashai, N. 2007. Knowledge flows and the modeling of the multinational enterprise. *Journal of International Business Studies*, 38(4): 639-657.

Aiken, L.S., & West, S.G. 1991. *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, CA: Sage.

Almeida, P., Song, J., & Grant, R. 2002. Are firms superior to markets and alliances? An empirical investigation of cross-border knowledge building. *Organization Science*, 13(2): 147-161.

Ambos, T.C., Ambos, B. & Schlegelmilch, B.B. 2006. Learning from foreign subsidiaries: an empirical investigation of headquarters' benefit from reverse knowledge transfers, *International Business Review*, 15(3): 294-312.

Anderson, J. 1983. *The architecture of cognition*. Cambridge, MA: Harvard University Press.

Argote, L., & Ingram P. 2000. Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*, 82(1): 150-169.

Barner-Rasmussen, W., & Bjorkman, I. 2005. Surmounting interunit barriers; Factors associated with interunit communication intensity in the multinational corporation. *International Studies of Management & Organization*, 35 (1): 28-46.

Bartlett, C.A., & Ghoshal, S. 1987. Managing across borders: New organizational responses. *Sloan Management Review*, 28 (1): 43-53.

Bartlett, C.A., & Ghoshal, S. 1990. Managing innovation in the transnational corporation. In C.A. Bartlett, Y. Doz & G. Hedlund, eds., *Managing the global firm*, London/New York: Routledge, 215-255.

Becker-Ritterspach, F.A.A. 2006. The social constitution of knowledge integration in MNEs: A theoretical framework. *Journal of International Management*, 12(3): 358-377.

Bélanger, J., Berggren, C., Björkman, T., & Köhler, C. (eds) 1999. *Being local worldwide; ABB and the challenge of global management*. Ithaca, NY: Cornell University Press.

Birkinshaw, J., & Hood, N. 1998. *Multinational corporate evolution and subsidiary development*. Basingstoke/New York: St Martin's Press.

Birkinshaw, J., Hood, N., & Jonsson, S. 1998. Building firm-specific advantages in multinational corporations: The role of subsidiary initiative. *Strategic Management Journal*, 19(3): 221-241.

Blanton, H., & Jaccard, J. 2006. Tests of multiplicative models in psychology: A case study using the unified theory of implicit attitudes, stereotypes, self-esteem, and self-concept. *Psychological Review*, 113(4): 155-169.

Björkman, I., Barner-Rasmussen, W., & Li, L. 2004. Managing knowledge transfer in MNCs: The impact of headquarters control mechanisms. *Journal of International Business Studies*, 35(5): 443-455.

Bresman, H., Birkinshaw, J., & Nobel, R. 1999. Knowledge transfer in international acquisitions. *Journal of International Business Studies*, 30(3): 439-462.

Brown, J.S., & Duguid, P. 1991. Organizational learning and communities of practice: Toward a unified view of working, learning, and innovation. *Organization Science*, 2(1):40-57.
Brown, J.S., & Duguid, P. 1998. Organizing knowledge. *California Management Review*, 40(3): 90-111.
Brown, J.S., & Duguidm P. 2000. *The social life of information*. Boston: Harvard Business School Press.
Brown, J.S., & Duguid, P. 2001. Knowledge and organization: A social-practice perspective. *Organization Science*, 12(2): 198-213.
Buckley, P.J., & Carter, M.J. 1996. The economics of business process design: Motivation, information and coordination within the firm. *International Journal of the Economics of Business*, 3(1): 5-25.
Byrne, B.M. 1998. *Structural equation modeling with LISREL, PRELIS and SIMPLIS: Basic concepts, applications, and programming*. Mahwah, NJ: Lawrence Erlbaum.
Carlile, P.R. 2004. Transferring, translating, and transforming: An integrative framework for managing knowledge across boundaries. *Organization Science*, 15(5): 555-568.
Cortina, J.M. 1993. What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology*, 78(1): 98-104.
Daft, R.L., & Lengel, R.H. 1986. Organizational information requirements, media richness & structural design. *Management Science*, 32(5): 554-572.
Davenport, T.H., & Prusak, L. 1998. *What do we talk about when we talk about knowledge?* Boston: Harvard Business School Press.
Dhannaraj, C., Lyles, M., Steensma, H.K., & 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(5): 428-442.
Diamantopoulos, A., & Siguaw, J.A. 2006. Formative versus reflective indicators in organizational measure development: A comparison and empirical illustration. *British Journal of Management*, 17(4): 263-282.
Easterby-Smith, M., & Araujo, L.J. 1999. Organizational learning: Current debates and opportunities. In M. Easterby-Smith, J. Burgoyne, L. Araujo, eds., *Organizational learning and the learning organization.* London: Sage, 1-22.
Easterby-Smith, M., Crossan, M., & Nicolini, D. 2000. Organizational learning: Debates past, present and future. *Journal of Management Studies*, 37(6): 783-796.
Egelhoff, W.G. 1993. Information-processing theory and the multinational corporation. In S. Ghoshal & D. Eleanor Westney, eds, *Organization theory and the multinational corporation*, New York: St Martin's Press, 182-210.
Egelhoff, W.G., Gorman, L., & McGormick, S. 2003. *Causes of knowledge flows in MNCs*. Paper presented at the 29th EIBA Conference, Copenhagen.
Elkjaer, B. 2003. Social learning theory: Learning as participation in social process. In M. Easterby-Smith & M.A. Lyles, eds., *The Blackwell handbook of organizational learning and knowledge management*. Malden, MA: Blackwell, 38-53.
Farjoun, M. 1998. The independent and joint effects of the skills and physical bases of relatedness in diversification. *Strategic Management Journal*, 19(7): 611-630.
Fichman, M., & Cummings, J.N. 2003. Multiple imputation for missing data: Making the most of what you know. *Organizational Research Methods*, 6(3): 282-308.
Fineman, S. 2003. Emotionalizing organizational learning. In M. Easterby-Smith & M.A. Lyles, eds., *The Blackwell handbook of organizational learning and knowledge management*. Malden, MA: Blackwell, 557-574.
Forsgren, M. 1997. The advantage paradox of the multinational corporation. In I. Björkman & M. Forsgren, eds., *The nature of the international firm*. Copenhagen: Copenhagen Business School, 69-85.
Foss, N.J., & Pedersen, T. 2002. Transferring knowledge in MNCs: The role of sources of subsidiary knowledge and organizational context. *Journal of International Management*, 8(1): 1-19.
Foss, N.J., & Pedersen, T. 2004. Organizing knowledge processes in the multinational corporation: An introduction. *Journal of International Business Studies*, 35(5): 340-349.

Fox, S. 2000. Communities of practice, Foucault and actor-network theory. *Journal of Management Studies*, 37(6): 853-867.
Frost, T.S., Birkinshaw, J.M., & Ensign, P.C. 2002. Centers of excellence in multinational corporations. *Strategic Management Journal*, 23(11): 997-1018.
Galbraith, J. 1973. *Designing complex organizations*. Reading, MA: Addison-Wesley.
Galunic, D. & Rodan, S. 1998. Resource Recombinations in the Firm: Knowledge Structures and the Potential for Schumpeterian Innovation, *Strategic Management Journal*, 19(12): 1193-1201

Gates, S.R., & Egelhoff, W.G. 1986. Centralization in headquarters – subsidiary relationships. *Journal of International Business Studies*, 17(2): 71-92.
Ghoshal, S., & Bartlett, C.A. 1988. Creation, adoption, and diffusion of innovations by subsidiaries of multinational corporations. *Journal of International Business Studies*, 19(3): 365-388.
Ghoshal, S., & Bartlett, C.A. 2000. The multinational corporation as an interorganizational network. *Academy of Management Review*, 15(4): 603-625.
Ghoshal, S., Korine, H., & Szulanski, G. 1994. Interunit communication in multinational corporations. *Management Science*, 40(1): 96-110.
Ghoshal, S., & Nohria, N. 1989. Internal differentiation within multinational corporations. *Strategic Management Journal*, 10(4): 323-337.
Ghoshal, S., & Nohria, N. 1993. Horses for courses: Organizational forms for multinational corporations. *Sloan Management Review*, 34(2): 23-35.
Gooderham, P.N., & Ulset, S. 2002. 'Beyond the M-form': Towards a critical test of the new form. *International Journal of the Economics of Business*, 9(1): 117-138.
Grant, R.M. 1996. Towards a knowledge-based theory of the firm. *Strategic Management Journal*, 17(Special Issue): 109-122.
Gupta, A.K., & Govindarajan, V. 1991. Knowledge flows and the structure of control within multinational corporations. *Academy of Management Review*, 16(4): 768-792.
Gupta, A.K., & Govindarajan, V. 1994. Organizing for knowledge flows within MNCs. *International Business Review*, 3: 443-457.
Gupta, A.K., & Govindarajan, V. 2000. Knowledge flows within multinational corporations. *Strategic Management Journal*, 21(4): 473-496.
Hair, J., Anderson, R.E., Tatham, R.L., & Blackm W.C. 1998. *Multivariate Data Analysis*, Englewood Cliffs, N.J.: Prentice Hall.
Håkanson, L., & Nobel R. 2001. Organizational characteristics and reverse technology transfer. *Management International Review*, 41(4): 395-420.
Hansen, M.T. 2002. Knowledge networks: Explaining effective knowledge sharing in multiunit companies. *Organization Science*, 13(3): 232-248.
Hansen, M.T., Mors, M.L., & Løvas, B. 2005. Knowledge sharing in organizations: Multiple networks, multiple phases. *Academy of Management Journal*, 48(5): 776-793.
Harvey, L., & Anderson, J. 1996. Transfer of declarative knowledge in complex information-processing domains. *Human-Computer Interaction*, 11(1): 69-96.
Harzing, A.W.K. 1997. Response rates in international mail surveys: Results of a 22 country study, *International Business Review*, 6(6): 641-665.
Harzing, A.W.K. 1999. *Managing the multinationals: An international study of control mechanisms*. Cheltenham: Edward Elgar.
Harzing, A.W.K., & Sorge, A.M. 2003. The relative impact of country-of-origin and universal contingencies on internationalization strategies and corporate control in multinational enterprises: World-wide and European perspectives. *Organization Studies*, 24(2): 187-214.
Harzing, A.W.K., & Noorderhaven, N.G. 2006. Knowledge flows in MNCs: An empirical test and extension of Gupta & Govindarajan's typology of subsidiary roles, *International Business Review*, 15(3): 195-214.
Hedlund, G. 1986. The Hypermodern MNC - A Heterarchy?, *Human Resource Management*, 25(1): 9-35.
Holm, U., & Pedersen, T. (eds. 2000). *The emergence and impact of MNC centres of excellence*. London: MacMillan.

Jonsson, A., & Kalling, T. 2007. Challenges to knowledge sharing across national and intra-organizational boundaries: Case studies of IKEA and SCA Packaging. *Knowledge Management Research & Practice*, 5(3): 161-172.
Kiesler, S., & Cummings, J. 2002. What do we know about proximity and distance in work groups? A legacy of research. In P. Hinds & S. Kiesler, *Distributed work*. Cambridge, MA: MIT Press, 37-80.
Kirkman, B.L., Rosen, B., Tesluk, P.E., & Gibson, C.B. 2004. The impact of team empowerment on virtual team performance: The moderating role of face-to-face interaction. *Academy of Management Journal*, 47(2): 175-192.
Kogut, B., & Zander, U. 1993. Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of International Business Studies*, 24(4): 625-646.
Kogut, B., & Zander, U. 1996. What do firms do? Coordination, identity, and learning. *Organization Science*, 7(5): 502-518.
Kraut, R., Fussel, S., Brennan, S., & Siegel, J. 2002. Understanding effects of proximity on collaboration: Implications for technologies to support remote collaborative work. In P. Hinds & S. Kiesler, *Distributed work*. Cambridge, MA: MIT Press, 137-162.
Lave, J., & Wenger, E. 1993. *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.
Lawrence, P., & Lorsch, J. 1967. *Organizations and environments: Managing differentiation and integration*. Cambridge, MA: Harvard Business School Press.
Lindell, M.K., & Whitney, D.J. 2001. Accounting for common method variance in cross-sectional research designs. *Journal of Applied Psychology*, 86(1): 114-121.
McCann, P., & Mudambi, R. 2005. Analytical differences in the economics of geography: The case of the multinational firm. *Environment and Planning A*, 37(10): 1857-1876.
McEvily, S.K., & Chakravarthy, B. 2002. The persistence of knowledge-based advantage: An empirical test for product performance and technological knowledge. *Strategic Management Journal*, 23(4): 285-305.
Maznevski, M., & Chudoba, K.M. 2000. Bridging space over time: Global virtual team dynamics and effectiveness. *Organization Science*, 11(5): 473-492.
Minbaeva, D., Pedersen, T., Bjorkman, I., Fey, C., & Park, H. 2003. MNC knowledge transfer, subsidiary absorptive capacity and knowledge transfer. *Journal of International Business Studies*, 34(6): 586-99.
Monteiro, L.F., Arvidsson, N., & Birkinshaw, J. 2008. Knowledge flows within multinational corporations: Explaining subsidiary isolation and its performance implications. *Organization Science*, 19(1): 90-107.
Mudambi, R. 2002. Knowledge management in multinational firms. *Journal of International Management*, 8(1): 1-9.
Mudambi, R., & Navarra, P. 2004. Is knowledge power? Knowledge flows, subsidiary power and rent-seeking within MNCs. *Journal of International Business Studies*, 35(5): 385-406.
Nadler, J., Thompson, L., & Van Boven, L. 2003. Learning negotiation skills: Four models of knowledge creation and transfer. *Management Science*, 49(4): 529-540.
Nohria, N., & Ghoshal, S. 1994. Differentiated fit and shared values: Alternatives for managing headquarters-subsidiary relations. *Strategic Management Journal*, 15(6): 491-502.
Nohria, N., & Ghoshal, S. 1997. The Differentiated Network: Organizing Multinational Corporations for Value Creation, San Francisco: Jossey-Bass.
Nonaka, I., & Takeuchi, H. 1995. *The knowledge-creating company: How Japanese firms create the dynamics of innovation*. New York: Oxford University Press.
Noorderhaven, N.G., & Harzing, A.W.K. 2003. The "country-of-origin effect" in multinational corporations: Sources, mechanisms and moderating conditions. *Management International Review*, 43(Special issue 2): 47-66.
Otterbeck, L., (ed.) 1981. *The management of headquarters subsidiary relationships in multinational corporations*. Aldershot: Gower.
Persson, M. 2006. The impact of operational structure, lateral integrative mechanisms and control mechanisms on intra-MNE knowledge transfer. *International Business Review*, 15(5): 547-569.

Plaskoff, J. 2003. Intersubjectivity and community building: Learning to learn organizationally. In M. Easterby-Smith & M.A. Lyles, eds., *The Blackwell handbook of organizational learning and knowledge management*. Malden, MA: Blackwell, 161-184.
Podsakoff, P. M., & Organ, D.W. 1986. Self-reports in organisational research: Problems and prospects, *Journal of Management*, 12(4): 531-544.
Reagans, R., & McEvily, B. 2003. Network structure and knowledge transfer: The effects of cohesion and range. *Administrative Science Quarterly*, 48(2): 240-267.
Rice, R.E. 1993. Media appropriateness: Using social presence theory to compare traditional and new organizational media. *Human Communication Research*, 19(4): 451-484.
Roth, P. 1994. Missing data: A conceptual review for applied psychologists, *Personnel Psychology*, 47(3): 537-560.
Rugman, A., & Verbeke, A. 2001. Subsidiary-specific advantages in multinational enterprises. *Strategic Management Journal*, 22(3): 237-250.
Schultz, M. 2003. Pathways of relevance: Exploring inflows of knowledge into subunits of multinational corporations. *Organization Science*, 14(4): 440-459.
Short, J., Williams, E., & Christie, & B. 1976. *The social psychology of telecommunications*. New York: Wiley.
Subramaniam, M. 2006. Integrating Cross-Border Knowledge for Transnational New Product Development. *Journal of Product Innovation Management*, 23(6): 541-555.
Subramanian, M., & Venkatraman, N. 2001. Determinants of transnational new product development capability: testing the influence of transferring and deploying tacit overseas knowledge, *Strategic Management Journal*, 22 (4): 359-378.
Szulanski, G. 1996. Exploring internal stickiness: Impediments to the transfer of best practices within the firm. *Strategic Management Journal*, 17(Special issue): 27-44.
Szulanski, G. 2000. The Process of Knowledge Transfer: A Diachronic Analysis of Stickiness, *Organizational Behavior and Human Decision Processes*, 82 (1): 9-27.
Tsai, W. 2001. Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal*, 44(5): 996-1004.
Tsai, W., & Ghoshal, S. 1998. Social capital and value creation: The role of intrafirm networks. *Academy of Management Journal*, 41(4): 464-476.
Tsoukas, H. 2003. Do we really understand tacit knowledge? In M. Easterby-Smith & M.A. Lyles, eds., *The Blackwell handbook of organizational learning and knowledge management*. Malden, MA: Blackwell, 410-427.
Urry, J. 2003. Social networks, travel and talk. *British Journal of Sociology*, 54(2): 155-175.
Van Baalen, P., Bloemhof-Ruwaard, J., & Van Heck, E. 2005. Knowledge sharing in an emerging network of practice: The role of a knowledge portal. *European Management Journal*, 23(3): 300-314.
Wenger, E. 1998. *Communities of practice; Learning, meaning, and identity*. New York: Cambridge University Press.
Zander, U. 1991. *Exploiting a technological edge: Voluntary and involuntary dissemination of technology*. Institute of International Business: Stockholm.

NOTES

[i] This possibility was pointed out to us by an anonymous reviewer

[ii] We were not able to completely balance the sample frame, as the Netherlands has no MNCs in the motor vehicles and parts industry and few MNCs in the electronics industry, and Germany has few MNCs in both the electronics and food & beverages industry.

[iii] As the alpha reliability of this construct is rather low, we also performed the analysis with the three separate items instead of the multi-item scale (see the Robustness Analysis section).

Figure 1: Interaction Effects

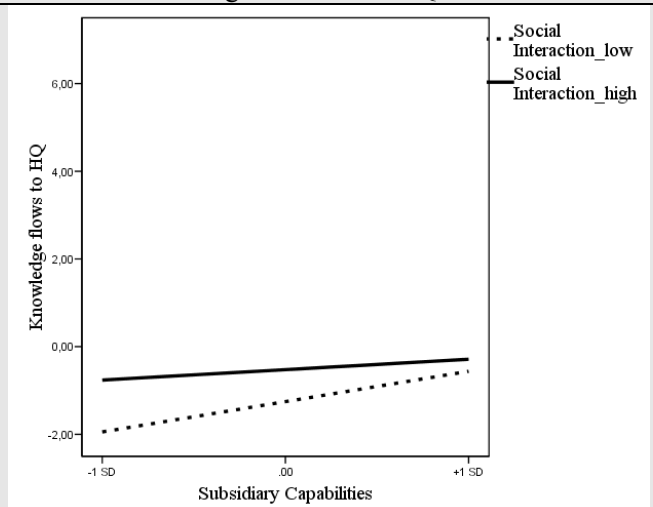
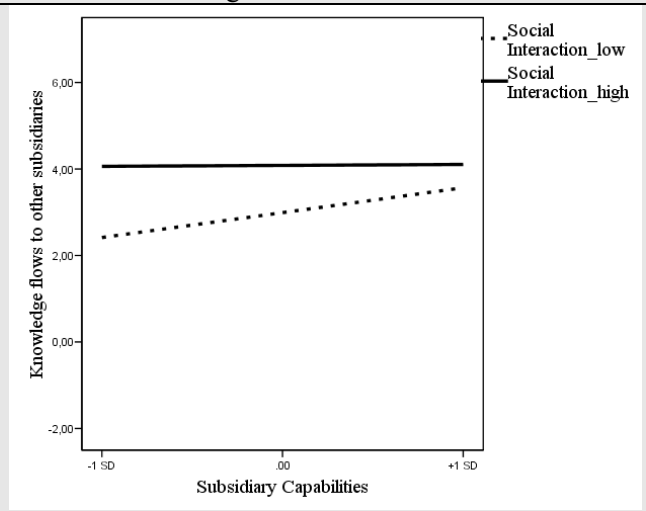
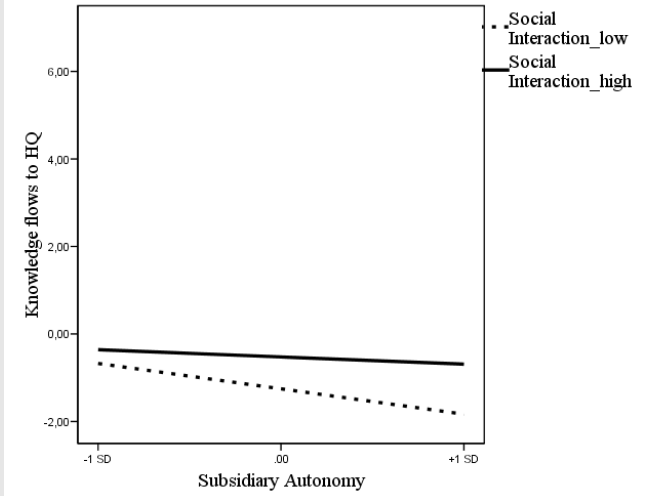
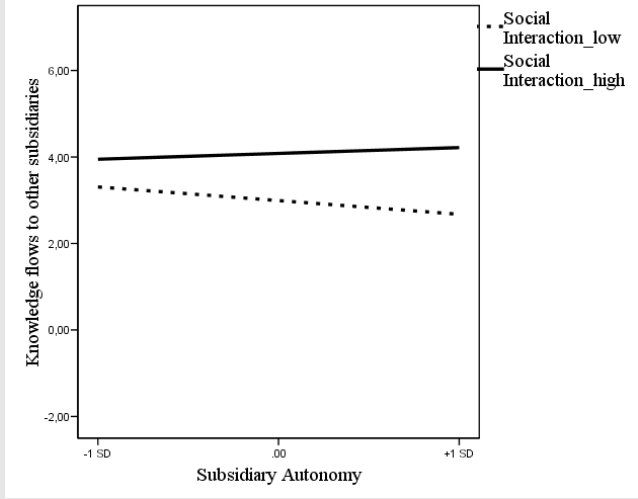
	Effect on Knowledge outflows to HQ	Effect on Knowledge outflows to other subs
Social Interaction Intensity with Subsidiary Capabilities		
Social Interaction Intensity with Subsidiary Autonomy		

Table 1: Descriptive statistics and correlations of variables in the study

		mean	s.d.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Knowledge outflows to headquarters	3.05	1.51															
2	Knowledge inflows from HQ	3.81	1.13	1.000														
3	Knowledge outflows to subsidiaries	3.26	1.40	.12	1.00													
4	Knowledge inflows from subsidiaries	2.84	1.17	.38**	.33**	1.00												
5	Subsidiary age (years)	39.11	30.22	.11	.07	-.01	1.00											
6	Subsidiary size (log)	5.16	1.42	.02	.16*	.03	.28**	1.00										
7	MNC size (log)	10.75	1.15	.15*	.03	.02	.11	.30**	1.00									
8	Type of subsidiary	0.44	0.50	-.11	.01	-.13	.10	-.10	-.04	1.00								
9	Upstream functions	0.62	0.49	-.03	.06	.03	.11	.21**	-.12	.06	1.00							
10	Formal coordination	4.84	1.15	.18*	.08	.12	.20*	.12	.19*	.00	.03	1.00						
11	Social interaction	3.86	1.26	.30**	.44**	.40**	.18*	.16*	.15	-.14	-.12	.29**	1.00					
12	Workflows to HQ	6.83	19.62	.22**	-.07	-.01	-.04	.09	.01	-.01	.15*	-.04	.02	1.00				
13	Workflows from HQ	27.07	31.92	.36**	-.00	-.05	-.00	-.02	.12	-.20**	-.29**	-.06	.10	.11	1.00			
14	Workflows to other subsidiaries	12.58	21.48	-.05	.14	.09	.05	.12	.01	-.03	.19*	.02	.00	-.06	-.20**	1.00		
15	Workflows from other subsidiaries	23.14	29.52	.04	.11	.22**	-.05	-.10	.14	-.10	-.34**	.16*	.12	-.20**	-.27**	.12	1.00	
16	Subsidiary capabilities	4.37	0.82	-.04	.29**	-.01	.08	.25**	-.01	-.01	.23**	.10	.21**	-.03	-.12	.08	-.03	1.00
17	Subsidiary autonomy	2.29	0.84	-.35**	-.04	-.07	.10	.03	-.09	.14	.27**	-.16*	-.07	-.07	-.45**	-.04	-.26	.21**

N = 169; * $p < .05$ (two-tailed); ** $p < .01$ (two-tailed)

Table 2: Factors influencing knowledge flows to/from MNC headquarters

Dependent Variable:	Knowledge flows to HQ			Knowledge flows from HQ		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	2.703*	-.769	-.889	2.232*	2.815**	2.841**
Subsidiary age	.000	-.001	-.000	.004	.003	.003
Subsidiary size	.076	-.009	-.027	-.062	-.077	-.084
MNC size	-.001	.022	.044	.114	.104	.105
Type of subsidiary	-.007	.241	.224	-.302	-.031	.004
Upstream functions	-.156	.063	.067	-.007	.331†	.332†
Formal coordination	-.031	-.228*	-.229*	.144†	.027	.032
Intensity of social interaction		.323**	.289**		.213**	.194**
Workflows to HQ		.004	.003		.010**	.009*
Workflows from HQ		.006†	.003		.009**	.009**
Subsidiary capabilities		.507***	.564***		-.034	.005
Subsidiary autonomy		-.422**	-.441**		-.382***	-.406***
Interactions with social interaction:						
with Workflows to HQ			.005			-.003
with Workflows from HQ			.002			.004†
with Subsidiary capabilities			-.219†			-.066
with Subsidiary autonomy			.195†			.137†
R-squared	.052	.259	.298	.081	.328	.348
Δ R-squared		.207	.039		.248	.020
F-statistic	.602	2.744***	2.676***	.965	3.834***	3.364***
Hierarchical F		8.343***	2.000†		10.992***	1.088

† p<.10; * p<.05; ** p<.01; *** p<.001; Controls for industry and MNC home country included but not reported; Significance levels reported one-sided where hypothesized, two-sided otherwise.

Table 3: Factors influencing knowledge flows to/from other subsidiaries

Dependent Variable:	Knowledge flows to other subsidiaries			Knowledge flows from other subsidiaries		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
(constant)	2.438*	3.933***	3.537**	1.994*	2.943**	2.893**
Subsidiary age	.000	-.002	-.003	-.002	-.003	-.003
Subsidiary size	.207*	.113	.085	.023	.007	.000
MNC size	-.063	-.074	-.029	.035	-.018	-.006
Type of subsidiary	.065	.281	.285	-.344†	-.148	-.173
Upstream functions	-.142	.047	.065	-.025	.376†	.394†
Formal coordination	.047	-.145	-.108	.113	.000	-.002
Intensity of social interaction		.480***	.433***		.389***	.389***
Workflows to other subsisidaries		.007†	.008*		.002	.004
Workflows from other subsidiaries		.003	.004		.008**	.009**
Subsidiary capabilities		.354**	.364**		-.193*	-.174†
Subsidiary autonomy		-.147	-.108		.009	.019
Interactions with social interaction:						
with Workflows to other subs			.001			.003
with Workflows from other subs			.002			-.003
with Subsidiary capabilities			-.268**			-.108
with Subsidiary autonomy			.213*			-.044
R-squared	.078	.325	.371	.110	.283	.300
Δ R-squared		.248	.046		.173	.017
F-statistic	.925	3.778***	3.721***	1.356	3.095***	2.704***
Hierarchical F		10.933***	2.653*		7.200***	.887

† p<.10; * p<.05; ** p<.01; *** p<.001; Controls for industry and MNC home country included but not reported; Significance levels reported one-sided where hypothesized, two-sided otherwise